This is a Notice regarding your request for acceptance of a fee deficiency submission under 37 CFR 1.28(c), filed on June 19, 2012.

The Office no longer investigates or rejects original or reissue applications under 37 CFR 1.56. 1098.Off. Gaz. Pat. Office 502 (January 3, 1989). Therefore, nothing in this Notice is intended to imply that an investigation was done.

Your fee deficiency submission under 37 CFR 1.28 is hereby ACCEPTED. Therefore, status as a small entity has been removed and any future fee(s) submitted must be paid at the large entity rate.

Additionally, the request is not signed by an attorney of record. However, in accordance with 37 CFR 1.34(a), the signature of Carol L. Druzbick appearing on the request shall constitute a representation to the United States Patent and Trademark Office that she is authorized to represent the particular party in whose behalf she acts. Therefore, since the address given in the present request differs from the correspondence address of record, a courtesy copy of this decision is being mailed to the address given in the request.

Inquiries related to this communication should be directed to the undersigned at (571) 272-3226.

/Andrea Smith/
Andrea Smith
Petitions Examiner
Office of Petitions

cc: Carol L. Druzbick
P.O. Box 221200
Chantilly, VA 20153-1200
In re Patent No. 7,263,239
Issue Date: August 28, 2007
Application No. 10/373,691
Filed: February 27, 2003
Patentee(s): Jung Yong Kang

This is a Notice regarding your request for acceptance of a fee deficiency submission under 37 CFR 1.28(c), filed on June 19, 2012.

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/Andrea Smith/
Andrea Smith
Petitions Examiner
Office of Petitions

cc: Carol L. Druzbick
P.O. Box 221200
Chantilly, VA  20153-1200
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Jung Yong KANG

Confirmation No.: 5193

Serial No.: 10/373,691
Patent No.: 7,263,239

Group Art Unit: 2824

Filed: February 27, 2003
Issued: August 28, 2007

Examiner: Yuzhen GE

Customer No.: 34610

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

PETITION TO ACCEPT NOTIFICATION OF LOSS OF ENTITLEMENT TO SMALL ENTITY STATUS UNDER 37 C.F.R. §1.28(c)

ATTENTION: OFFICE OF PETITIONS
U.S. Patent and Trademark Office
Customer Service Window, MAIL STOP PETITIONS
Randolph Building 401 Dulany Street
Alexandria, Virginia 22314

Sir:

Applicant petitions the U.S. Patent and Trademark Office to Accept Notification of Loss of Entitlement To Small Entity Status in connection with the above-identified application pursuant to 37 C.F.R. §1.28(c). Please contact Applicant’s undersigned representative with any questions.

APPLICANT HEREBY PETITIONS FOR THE ACCEPTANCE OF THIS NOTIFICATION OF LOSS OF ENTITLEMENT TO SMALL ENTITY STATUS UNDER 37 C.F.R. §1.28(c) OF THIS APPLICATION

NOTE: The error will be excused upon compliance with the following: items:

1. Payment of Deficiency Owed Under 37 C.F.R. 1.28(c)(3)(i)

The Commissioner is hereby authorized to charge my Deposit Account No. 10-0607 in the amount of $1,265.00.
2. **Itemization of the Deficiency Payment Under 37 C.F.R. 1.28(c)(2)(ii)**

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Please charge any shortage in fees due in connection with the filing of this, concurrent and future replies, including extension of time fees, to Deposit Account 16-0607 and please credit any excess fees to such deposit account.

Respectfully submitted,
KED & ASSOCIATES, LLP

Carol L. Druzbick
Registration No. 40,287

Correspondence Address:
P.O. Box 221200
Chantilly, VA 20153-1200
703 766-3777 CLD/mond
Date: June 19, 2012
Please direct all correspondence to Customer Number 34610

Encs: Payment of Deficiency Owed Under 37 C.F.R. 1.28(c)(2)
Itemization of the Deficiency Payment Under 37 C.F.R. 1.28(c)(2)(ii)
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Jung Yong KANG

Confirmation No.: 5193

Serial No.: 10/373,691 Group Art Unit: 2624
Patent No.: 7,263,239

Filed: February 27, 2003 Examiner: Yuzhen GE
Issued: August 28, 2007

Customer No.: 34610

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSING TRANSFORM

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U.S. Patent and Trademark Office
Customer Service Window, MAIL STOP Petitions
Randolph Building 401 Dulany Street
Alexandria, Virginia 22314

Sir:

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Respectfully submitted,
KED & ASSOCIATES, LLP

Carol L. Druzbick
Registration No. 40,287

Correspondence Address:
P.O. Box 221200
Chantilly, VA 20153-1200
703 766-3777 CLD/tmd

Date: June 19, 2012
Please direct all correspondence to Customer Number 34610

Encs: Payment of Deficiency Owed Under 37 C.F.R. 1.28(c)(2)
Itemization of the Deficiency Payment Under 37 C.F.R. 1.28(c)(2)(ii)
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### Warnings:

### Information:
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.
Docket No.: RPL-0411

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Jung Yong KANG

Serial No.: 10/373,691
Patent No.: 7,263,239

Filed: February 27, 2003
Issued: August 28, 2007

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSING TRANSFORM

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ATTENTION: OFFICE OF PETITIONS
U.S. Patent and Trademark Office
Customer Service Window, MAIL STOP PETITIONS
Randolph Building 401 Dulany Street
Alexandria, Virginia 22314

Sir:

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Carol L. Druzbick
Registration No. 40,287

Correspondence Address:
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Chantilly, VA 20153-1200
703 766-3777 CLD/md

Date: June 19, 2012

Please direct all correspondence to Customer Number 34610

Encs: Payment of Deficiency Owed Under 37 C.F.R. 1.28(c)(2)
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APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO.
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10/373,691 | 08/28/2007 | 7263239 | 2950-0241P | 5193

2292 | 7590 | 08/08/2007

BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 734 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Jung Yong Kang, Kyunggi-do, KOREA, REPUBLIC OF;
PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail

Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

or Fax
(571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate “FEE ADDRESS” for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

2292 7590 04/26/2007
BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

APPLICATION NO. 10/173,691

FILING DATE 02/27/2003

FIRST NAMED INVENTOR Jung Yong Kang

ATTORNEY DOCKET NO. 2950-0241P

CONFIRMATION NO. 5193

TITLE OF INVENTION: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

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1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.365).
   - [ ] Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - [ ] "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list:
   - (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   - (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

   Birch, Stewart, Kolasch & Birch, LLP

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

   PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

   (A) NAME OF ASSIGNEE
   Humax Co., Ltd.

   (B) RESIDENCE: (CITY and STATE OR COUNTRY)
   Kyonggi-do, Republic of Korea

   Please check the appropriate assignee category or categories (will not be printed on the patent):
   - [ ] Individual
   - [ ] Corporation or other private group entity
   - [ ] Government

4a. The following fee(s) are submitted:
   - [ ] Issue Fee
   - [ ] Publication Fee (No small entity discount permitted)
   - [ ] Advance Order - # of Copies 4

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)
   - [ ] A check is enclosed.
   - [ ] Payment by credit card. Form PTO-2038 is attached.
   - [ ] The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number [42-2448] (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)
   - [ ] a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
   - [ ] b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

   NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

   Authorized Signature
   [Signature]

   Date
   [Date]

   Registered # 27295

   Registration No. 22,463

   This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

   Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

   PTOL-85 (Rev. 07/06) Approved for use through 04/30/2007.

   OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:
Charge any Additional Fees required under 37 C.F.R. Section 1.16 and 1.17

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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.
NOTICE OF ALLOWANCE AND FEE(S) DUE

BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

APPLICATION NO. 10/373,691
FILING DATE 02/27/2003
FIRST NAMED INVENTOR Jung Yong Kang
ATTORNEY DOCKET NO. 2950-0241P
CONFIRMATION NO. 5193

TITLE OF INVENTION: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

Page 1 of 3

PTOL-85 (Rev. 07/06) Approved for use through 04/30/2007.
**PART B - FEE(S) TRANSMITTAL**

Complete and send this form, together with applicable fee(s), to: **Mail**

Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

or **Fax**

(571)-273-2885

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

**CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)**

2292 7590 04/20/2007

BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

**APPLICATION NO.** 10/373,691 **FILING DATE** 02/27/2003

**FIRST NAMED INVENTOR** Jung Yong Kang **ATTORNEY DOCKET NO.** 2950-0241P **CONFIRMATION NO.** 5193

**TITLE OF INVENTION:** METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

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**EXAMINER** GE, YUZHENG **ART UNIT** 2624 **CLASS-SUBCLASS** 382-250000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.353).
   - Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list:
   - (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   - (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

3. **ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)**

   PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

   **(A) NAME OF ASSIGNEE**

   **(B) RESIDENCE: (CITY and STATE OR COUNTRY)**

   Please check the appropriate assignee category or categories (will not be printed on the patent):
   - [ ] Individual
   - [ ] Corporation or other private group entity
   - [ ] Government

4a. The following fee(s) are submitted:
   - [ ] Issue Fee
   - [ ] Publication Fee (No small entity discount permitted)
   - [ ] Advance Order - # of Copies

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)
   - [ ] A check is enclosed.
   - [ ] Payment by credit card. Form PTO-2038 is attached.
   - [ ] The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ____ (enclose an extra copy of this form).  

5. Change in Entity Status (from status indicated above)
   - [ ] a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
   - [ ] b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

**NOTE:** The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or another party in interest as shown by the records of the United States Patent and Trademark Office.

**Authorized Signature** ______________________________ **Date** ____________

**Typed or printed name** ______________________________ **Registration No.** ____________

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**PTOL-85 (Rev. 07/06) Approved for use through 04/30/2007.**

**OMB 0651-0033** U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)  
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 734 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 734 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.
Notice of Allowability

Application No. 10/373,691
Applicant(s) KANG, JUNG YONG
Examiner Yuzhen Ge
Art Unit 2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS. This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 4/6/07.

2. ☑ The allowed claim(s) is/are 1-4, 14-15, and 18-19 (revised as claims 1-8).

3. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☑ All   b) ☐ Some*   c) ☐ None   of the:
   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. ______.
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: ______.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsman's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date ______.
   (b) ☐ including changes required by the attached Examiner's Amendment/Comment or in the Office action of Paper No./Mail Date ______.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)
1. ☐ Notice of References Cited (PTO-892)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date ______
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date ______
7. ☐ Examiner's Amendment/Comment
8. ☑ Examiner's Statement of Reasons for Allowance
9. ☐ Other ______

WENPENG CHEN
PRIMARY EXAMINER

9/10/07
Examiner's Remark

Applicant's amendment, filed on 4/6/2007, has been received and entered into the file.
The 103 rejections of the pending claims have been overcome in view of applicant's amendments by rewriting the allowable claims in independent form and canceling non-allowed claims and are hereby withdrawn.

Allowable Subject Matter

1. Claims 1-4, 14-15, and 18-19 are allowed. An examiner's statement of reasons for allowance is provided in an earlier office action and will not be repeated here.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yuzhen Ge whose telephone number is 571-272 7636. The examiner can normally be reached on 7:30am-4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Yuzhen Ge
Examiner
Art Unit 2624

WENPENG CHEN
PRIMARY EXAMINER

4/10/07
# Issue Classification

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## INTERNATIONAL CLASSIFICATION

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### Yuzhen Ge
(Assistant Examiner) 4/10/2007

### WENPENG CHEN
Primary Examiner

### B. PHOENIX
(Legal Instruments Examiner) 4/17/07
(Primary Examiner) 4/10/07

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  - See search history printout

- Consulted Joe Mancuso for search strategy.
  - 4/20/2006 YG

- Updated the above search
  - 10/3/2006 YG

- Updated the above search
  - 4/10/2007 YG

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BIRCH, STEWART, KOLASCH & BIRCH, LLP

INTELLECTUAL PROPERTY LAW
8110 GATEHOUSE ROAD
SUITE 500 EAST
FALLS CHURCH, VA 22042-1210
USA
(703) 205-8000
FAX: (703) 205-8050
(703) 698-4590 (GM IV)
e-mail: mailroom@bskb.com
web: http://www.bskb.com

CALIFORNIA OFFICES:
COSTA MESA, CALIFORNIA
LOS ANGELES, CALIFORNIA

Date: February 27, 2003
Docket No.: 2950-0241P

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): KANG, Jung Yong

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

Enclosed are:

☑ A specification consisting of Twenty-Five (25) pages
☑ Seven (7) sheet(s) formal drawings
☑ An assignment of the invention
☐ Applicant claims small entity status under 37 C.F.R. § 1.27
☐ Applicant does not claim priority
☒ Certified copy(ies) is(are) attached hereto.
☐ Certified copy(ies) will follow.
Amend the specification by inserting before the first line thereof the following:

a. ☒ --This nonprovisional application claims priority under 35 U.S.C. § 119(a) on Patent Application No. 2002-0063600 filed in KOREA on October 17, 2002, which is herein incorporated by reference.--

b. ☐ --This nonprovisional application claims priority under 35 U.S.C. § 119(e) on U.S. Provisional Application No. filed on , which is herein incorporated by reference.--

Executed Declaration (☒ Original ☐ Photocopy)

☐ Application Data Sheet in accordance with 37 C.F.R. § 1.76

☐ Preliminary Amendment

☐ Information Disclosure Statement, PTO-1449 and reference(s)

☐ Other:

☐ Applicant requests early publication - $300.00 publication fee


The filing fee has been calculated as shown below:

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Docket No. 2950-0241P

☒ A check in the amount of $415.00 to cover the filing fee and recording fee (if applicable) is enclosed.

☐ Please charge Deposit Account No. 02-2448 in the amount of $0.00. A triplicate copy of this transmittal form is enclosed.

☒ Please send correspondence to:
BIRCH, STEWART, KOLASCH & BIRCH, LLP or Customer No. 002292
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By Joseph A. Kolasch, #22,463

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

JAK/jaf
2950-0241P

Attachment(s)

(Rev. 02/27/03)
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Jung Yong KANG

Application No.: 10/373,691

Confirmation No.: 5193

Filed: February 27, 2003

Art Unit: 2624

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

Examiner: Y. Ge

AMENDMENT AFTER FINAL ACTION UNDER 37 C.F.R. 1.116

MS AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated November 9, 2006, please amend the above-identified U.S. patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Jung Yong KANG

Application No: 10/373,691                   Confirmation No.: 5193
Filed: February 27, 2003                    Art Unit: 2624
For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

AMENDMENT AFTER FINAL ACTION UNDER 37 C.F.R. 1.116

MS AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated November 9, 2006, please amend the above-identified U.S. patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.
AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size $M \times N$, where $M \neq N$, determining the size $P \times Q$, where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(b) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient; and

(c) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size $P \times Q$,

wherein the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and an enlarged image to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image and dividing the number of columns of the original image by the chosen common divisor.

2. (Original) The method of claim 1, further comprising the step of producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

3. (Original) The method of claim 1, wherein said k-coefficient is proportional to $\sqrt{\frac{P \times Q}{M \times N}}$, the square root value of the size of the zero-appended discrete cosine transformed image block divided by the size of the discrete cosine transformed image block.
4. (Original) The method of claim 1, wherein the numbers of the appended rows and columns of zeros depend on the size of an enlarged image to be produced.

5. – 13. (Canceled)

14. (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size $M \times N$ where $M \neq N$ from a data stream reproduced from a storage medium;

(b) determining the size $P \times Q$ where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(c) computing a $k$-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the $k$-coefficient;

(d) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the $k$-coefficient to produce enlarged image blocks of size $P \times Q$; and

(e) producing an enlarged image by combining the enlarged image blocks of size $P \times Q$,

wherein the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the original image by the chosen common divisor.
15. (Original) The method of claim 14, wherein said step (a) converts the program stream reproduced from the storage medium into a packetized elementary stream and extracts the discrete cosine transformed image blocks from the packetized elementary stream.

16. – 17. (Canceled)

18 (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size $M \times N$ where $M \neq N$ from a data stream reproduced from a storage medium;

(b) determining the size $P \times Q$ where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(c) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient;

(d) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size $P \times Q$; and

(e) producing an enlarged image by combining the enlarged image blocks of size $P \times Q$; The method of claim 14,

wherein the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.
19 (New) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size \( M \times N \), where \( M \neq N \), determining the size \( P \times Q \), where \( P \neq Q \) to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size \( P \times Q \);

(b) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient; and

(c) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size \( P \times Q \),

wherein the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.
REMARKS

Applicant thank the Examiner for the through consideration given the present application. Claims 1-4, 14, 15, 18 and 19 are currently being prosecuted. The Examiner is respectfully requested to reconsider his rejections in view of the amendments and remarks as set forth below.

Entry of Amendment

Applicant submits that entry of the present Amendment is appropriate. Applicant has re-written the allowable claims in independent form and canceled the non-allowed claims in order to place the application prima facie in condition for allowance. Accordingly, entry of the Amendment and full consideration thereof is considered to be proper.

Allowable Subject Matter

It is gratefully acknowledged that the Examiner considers the subject matter of claims 8, 16 and 18 as being allowable if rewritten in independent form. While not conceding the appropriateness of the Examiner’s objections, claims 1 and 14 have been amended to include the allowable limitations of claims 8 and 16 and claim 18 has been rewritten in independent form. Accordingly, all of the claims are now in condition for allowance.

Rejection Under 35 USC 103

Claims 1-5, 7-14, 15 and 17 stand rejected under 35 USC 103 as being obvious over Feig et al. (US Patent 6,002,809) in view of Acharya (US Publication 2003/0021486). Claim 6 stands rejected under 35 USC 103 as being obvious over Feig et al. and Acharya in view of DeQuerioz (US Patent 6,563,955). Claims 9-13 stand rejected under 35 USC 103 as being Feig et al. and Archarya in view of Boyce et al. (US Patent 6,262,770). These rejections are respectfully traversed.

By way of the present Amendment, Applicant has canceled claims 5-13 and have rewritten claims 1 and 14 to include the allowable limitations of claims 8 and 16. Claim 18 has also been rewritten in independent form. Accordingly, Applicant submit that all of these
rejections are rendered moot by the addition of allowable limitations to all the independent claims.

Thus, claim 1 is allowable since it includes the limitations of allowable claim 8. Claims 2-4 depend from claim 1 and accordingly are also considered to be allowable. Claim 14 is allowable since it now includes the limitations of claim 16. Claim 15 depends from claim 14 and as such is also considered to be allowable. Claim 18 has been rewritten in independent form including the limitations of claim 14 and also is considered to be allowable.

Applicants have also added new independent claim 19 which is a combination of claim 1 and 18. Since claim 18 is similar to claim 8, claim 19 is very similar to amended claim 1. However, there are wording differences in the final paragraph of the claim. Applicants submit that this claim is likewise allowable since the Examiner has indicated that claim 18 includes allowable subject matter. Accordingly, Applicant submits that this new claim is also allowable.

Conclusion

In view of the Examiner’s indication of allowable subject matter and in view of the rewriting of the claims as indicated above, Applicant submits that all of the claims are in condition for allowance. Accordingly, an early and favorable action is respectfully requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert F. Gnuse Reg. No. 27,295 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.
If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

Dated: April 6, 2007

Respectfully submitted,

By

[Signature]

ROBERT F. GNUSE
Registration # 27295

BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000
Attorney for Applicant
**Electronic Patent Application Fee Transmittal**

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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

- Charge any Additional Fees required under 37 C.F.R. Section 1.16 and 1.17

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### Warnings:

### Information:

| 2     | Fee Worksheet (PTO-06) | fee-info.pdf | 8335 | no | 2   |

### Total Files Size (in bytes): 539589

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.
**FEE TRANSMITTAL**

For FY 2007

**Complete if Known**

- Application Number: 10/373,691-Conf. #6193
- Filing Date: February 27, 2003
- First Named Inventor: Jung Yong KANG
- Examiner Name: Y. Ge
- Art Unit: 2624
- Attorney Docket No.: 2950-0241P

**TOTAL AMOUNT OF PAYMENT** $650.00

**METHOD OF PAYMENT** (check all that apply)

- Check
- Credit Card
- Money Order
- None
- Other (please identify):

**Deposit Account**

- Deposit Account Number: 02-2448
- Deposit Account Name: Birch, Stewart, Kolasch & Birch, LLP

For the above-identified deposit account the Director is hereby authorized to: (check all that apply)

- Charge fee(s) indicated below
- Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
- Credit any overpayments

**FEE CALCULATION**

1. **BASIC FILING, SEARCH, AND EXAMINATION FEES**

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2. **EXCESS CLAIM FEES**

- Each claim over 20 (including Reissues)
- Each independent claim over 3 (including Reissues)
- Multiple dependent claims

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HP = highest number of claims paid for if greater than 20

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HP = highest number of independent claims paid for if greater than 3

3. **APPLICATION SIZE FEE**

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(f).

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Fee Paid ($) = x

4. **OTHER FEE(S)**

- Non-English Specification. $130 fee (no small entity discount)
- Other (e.g., late filing surcharge): 1252 Extension for response within second month: $450.00

**SUBMITTED BY**

- **Signature**: Joseph A. Kolasch
- **Registration No.** 22,463
- **Telephone** (703) 205-8000
- **Date** April 6, 2007

**ROBERT E. GUSE**

Registration # 27295

Birch, Stewart, Kolasch & Birch LLP

JAK/RFG/cdr
PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)  
FY 2006  
(Fees pursuant to the Consolidated Appropriations Act, 2005 (H R 4818).)  

Docket Number (Optional)  
2950-0241P  

Application Number  
10/373,691-Conf. #5193  
Filed  
February 27, 2003  

For  
METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM  

Art Unit  
2624  
Examiner  
Y Ge  

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.  
The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):  

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| Three months (37 CFR 1.17(a)(3)) | $1020 | $510             |  
| Four months (37 CFR 1.17(a)(4)) | $1590 | $795             |  
| Five months (37 CFR 1.17(a)(5)) | $2160 | $1080            |  

Applicant claims small entity status  
See 37 CFR 1.27  
A check in the amount of the fee is enclosed  
Payment by credit card  
Form PTO-2038 is attached  

The Director has already been authorized to charge fees in this application to a Deposit Account  
The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to  
Deposit Account Number 02-2448  
I have enclosed a duplicate copy of this sheet  

I am the  
X applicant/inventor  
assignee of record of the entire interest  
See 37 CFR 3.71  
Statement under 37 CFR 3.73(b) is enclosed  
(Form PTO/SB/96)  
attorney or agent of record  
Registration Number 22,463  
attorney or agent under 37 CFR 1.34  
Registration number if acting under 37 CFR 1.34  

Signature  

Date  
April 6, 2007  

Joseph A. Kolasch  
Typed or printed name  
Registration #27295  
Telephone Number (703) 205-8000  

NOTE  
Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required  
Submit multiple forms if more than one signature is required see below  

Total of 1 forms are submitted
**APPLICATION AS FILED – PART I**

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If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(e).

**APPLICATION AS AMENDED – PART II**

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**CALCULATE**

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" in THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" in THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (total or independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner: Patsy Zimmerman

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.
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BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

EXAMINER
GE, YUZHEN

ART UNIT  PAPER NUMBER
2624


Please find below and/or attached an Office communication concerning this application or proceeding.
**Office Action Summary**

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<td>KANG, JUNG YONG</td>
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<td>Examiner</td>
<td>Art Unit</td>
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<td>Yuzhen Ge</td>
<td>2624</td>
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--- **The MAILING DATE of this communication appears on the cover sheet with the correspondence address** ---

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☑ Responsive to communication(s) filed on 9/26/06.

2a) ☑ This action is FINAL.  
2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4) ☑ Claim(s) 1-18 is/are pending in the application.
   
   4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5) ☐ Claim(s) ______ is/are allowed.

6) ☑ Claim(s) 1-7, 9-15 and 17 is/are rejected.

7) ☑ Claim(s) 8, 16 and 18 is/are objected to.

8) ☐ Claim(s) ______ are subject to restriction and/or election requirement.

**Application Papers**

9) ☐ The specification is objected to by the Examiner.

10) ☑ The drawing(s) filed on 26 September 2006 is/are:  
    a) ☑ accepted or b) ☐ objected to by the Examiner.
    
    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
    
    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   a) ☐ All  
   b) ☐ Some *  
   c) ☐ None of:
   
   1. ☑ Certified copies of the priority documents have been received.
   2. ☑ Certified copies of the priority documents have been received in Application No. ______.
   3. ☑ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

   * See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsman's Patent Drawing Review (PTO-948)  
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
4) ☐ Interview Summary (PTO-413)  
5) ☐ Notice of Informal Patent Application (PTO-152)  
6) ☐ Other: ______.

---

U.S. Patent and Trademark Office  
PTOL-326 (Rev. 7-05)  
Office Action Summary  
Part of Paper No./Mail Date 1
Examiner’s Remark

1. Applicant's amendment, filed on Sept. 26, 2006, has been received and entered into the file. The objection to drawings has been overcome in view of applicant's amendments/remarks and is hereby withdrawn. Independent claims 1, 9 and 14 have been amended. Applicant's arguments with respect to M ≠ N and P ≠ Q in claims 1, 9 and 14 have been considered but are moot in view of the new ground(s) of rejection. Respect to applicant's argument that k is not integer, the examiner would like to point out that nowhere in the claims and in the specification specifies that k is an integer.

DETAILED ACTION

Claim Rejections - 35 USC § 103


Regarding Claim 1, Feig et al teach a method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size MxN, where N ≠ M,

determining the size PxQ, where P ≠ Q to which each of the discrete cosine transformed image blocks is to be enlarged (col. 20, lines 33-39, PxQ is the image block received and the K1×L1 is the image block after enlargement);
(b) computing a k-coefficient for the discrete cosine transformed image blocks and multiplying each of the discrete cosine transformed image blocks by the k-coefficient (col. 20, lines 39-42); and

(c) performing inverse discrete cosine transform (IDCT) operations on discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size P x Q (col. 20, lines 42-45).

However they do not explicitly teach the step of padding 0s in the method. In the same field of endeavor, Acharya teaches padding 0s in the high frequency area of each of the discrete cosine transformed image blocks to up scale the image blocks (Figs. 5 and 6). It is desirable to display a higher resolution image or recover the original resolution of the image from a down-sampled compressed one (paragraph [0002] of Acharya). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to use the method of Acharya in the method of Feig et al, that is, to append rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks to enlarge the image for displaying purposes.

Regarding Claim 2, Feig et al and Acharya teach the method of claim 1. Feig et al further teach the step of producing an enlarged image by combining the enlarged image blocks of size P x Q (col. 8, lines 8-16, inherent from displaying on a monitor that the enlarged image blocks of size P x Q have to be combined)
Regarding Claim 3, Feig et al and Acharya teach the method of claim 1. Feig et al further teach wherein said k-coefficient is proportional to the square root value of the size of the zero-appended discrete cosine transformed image block divided by the size of the discrete cosine transformed image block (col.3, lines 64-66, the K1xL1 of Feig et al is equivalent to PxQ and PxQ of Feig et al is equivalent to MxN).

Regarding Claim 4, Feig et al and Acharya teach the method of claim 1. Feig et al further teach wherein the numbers of the appended rows and columns of zeros depend on the size of an enlarged image to be produced (col. 2, lines 30-35, col. 3, lines 55-57). Acharya further teach wherein the numbers of the appended rows and columns of zeros depend on the size of an enlarged image to be produced (paragraphs [0027], Figs. 5 and 6).

Regarding Claim 5, Feig et al and Acharya teach the method of claim 1. Feig et al further teach the step of dividing the original image into image blocks of size MxN and performing a discrete cosine transform (DCT) operation on each of the image blocks (col. 5, lines 30-42).

Claim 14 adds to claim 1 the limitation that the image block is from a data stream reproduced from a storage medium. Feig et al further teach the image is from a data stream reproduced from a storage medium (425 in Figs. 4 and 5, col. 21, lines 7-32).

Regarding Claims 7 and 17, Feig et al and Acharya teaches the method of claims 1 and 14. Acharya further teach wherein the size PxQ of each of the zero-appended image blocks is
determined based on the size of the original image and the size of an enlarged image to be produced (paragraph [0027], the block size of 10x10 from original block size 8x8 is determined based on the original image size 640x480 and the enlarged image size 800x600 for a up-scale factor of 1.25, because the upscale factor from 640 to 800 is 1.25 and from 480 to 600 is also 1.25 and therefore the original block size 8x8 times 1.25 is 10x10). Feig et al further teach that the scaling is based on the original image size and the enlarged image size (col. 2, lines 30-35, col. 3, lines 55-61)

Regarding Claim 15, Feig et al and Acharya teach the method of claim 14. Feig et al further teach wherein said step (a) converts the program stream reproduced from the storage medium into a packetized elementary stream and extracts the discrete cosine transformed image blocks from the packetized elementary stream (col. 6, lines 19-34, 425 of Figs. 4 and 5). Acharya further teach said step (a) converts the program stream reproduced from the storage medium into a packetized elementary stream and extracts the discrete cosine transformed image blocks from the packetized elementary stream (paragraphs [0002], [0026], Fig. 4, it is inherent from MPEG decoder that the discrete cosine transformed image blocks are extracted from the packetized elementary stream).

3. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Feig et al and Acharya in view of De Queiroz (US Patent 6,563,955).
Regarding Claim 6, Feig et al and Acharya teaches the method of claim 5. However they do not teach wherein said size MxN of each of the image blocks is chosen by a user. De Queiroz teaches to tailor the size of the blocks to the needs to the user (col. 11, lines 25-27). It is desirable to compress images of different type differently and let user control the compression process (col. 2, lines 17-33, col. 11, lines 25-27). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to use the approach of De Queiroz to let user choose the block size.


Claim 9 adds to claim 1, claim 10 adds to claim 8 and 18, the limitation that the image block is from a digital broadcast. Feig et al and Acharya do not specifically teach the image is from a digital broadcast. In the same field of endeavor, Boyce et al teach a method and apparatus for changing the resolution of images from digital broadcast (col. 4, lines 24-44). It is desirable to have improved quality and efficient use of spectral bandwidth (col. 1, lines 30-36). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to decode and resize images from digital broadcast taught by Boyce et al in the method of Feig et al and Acharya.

Regarding Claim 12, Feig et al and Acharya teaches the method of claim 9. Acharya further teaches to upscale an image by a ratio (paragraph [0027]). Feig et al further teach wherein the
number of rows of each of the enlarged image blocks is determined by dividing the number of rows of the enlarged image to be produced by the number of rows of the original image and multiplying the quotient by the number of rows of each of the image blocks and the number of columns of each of the enlarged image blocks is determined by dividing the number of columns of the enlarged image to be produced by the number of columns of the original image and multiplying the quotient by the number of columns of each of the image blocks (col. 3, lines 55-64, the enlarged size is $K_1 \times L_1$ and the original size is $P \times Q$, and the scaling factor $K_1/P$ is used for rows and the scaling factor of $L_1/Q$ is used for columns).

Regarding Claims 11 and 13, Feig et al, Acharya and Boyce et al teaches the method of claims 9 and 10. Feig et al further teach to use integer as the size $P$ and $Q$ of each enlarged image block (col. 4, lines 1-4, $K_1(P)$ and $K_2(Q)$ are integers, col. 20, lines 33-39).

**Allowable Subject Matter**

Claims 8, 16, and 18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter. The prior art fails to teach the listed claims each of which specifically comprises the following listed feature(s) in combination with other limitations in the claims.

Claims 8 and 16 — the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and an enlarged image
to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image and dividing the number of columns of the original image by the chosen common divisor.

Claim 18 -- the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.

Conclusion

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, THIS ACTION IS MADE FINAL. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37
CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yuzhen Ge whose telephone number is 571-272 7636. The examiner can normally be reached on 7:30am-4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Bhavesh Mehta can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either PrivatePAIR or PublicPAIR. Status information for unpublished applications is available through PrivatePAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the PrivatePAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Yuzhen Ge  
Examiner  
Art Unit 2624

WENPENG CHEN  
PRIMARY EXAMINER

[Signature]

11/6/06
# Index of Claims

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- EAST (USPAT, US-PUPUB, EPO, JPO, DERWENT, IBM_TDB, USOCR)
- See search history printout

- Consulted Joe Mancuso for search strategy.

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- Updated the above search
### PATENT APPLICATION FEE DETERMINATION RECORD

 Substitute for Form PTO-875

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**APPLICATION AS FILED – PART I**

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  - RATE ($): N/A
  - FEE ($): N/A

- **SEARCH FEE**
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- **EXAMINATION FEE**
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  **TOTAL CLAIMS**
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  **INDEPENDENT CLAIMS**
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**APPLICATION AS AMENDED – PART II**

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- **CLAIMS REMAINING AFTER AMENDMENT**
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- **INDEPENDENT CLAIMS**
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- **APPLICATION SIZE FEE**
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- **CLAIMS REMAINING AFTER AMENDMENT**
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  - ADDITIONAL FEE ($): OR X $50 =

- **APPLICATION SIZE FEE**
  - (37 CFR 1.16(q))
  - NUMBER FILED: OR TOTAL ADD'L FEE

  **CALCULATE**

- If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

- If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

- If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

### Legal Instrument Examiner:

Patsy Zimmerman

---

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.
AMENDMENT TRANSMITTAL LETTER

Application No. 10/373,691-Conf. #5193
Filing Date February 27, 2003
Examiner Y. Ge
Art Unit 2624

Applicant(s): Jung Yong KANG

Invention: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

Transmitted herewith is an amendment in the above-identified application. The fee has been calculated and is transmitted as shown below.

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Multiple Dependent Claims (check if applicable) [ ]

Other fee (please specify):

TOTAL ADDITIONAL FEE FOR THIS AMENDMENT: 0.00

[ ] Large Entity [ ] Small Entity
[ ] No additional fee is required for this amendment.

Please charge Deposit Account No. 02-2448 in the amount of $ . A duplicate copy of this sheet is enclosed.

A check in the amount of $ is enclosed.

[ ] Payment by credit card. Form PTO-2038 is attached.

The Director is hereby authorized to charge and credit Deposit Account No. 02-2448 as described below. A duplicate copy of this sheet is enclosed.

[ ] Credit any overpayment.

[ ] Charge any additional filing or application processing fees required under 37 CFR 1.16 and 1.17.

Joseph A. Kolaski
Attorney Reg. No.: 22,463

Dated: September 26, 2006

BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P.O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000

Birch, Stewart, Kolasch & Birch, LLP JAK/RFG/njp
In the United States Patent and Trademark Office

In re Patent Application of:
Jung Yong KANG

Application No.: 10/373,691
Confirmation No.: 5193

Filed: February 27, 2003
Art Unit: 2624

For: METHOD FOR RESIZING IMAGES USING THE
INVERSE DISCRETE COSINE TRANSFORM
Examiner: Ge, Yuzhen

AMENDMENT IN RESPONSE TO NON-FINAL OFFICE ACTION

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

September 26, 2006

Sir:

INTRODUCTORY COMMENTS

In response to the Examiner’s Office Action dated June 26, 2006, the following amendments and remarks are respectfully submitted in connection with the above-identified application.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Amendments to the Drawings begin on page 7 of this paper and include one replacement sheet.

Remarks/Arguments begin on page 8 of this paper.
AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

   (a) receiving discrete cosine transformed image blocks of size $M \times N$, where $M \neq N$, determining the size $P \times Q$, where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

   (b) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient; and

   (c) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size $P \times Q$.

2. (Original) The method of claim 1, further comprising the step of producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

3. (Original) The method of claim 1, wherein said k-coefficient is proportional to $\sqrt{\frac{(P \times Q)}{(M \times N)}}$, the square root value of the size of the zero-appended discrete cosine transformed image block divided by the size of the discrete cosine transformed image block.
4. (Original) The method of claim 1, wherein the numbers of the appended rows and columns of zeros depend on the size of an enlarged image to be produced.

5. (Original) The method of claim 1, further comprising the step of dividing the original image into image blocks of size $M \times N$ and performing a discrete cosine transform (DCT) operation on each of the image blocks.

6. (Original) The method of claim 5, wherein said size $M \times N$ of each of the image blocks is chosen by a user.

7. (Original) The method of claim 1, wherein the size $P \times Q$ of each of the zero-appended image blocks is determined based on the size of the original image and the size of an enlarged image to be produced.

8. (Original) The method of claim 5, wherein the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and an enlarged image to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image and dividing the number of columns of the original image by the chosen common divisor.

9. (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:
(a) receiving discrete cosine transformed image blocks of size $M \times N$ where $M \neq N$ from a digital broadcast;

(b) determining the size $P \times Q$ where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(c) computing a $k$-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the $k$-coefficient;

(d) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the $k$-coefficient to produce enlarged image blocks of size $P \times Q$; and

(e) producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

10. (Original) The method of claim 9, wherein the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.
11. (Original) The method of claim 10, wherein the numbers of rows and columns of each of the enlarged image blocks are made to be the integers closest to the values determined by the division operations.

12. (Original) The method of claim 9, wherein the number of rows of each of the enlarged image blocks is determined by dividing the number of rows of the enlarged image to be produced by the number of rows of the original image and multiplying the quotient by the number of rows of each of the image blocks and the number of columns of each of the enlarged image blocks is determined by dividing the number of columns of the enlarged image to be produced by the number of columns of the original image and multiplying the quotient by the number of columns of each of the image blocks.

13. (Original) The method of claim 9, wherein the size P and Q of each enlarged image block are determined to respective integers closest to values resulted from division of the enlarged image size by the number of the image blocks.

14. (Currently Amended) A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size $M \times N$ where $M \neq N$ from a data stream reproduced from a storage medium;

(b) determining the size $P \times Q$ where $P \neq Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the
discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(c) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient;

(d) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size $P \times Q$; and

(e) producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

15. (Original) The method of claim 14, wherein said step (a) converts the program stream reproduced from the storage medium into a packetized elementary stream and extracts the discrete cosine transformed image blocks from the packetized elementary stream.

16. (Original) The method of claim 14, wherein the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the original image by the chosen common divisor.

17. (Original) The method of claim 14, wherein the size $P \times Q$ of each of the zero-appended image blocks is determined based on the size of the original image and the size of the enlarged image to be produced.
18. (Original) The method of claim 14, wherein the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.
AMENDMENTS TO THE DRAWINGS

The attached sheet(s) of drawings are legible copies of Fig. 5 and Fig. 6, no changes have been made.

Attachment: One Replacement sheet (Figs. 5 and 6)
REMARKS

Applicant thanks the Examiner for the thorough consideration given the present application. Claims 1-18 are currently being prosecuted. The Examiner is respectfully requested to reconsider his rejections in view of the amendments and remarks as set forth below.

DRAWINGS

The Examiner objects to the drawings because labels for figures 5 and 6 are barely legible. Applicant understands this to mean that the copy that the Examiner has is too faint to read. Accordingly, Applicant is resubmitting a new copy of the same sheet which is darker. If the Examiner has other difficulties with the drawings, he is respectfully requested to be more specific.

Rejections under 35 U.S.C. § 102


The Examiner states that Acharya teaches a method for resizing an original image using an inverse discrete cosine transform where the image is divided into image blocks and discrete cosine transformed, where the size of the enlarged image blocks is determined, a k-coefficient is computed and an inverse discrete cosine transform is performed. The Examiner points out that in the reference M=N and P=Q.

Applicant submits that claim 1 is not anticipated by this reference. By way the present amendment, Applicant has specified that M ≠N and P ≠Q. Thus, the present invention utilizes image blocks which are not "square", and which consist of a matrix where the dimensions are the same. Applicant submits that Acharya does not teach this concept.

The Examiner is referred to the paragraph on page 2 starting at line 9 of the present specification. Applicant has stated there that it is well known to use a combination of DTC and quantization to increase the size of a block to an integral multiple. Thus, an 8x8 matrix can be changed to one that is 16x16 or 24x24. The present invention is designed to perform a similar
operation where the blocks are not square, but instead are rectangular shaped. Applicant submits that Acharya and the other references does not teach this concept. In paragraph 0027 of Acharya, the blocks are scaled by a fractional coefficient of \( k=1.25 \) rather than an integral multiplier. However, the matrix is still square. This differs from the present invention where the blocks have dimensions of 10x13 as shown in figure 5 or 8x15 as shown in figure 6. Since Acharya and the other references do not teach this concept, Applicant submits that claim 1 is allowable.

Claims 2-8 depend from claim 1 and as such are also considered to be allowable. In addition, each of these claims recite other features that make them additionally allowable. It is noted that claim 3 discusses the term of the k-coefficient as being \( \sqrt{\frac{P \times Q}{M \times N}} \). This is not shown in the reference. In claim 5, Applicant submits that the reference does not show image blocks of size \( M \times N \) since these dimensions have now been determined to be unequal to each other as defined by claim 1. Accordingly, Applicant submits that these claims are additionally allowable.

**Rejections under 35 U.S.C. § 103**

Claim 6 stands rejected under 35 U.S.C. § 103 as being obvious over Acharya in view of De Queiroz (US Patent 6,563,955). This rejection is respectfully traversed.

Further, Applicant submits that this claim is allowable based on its dependency from allowable claim 1. Further, Applicant submits that the De Queiroz reference does not teach non-square image blocks as presently defined in claim 1. Even if De Queiroz does teach that the size of the blocks are chosen by the user, Applicant submits that this claim is still not obvious over the combination of the references.

Claims 7, 8 and 14-18 stand rejected under 35 U.S.C. § 103 as being obvious over Acharya. This rejection is respectfully traversed.

Claim 14 is an independent claim which is similar to claim 1 and adds the limitation that the image blocks are received from a data stream reproduced from a storage medium. The Examiner
feels that it would be obvious to reproduce image block from a data stream from a storage medium. Applicant submits that claim 14 remains allowable even if this feature is obvious since it includes the other limitations of claim 1, and especially that the dimensions of the blocks are not equal, that is that $M \neq N$ and $P \neq Q$.

Further, claims 15-18 depend from claim 14 and as such they are also considered to be allowable. Further, each of these claims has other features that make them additionally allowable. Thus, claims 7 and 17 determine the size of $P \times Q$ based on the size of the enlarged image to be produced. Also, claim 15 points out that the image blocks are from a packetized elementary stream.

More importantly, claims 8, 16 and 18 discuss in detail the process for determining the number of rows and columns on the enlarged image. The Examiner has pointed out how Acharya performs this process. However, Applicant sees no indication of this in the reference. It appears that the Examiner has taken the steps of the claim and tried to equate these to the process shown by the reference even though such a process is not described. If the Examiner persists in this rejection, he is requested to point out where in the Acharya reference such a process is shown. Applicant submits that these claims are additionally allowable.

Claims 9-13 stand rejected under 35 U.S.C § 103 as being obvious over Acharya in view of Boyce et al. (US Patent 6,262,770). This rejection is respectfully traversed.

The Examiner cites Boyce et al. to teach a method for changing images from a digital broadcast. Applicant submits that even if Boyce et al. does teach the process where the images come from a digital broadcast, it does not aid the Acharya reference in overcoming its deficiencies noted above. In particularly, the combination of Acharya and Boyce et al. still does not teach a method where $M \neq N$ and $P \neq Q$. Accordingly, Applicant submits that claim 9 is likewise allowable.

Claims 10-13 depend from claim 9 and as such are considered to be allowable. Each of these claims has other features to make them additionally allowable. Claims 10 and 12 specifically describes the process for determining the number of rows and columns of the enlarged image blocks. Applicant submits that the references does not show this process either. Thus, this situation is
analogous to the arguments presented above in regard to claims 8, 16 and 18. For these reasons, Applicant submits that claims 10 and 12 are further allowable. Claims 11 and 13 further describe this process in more detail and are also allowable for the same reasons. Accordingly, Applicant submits that claims 9-13 also overcome this rejection.

CONCLUSION

In view of the above remarks, it is believed that the claims are clearly distinguished over patents relied upon by the Examiner, either alone or in combination. In view of this, reconsideration of the rejections and allowance of all the claims are respectfully requested.

Should there be any outstanding matters which need to be resolved in the present application, the Examiner is respectfully requested to contact Robert F. Gnuse (Registration No. 27,295) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Dated: September 26, 2006

Respectfully submitted,

[Signature]

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Attachments: Replacement Sheet Figs. 5 and 6
**FIG. 5**

two-dimensional image block

8

Zero Appendix k-coefficient
IDCT (PxQ)

enlarged two-dimensional image block

8

10

8

13

**FIG. 6**

two-dimensional image block

8

Zero Appendix k-coefficient
IDCT (PxQ)

enlarged two-dimensional image block

8

15

8
Please find below and/or attached an Office communication concerning this application or proceeding.
Office Action Summary

Application No. 10/373,691
Applicant(s) KANG, JUNG YONG
Examiner Yuzhen Ge
Art Unit 2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) [ ] Responsive to communication(s) filed on ______.
2a) [ ] This action is FINAL.
2b) [x] This action is non-final.
3) [ ] Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) [x] Claim(s) 1-18 is/are pending in the application.
   4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) [ ] Claim(s) _____ is/are allowed.
6) [x] Claim(s) 1-18 is/are rejected.
7) [ ] Claim(s) _____ is/are objected to.
8) [ ] Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) [ ] The specification is objected to by the Examiner.
10) [x] The drawing(s) filed on _____ is/are: a) [ ] accepted or b) [x] objected to by the Examiner.
    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) [ ] The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) [ ] Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
    a) [x] All    b) [ ] Some    c) [ ] None of:
    1. [x] Certified copies of the priority documents have been received.
    2. [ ] Certified copies of the priority documents have been received in Application No. ______.
    3. [ ] Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) [x] Notice of References Cited (PTO-892)
2) [ ] Notice of Draftsman's Patent Drawing Review (PTO-948)
3) [ ] Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
   Paper No(s)/Mail Date ______

4) [ ] Interview Summary (PTO-413)
    Paper No(s)/Mail Date ______
5) [ ] Notice of Informal Patent Application (PTO-152)
6) [ ] Other: ______
DETAILED ACTION

Drawings

1. The drawings are objected to because the labels for Figs. 5 and 6 are barely legible. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102


Regarding Claim 1, Acharya teaches a method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:
(a) receiving discrete cosine transformed image blocks of size MxN, determining the size PxQ to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size PxQ (paragraphs [0027], Figs. 5 and 6, here M=N and P=Q=kN);

(b) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient (paragraphs [0027], Figs. 5 and 6, here M=N and P=Q=kN); and

(c) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size PxQ (paragraphs [0027], Figs. 5 and 6, here M=N and P=Q=kN).

Regarding Claim 2, Acharya teach the method of claim 1, further comprising the step of producing an enlarged image by combining the enlarged image blocks of size PxQ (paragraphs [0014, 0027], Figs. 4(a) and 4(b)).

Regarding Claim 3, Acharya teach the method of claim 1, wherein said k-coefficient is proportional to the square root value of the size of the zero-appended discrete cosine transformed image block divided by the size of the discrete cosine transformed image block (paragraphs [0027], Figs. 5 and 6, here k= sqrt (PxQ/MxN) =P/N when P=Q, M=N, and
therefore \( P \times Q = P^2 \) and \( M \times N = N^2 \) and when \( P \times Q \) is the enlarged block size and \( M \times N \) is the original block size).

Regarding Claim 4, Acharya teaches the method of claim 1, wherein the numbers of the appended rows and columns of zeros depend on the size of an enlarged image to be produced (paragraphs [0027], Figs. 5 and 6).

Regarding Claim 5, Acharya teaches the method of claim 1, further comprising the step of dividing the original image into image blocks of size \( M \times N \) and performing a discrete cosine transform (DCT) operation on each of the image blocks (paragraphs [0012-0013], Fig. 4, here \( M=N \)).

**Claim Rejections - 35 USC § 103**

2. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Acharya in view of De Queiroz (US Patent 6,563,955).

Regarding Claim 6, Acharya teaches the method of claim 5. However he does not teach wherein said size \( M \times N \) of each of the image blocks is chosen by a user. De Queiroz teaches to tailor the size of the blocks to the needs to the user (col. 11, lines 25-27). It is desirable to compress images of different type differently and let user control the compression process (col. 2, lines 17-33, col. 11, lines 25-27). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to use the approach of De Queiroz to let user choose the block size.

Claim 14 adds to claim 1 the limitation that the image block is from a data stream reproduced from a storage medium. Acharya teach storage medium that can be used to store images (paragraphs [0002], [0026], Fig. 4). Acharya does not specifically teach the image is from a data stream reproduced from a storage medium. It is desirable and conventional to store images (e.g., on a hard drive or a DVD or a computer). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to reproduce the image blocks from a data stream from a storage medium because of this conventionality and that this will allow the data to be processed at a desired time.

Regarding Claims 7 and 17, Acharya teaches the method of claims 1 and 14, wherein the size PxQ of each of the zero-appended image blocks is determined based on the size of the original image and the size of an enlarged image to be produced (paragraph [0027], the block size of 10x10 from original block size 8x8 is determined based on the original image size 640x480 and the enlarged image size 800x600 for a up-scale factor of 1.25, because the upscale factor from 640 to 800 is 1.25 and from 480 to 600 is also 1.25 and therefore the original block size 8x8 times 1.25 is 10x10).

Regarding Claims 8, 16 and 18, Acharya teaches the method of claims 5 and 14. Acharya also teaches that to enlarge an image of size 640x480 to 800x600 and the block size of the original
image is 8x8 and block size of the enlarged image block is 10x10 (paragraph [0027], a common divisor of 640 and 800 is 80 and a common divisor of 480 and 600 is also 60. Dividing 800 by 80 gives 10 and dividing 600 by 60 is 10, which will determine the block size of the enlarged image. Dividing 640 by 80 will give 8 and dividing 480 by 60 will give 8, which will determine the block size of the original image.). It is desirable to have a systematic way to derive the size of the original and enlarged image blocks. Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to determine the number of rows of each of the image blocks/enlarged image blocks by choosing a common divisor of the numbers of rows of the original image and an enlarged image to be produced and dividing the number of rows of the original image/enlarged image by the chosen common divisor, and to determine the number of columns of each of the image blocks/enlarged image block by choosing a common divisor of the numbers of columns of the original image and the enlarged image and dividing the number of columns of the original image/enlarged image by the chosen common divisor.

Regarding Claim 15, Acharya teaches the method of claim 14, wherein said step (a) converts the program stream reproduced from the storage medium into a packetized elementary stream and extracts the discrete cosine transformed image blocks from the packetized elementary stream (paragraphs [0002], [0026], Fig. 4, it is inherent from MPEG decoder that the discrete cosine transformed image blocks are extracted from the packetized elementary stream).

Claim 9 adds to claim 1, claim 10 adds to claim 8 and 18, the limitation that the image block is from a digital broadcast. Acharya does not specifically teach the image is from a digital broadcast. In the same field of endeavor, Boyce et al teach a method and apparatus for changing the resolution of images from digital broadcast (col. 4, lines 24-44). It is desirable to have improved quality and efficient use of spectral bandwidth (col. 1, lines 30-36). Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention, to decode and resize images from digital broadcast taught by Boyce et al in the method Acharya.

Regarding Claim 12, Acharya teaches the method of claim 9. He teaches to upscale an image by a ratio (paragraph [0027]). However he does not explicitly teach wherein the number of rows of each of the enlarged image blocks is determined by dividing the number of rows of the enlarged image to be produced by the number of rows of the original image and multiplying the quotient by the number of rows of each of the image blocks and the number of columns of each of the enlarged image blocks is determined by dividing the number of columns of the enlarged image to be produced by the number of columns of the original image and multiplying the quotient by the number of columns of each of the image blocks. Dividing the number of rows of the enlarged image to be produced by the number of rows of the original image is equivalent to finding the scaling factor k for rows and dividing the number of columns of the enlarged image to be produced by the number of columns of the original image is equivalent to finding the scaling
factor k for columns. Therefore it would have been obvious to one of ordinary skill in the art, at
the time of invention, to determine the number of rows of each of the enlarged image blocks by
multiplying the quotient/scaling factor by the number of rows of each of the image blocks and
similarly for the number of columns of each of the enlarged image blocks.

Regarding Claims 11 and 13, Acharya and Boyce et al teaches the method of claims 9 and 10.
Acharya further teach to use integer as the size \( P \) and \( Q \) of each enlarged image block (paragraph
[0027]). It is desirable to divide image into integer blocks so that computer can process them.
Therefore it would have been obvious to one of ordinary skill in the art, at the time of invention,
to determine the size \( P \) and \( Q \) of each enlarged image block as respective integers closest to
values resulted from division of the enlarged image size by the number of the image blocks.

Conclusion

Any inquiry concerning this communication or earlier communications from the
examiner should be directed to Yuzhen Ge whose telephone number is 571-272 7636. The
examiner can normally be reached on 7:30am-4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s
supervisor, Mancuso Joseph can be reached on 571-272-7695. The fax phone number for the
organization where this application or proceeding is assigned is 571-273-8300.
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Yuzhen Ge  
Examiner  
Art Unit 2624

[Signature]

JOSEPH MANCUSO  
SUPERVISORY PATENT EXAMINER
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.
**Search Notes**

**Application/Control No.**
10/373,691

**Examiner**
Yuzhen Ge

**Search Notes (Including Search Strategy)**

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EAST (USPAT, US-PUPUB, EPO, JPO, DERWENT, IBM_TDB, USOCR)
- See search history printout

Consulted Joe Mancuso for search strategy.

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CONFIRMATION NO. 5193

SERIAL NUMBER
10/373,691

FILING DATE
02/27/2003

CLASS
382

GROUP ART UNIT
2624

ATTORNEY DOCKET NO.
2950-0241P

APPLICANTS
Jung Yong Kang, Kyunggi-do, KOREA, REPUBLIC OF;

** CONTINUING DATA *********************
None

** FOREIGN APPLICATIONS ****************
REPUBLIC OF KOREA 2002-0063600 10/17/2002
Yes

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 04/16/2003

** SMALL ENTITY **

ADDRESS
002292
BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA
22040-0747

TITLE
Method for resizing images using the inverse discrete cosine transform

FILING FEE
RECEIVED
375

FEES: Authority has been given in Paper
No. ________ to charge/credit DEPOSIT ACCOUNT
No. ________ for following:

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☐ 1.16 Fees (Filing)
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# APPLICATION TRANSFER REQUEST FOR S.N. 10373691

## Section I. TRANSFER REQUEST BY

**TO:** Art Unit 2613 Class/sub 375/240.01  
**FROM:** A.U. 2631 Class ______

**REASON:**  
Resizing images using IDCT  
Gatekeeper concurrence ______

**Name LE, AMANDA T**  
**Date 5/2/2003**

## Section IIa. DISPOSITION BY RECEIVING TC

**By:** YC A.U.2613 Date 11/4/03

**NOT ACCEPTED**  
Forward to receiving TC Post Classifier 2621  
**REASON:** no TV specifics, more suitable for 382/2897

## Section IIb. DISPOSITION BY RECEIVING TC POST CLASSIFIER

- [ ] This dispute was resolved.  
  Forward to TC/AU ______ Class/Sub ______ / ______ Post Classifier ______ Date ______  
  Concurring ______

- [ ] This dispute was not resolved, forward to DISPUTE RESOLUTION PANEL

**Post Classifier Assessment:**  
Gatekeeper concurrence ______  
Post Classifier ______ Date ______

## Section III. DISPOSITION BY DISPUTE RESOLUTION PANEL

**Date ______**

**Panel Decision:**  
Forward To Technology Center/Art Unit ______ Class/sub ______ / ______

**REASON:**

**Panel Member ______**  
Concurring Panel Member ______
BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): KANG, Jung Yong

For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

Enclosed are:

☐ A specification consisting of Twenty-Five (25) pages
☐ Seven (7) sheet(s) formal drawings
☐ An assignment of the invention
☐ Applicant claims small entity status under 37 C.F.R. § 1.27
☐ Applicant does not claim priority

☐ Certified copy(ies) is(are) attached hereto.
☐ Certified copy(ies) will follow.
Amend the specification by inserting before the first line thereof the following:

a. -This nonprovisional application claims priority under 35 U.S.C. § 119(a) on Patent Application No. 2002-0063600 filed in KOREA on October 17, 2002, which is herein incorporated by reference.--

b. -This nonprovisional application claims priority under 35 U.S.C. § 119(e) on U.S. Provisional Application No. filed on , which is herein incorporated by reference.--

Executed Declaration (Original Photocopy)

Application Data Sheet in accordance with 37 C.F.R. § 1.76

Preliminary Amendment

Information Disclosure Statement, PTO-1449 and reference(s)

Other:

Applicant requests early publication - $300.00 publication fee


The filing fee has been calculated as shown below:

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Docket No. 2950-0241P

A check in the amount of $415.00 to cover the filing fee and recording fee (if applicable) is enclosed.

Please charge Deposit Account No. 02-2448 in the amount of $0.00. A triplicate copy of this transmittal form is enclosed.

Please send correspondence to:
BIRCH, STEWART, KOLASCH & BIRCH, LLP or Customer No. 002292
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By

Joseph A. Kolasc, #22,463

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

Attachment(s)

(Rev. 02/27/03)
METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a method for resizing an image using the inverse discrete cosine transform (IDCT) and, more particularly, but not by way of limitation, to a method for enlarging an original image to an arbitrary resolution.

2. Description of the Related Art

A typical method for enlarging an image is to process the image in the pixel domain, wherein the number of pixels is increased by interpolating the pixels of the original image based upon the correlations of the pixels. This method, however, has several drawbacks. It requires a complicated algorithm for computing the correlation of each of the adjacent pixel values, and moreover, the quality of the increased-size image may be
deteriorated by the interpolation operations.

Another method for enlarging an image is to process the image in the spatial frequency domain using the discrete cosine transform (DCT). An original image is divided into two-dimensional image blocks, for example, image blocks of size $8 \times 8$ pixels, and a DCT operation is performed on each of the image blocks to produce a DCT coefficient block having low and high spatial frequency components.

It is well known that the combination of DCT and quantization results in many of the frequency components being zero, especially the coefficients for high spatial frequencies because most of the energy in the original image is typically concentrated in low spatial frequencies. A common method taking advantage of this feature appends columns and rows of zeros to the high frequency area in the DCT coefficient block for increasing the size of the DCT coefficient block to integral multiples of $8 \times 8$, for example, $16 \times 16$ or $24 \times 24$. An inverse DCT operation on the increased-size DCT coefficient block leads to an enlarged image block.

While the methods disclosed in the referenced patents and applications show good results, there is a major limitation that an image cannot be enlarged to an arbitrary size and can only be enlarged to integral multiple times its original size. Also, adequate schemes for preventing possible distortions in an image after the image is enlarged to an arbitrary size have not been addressed yet.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method for enlarging an image to an arbitrary size without resulting in possible distortions in the enlarged image using the inverse discrete cosine transform (IDCT).

A method for resizing an original image using the inverse discrete cosine transform (IDCT) in accordance with the present invention is characterized in that it comprises, wherein an original image is divided into image blocks and each of the image blocks is discrete cosine transformed, the steps of: receiving discrete cosine transformed image blocks of size M x N, determining the size P x Q to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size P x Q; computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and
multiplying each of the zero-appended discrete cosine
transformed image blocks by the k-coefficient; and performing
IDCT operations on the zero-appended discrete cosine transformed
image blocks multiplied by the k-coefficient to produce enlarged
image blocks of size P \times Q.

Another method for resizing an original image using IDCT in
accordance with the present invention is characterized in that
it comprises, wherein an original image is divided into image
blocks and each of the image blocks is discrete cosine
transformed, the steps of: receiving discrete cosine transformed
image blocks of size M \times N from a digital broadcast; determining
the size P \times Q to which each of the discrete cosine transformed
image blocks is to be enlarged and appending rows and columns of
zeros to the high frequency area of each of the discrete cosine
transformed image blocks so that the size of each of the
discrete cosine transformed image blocks becomes the determined
size P \times Q; computing a k-coefficient for the zero-appended
discrete cosine transformed image blocks and multiplying each of
the zero-appended discrete cosine transformed image blocks by
the k-coefficient; performing IDCT operations on the zero-
appended discrete cosine transformed image blocks multiplied by
the k-coefficient to produce enlarged image blocks of size P \times Q;
and producing an enlarged image by combining the enlarged image
blocks of size P \times Q.

Another method for resizing an original image using IDCT in
accordance with the present invention is characterized in that
it comprises, wherein an original image is divided into image blocks and each of the image blocks is discrete cosine transformed, the steps of: receiving discrete cosine transformed image blocks of size $M \times N$ from a data stream reproduced from a storage medium; determining the size $P \times Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$; computing a $k$-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the $k$-coefficient; performing IDCT operations on the zero-appended discrete cosine transformed image blocks multiplied by the $k$-coefficient to produce enlarged image blocks of size $P \times Q$; and producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate the preferred embodiments of the invention, and together with the description, serve to explain the principles of the present invention.

In the drawings:

FIG. 1 depicts the structure of an image resizing apparatus embodying the invention;
FIGS. 2 and 3 are graphical depictions of the procedure for resizing images in accordance with the invention;

FIG. 4 is a graphical depiction of the procedure for resizing images in accordance with one embodiment of the invention;

FIGS. 5 and 6 are exemplary graphical images enlarged in accordance with the invention;

FIGS. 7 and 8 are graphical depictions for explaining how to compute the k-coefficient;

FIG. 9 is a block diagram of a digital broadcast receiver in accordance with one embodiment of the invention; and

FIG. 10 is a block diagram of an optical disk drive in accordance with another embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

FIG. 1 depicts the structure of an image resizing apparatus such as an image scaler in accordance with the present invention.

The apparatus comprises a discrete cosine transform (DCT) unit 10, a zero appending unit 11, a k-coefficient multiplying unit 12, and an inverse discrete cosine transform (IDCT) unit 12.

The DCT unit 10 divides an original image into image blocks of size m x n pixels and performs a DCT operation (DCT(m x n)) on each image block (a_{1,1} - a_{n,m}) to produce a corresponding DCT
coefficient block \((d_{1,1} - d_{n,m})\) of size \(m \times n\) as shown in FIG. 2.

The zero appending unit 11 appends rows and columns of zeros to the high frequency area in each received DCT coefficient block \((d_{1,1} - d_{n,m})\). The number of appended rows of zeros is not necessarily an integral multiple of the number of rows of the image block \((a_{1,1} - a_{n,m})\) and depends only on the number of rows of the enlarged image. Likewise, the number of appended columns of zeros is not necessarily an integral multiple of the number of columns of the image block \((a_{1,1} - a_{n,m})\) and depends only on the number of columns of the enlarged image.

As depicted in FIG. 3, the \(k\)-coefficient multiplying unit 12 multiplies each element of the zero-appended DCT coefficient block \((a_{1,1} - 0_{q,p})\) by the \(k\)-coefficient with a view to preventing the resulting enlarged image from becoming distorted. The \(k\)-coefficient is determined by the numbers of rows and columns of the DCT coefficient blocks before and after rows and columns of zeros are appended.

The IDCT unit 13 finally produces an image block \((a'_{1,1} - a'_{q,p})\) the size of which is increased to \(p \times q\) by performing an IDCT operation on the zero-appended DCT coefficient block multiplied by the \(k\)-coefficient \((kd_{1,1} - 0_{q,p})\) as shown in FIG. 3.

The above procedure leads to an image enlarged to an arbitrary resolution without having the resulting enlarged image distorted. Several exemplary embodiments of the invention will be explained below.

Consider embodiments in FIG. 4. The DCT unit 10 divides an
original image into image blocks of size $8 \times 8$ pixels and performs a DCT operation ($DCT(8 \times 8)$) on each image block ($a_{1,1}$ - $a_{8,8}$) to produce a corresponding DCT coefficient block of size $8 \times 8$ ($d_{1,1}$ - $d_{8,8}$).

The zero appending unit 11 appends 5 columns of zeros to the right of the DCT coefficient block ($d_{1,1}$ - $d_{8,8}$) and 2 rows of zeros to the bottom of the DCT coefficient block. The numbers of rows and columns of zeros depend only on the size of the image to be obtained by resizing.

The $k$-coefficient multiplying unit 12 multiplies each element of the zero-appended DCT coefficient block ($a'_{1,1}$ - $a'_{10,13}$) by the $k$-coefficient and then the IDCT unit 13 produces an enlarged image block ($a''_{1,1}$ - $a''_{10,13}$) the size of which is increased to $13 \times 10$ pixels by performing an IDCT operation on the zero-appended DCT coefficient block multiplied by the $k$-coefficient ($ka''_{1,1}$ - $k0_{10,13}$) as shown in FIG. 4.

As a result, the two-dimensional image block of size $8 \times 8$ pixels is transformed into an enlarged image block of size $13 \times 10$ pixels as shown in FIG. 5, in which the numbers of rows and columns of the enlarged image block are not integral multiples of the numbers of rows and columns of the original image block, respectively.

Similarly, a two-dimensional image block of size $8 \times 8$ pixels can be transformed to an increased-size image block of size $15 \times 8$ pixels by performing a DCT operation, appending rows and columns of zeros, multiplying the $k$-coefficient, and
performing a IDCT operation as explained above. In summary, an image block can be enlarged to an arbitrary size that is not integral multiple times its original size.

Consider another embodiment in which a standard definition (SD) image of size 720 × 480 pixels upconverted to a high definition (HD) image having 1,920 × 1,080 pixels. In this case, the DCT unit 10 divides the original image into 90 × 60 image blocks each of which is of size 8 × 8 pixels and performs a DCT operation on each of the 90 × 60 image blocks. To obtain an enlarged image of size 1,920 × 1,080 pixels, each DCT coefficient block should be enlarged to a DCT coefficient block having 18 rows and 21.3 columns. Since 21.3 columns are not feasible, 21.3 is approximated to the closest integer, 21. Each DCT coefficient block, therefore, is enlarged to an increased-size DCT coefficient block having 18 rows and 21 columns by appending 10 rows of zeros and 13 columns of zeros in the high frequency area of the original DCT coefficient block. An IDCT operation on each of the enlarged 21 × 18 DCT coefficient blocks finally produces the enlarged HD image block having a resolution of 1,890 × 1,080 pixels.

To upconvert an original image of size 720 × 480 pixels to an image of size 1,280 × 720 pixels, the DCT unit 10 divides the original image into 90 × 60 image blocks each of which is of size 8 × 8 pixels and performs a DCT operation on each of the 90 × 60 image blocks. To obtain an enlarged image of size 1,280 × 720
pixels, each image block of size 8 x 8 pixels is to be enlarged to an image block of size 14.2 x 12 pixels. Since 14.2 is not an integer, the closest integer, 14, is employed instead. As a result, each DCT coefficient block is enlarged to a DCT coefficient block of size 14 x 12 by appending 4 rows and 6 columns of zeros in the high frequency area of the original DCT coefficient block. An IDCT operation on each of the enlarged DCT coefficient blocks leads to the enlarged HD image having a resolution of 1,260 x 720 pixels.

The zero appending unit 11 calculates how many rows and columns of zeros should be appended to each DCT coefficient block with reference to the size of the original image block and that of the enlarged image block of a required size. In case the number of rows or columns of zeros to be appended is not an integer, the closest integer is used instead.

As yet another embodiment of the invention, the DCT unit 10 may use one of common divisors of the size of an original image block and that of the resulting resized image block.

Suppose that the size of an image is increased from 1,280 x 720 pixels to 1,920 x 1,080 pixels. The DCT unit 10 selects 160, one of the common divisors of 1,280 and 1,920 and 72, one of the common divisors of 720 and 1,080, and divides the original image into image blocks of size 8 x 10 pixels so that the number of resulting image blocks becomes 160 x 72. Then, the DCT unit 10 performs a DCT operation on each of the 160 x 72 image blocks after appending 4 columns and 5 rows of zeros to the DCT.
coefficient block to increase the size of an image block from 8 × 10 pixels to 12 × 15 pixels. An IDCT operation on each of the enlarged DCT coefficient blocks produces an enlarged image of size 1,920 × 1,080 pixels.

It is also possible to perform a DCT operation on an original image as a whole and to perform an IDCT operation on the corresponding DCT coefficient block after appending rows and columns of zeros to the DCT coefficient block as many as required for obtaining an enlarged image.

The method for computing the k-coefficient used in the k-coefficient multiplying unit 12 is described below.

The method for enlarging an image in accordance with the invention uses the two-dimensional DCT. The method, however, is described using the one-dimensional DCT to make it understood more easily. Because the two-dimensional DCT uses the fundamental operation of the one-dimensional DCT, the below explanation can be easily extended to the case of two-dimensional DCT.

The two dimensional DCT can be expressed as:

\[
F(u,v) = \frac{2c(u)c(v)}{\sqrt{MN}} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} f(m,n) \cos \left( \frac{(2m+1)\pi u}{2M} \right) \cos \left( \frac{(2n+1)\pi v}{2N} \right), \quad u = 0,1,\ldots, M-1 \quad v = 0,1,\ldots, N-1
\]

with

\[
c(k) = \begin{cases} 
\frac{1}{\sqrt{2}} & k = 0 \\
1 & \text{otherwise}
\end{cases}
\]

After some manipulations, the above equation can be rewritten as:
\[ F(u,v) = \sqrt{\frac{2}{M}} c(u) \sum_{m=0}^{M-1} \left( \sqrt{\frac{2}{N}} c(v) \sum_{n=0}^{N-1} f(m,n) \cos \left( \frac{(2n+1)\nu \pi}{2N} \right) \cos \left( \frac{(2m+1)\mu \pi}{2M} \right) \right), \quad u=0,1,\ldots,M-1, \quad v=0,1,\ldots,N-1 \]

which states that the two-dimensional DCT can be interpreted as an \( M \) point one-dimensional DCT of the result of a preceding \( N \) point one-dimensional DCT expressed as:

\[ F(k) = \sqrt{\frac{2}{N}} c(k) \sum_{n=0}^{N-1} f(n) \cos \left( \frac{(2n+1)k \pi}{2N} \right), \quad k=0,1,\ldots,n-1 \]

with

\[ c(k) = \begin{cases} 1 & \quad k = 0 \\ \frac{1}{\sqrt{2}} & \quad otherwise \end{cases} \]

For this reason, the following explanation will be given with reference to an example of the one-dimensional DCT instead.

The above equation of the one-dimensional DCT can be rewritten as the following matrix equation:

\[
\begin{bmatrix}
F(0) \\
F(1) \\
\vdots \\
F(N-1)
\end{bmatrix} = C(N)
\begin{bmatrix}
1 \\
\cos \frac{\pi}{2N} \\
\vdots \\
\cos \left( \frac{(N-1)\pi}{2N} \right)
\end{bmatrix}
\begin{bmatrix}
f(0) \\
f(1) \\
\vdots \\
f(N-1)
\end{bmatrix}
\]

with

\[
C(N) = \begin{bmatrix}
\frac{1}{\sqrt{N}} & 0 & 0 & 0 \\
0 & \frac{\sqrt{2}}{\sqrt{N}} & 0 & 0 \\
0 & 0 & \frac{\sqrt{2}}{\sqrt{N}} & 0 \\
0 & 0 & 0 & \frac{2}{\sqrt{N}}
\end{bmatrix}
\]

In the above matrix equation, a DCT coefficient \( F(k) \) is
computed by multiplying $f(k)$ by the corresponding cosine coefficients at $k = 0 \sim N-1$ and adding each of the multiplied values. FIG. 7 depicts the cosine coefficients by which $f(k)$ is multiplied at $k = 0 \sim N-1$ when $N=8$ and $N=10$.

FIG. 8 depicts an example for increasing $N$ from 8 to 10. It is shown that as $N$ increases so does the number of the cosine coefficients while the envelopes of the cosine coefficients of the two cases are the same. In other words, the cosine coefficients are obtained by sampling the same cosine function without regard to the value of $N$, but as $N$ increases, so does the number of the samples.

Computing a DCT coefficient requires multiplications of the cosine coefficients shown in FIG. 8 with $f(k)$ at $k = 0 \sim N-1$. When $N$ is increased from 8 to 10, it is clear that signals of the same slope are multiplied by the cosine coefficients of the same slope at $k = 0 \sim 7$ without regard to the value of $N$.

The only difference between the cases with $N = 8$ and $N = 10$ lies in the number of the multiplication terms to be summed, that is, the number of the terms equals the value of $N$. From this fact, the relation between the coefficients with $N = 8$ and $N = 10$ can be expressed as:

$$F_{10}(k) \propto \frac{10}{8} F_8(k).$$

It is seen that all of the off-diagonal elements of the matrix $C(N)$ are zero and the diagonal elements are inversely proportional to $\sqrt{N}$. When $C(N)$ is taken into consideration, therefore, the relation between $F_{10}(k)$ and $F_8(k)$ can be written as:
\[ F_{10}(k) = \sqrt{\frac{10}{8}} F_{8}(k). \]

Furthermore, when the input dimension \( N \) is extended from \( n \) to \( m \) (\( m > n \)), the relation between \( F_{m}(k) \) and \( F_{n}(k) \) can be expressed as:

\[ F_{m}(k) = \sqrt{\frac{m}{n}} F_{n}(k) \quad 0 \leq k < n. \]

The DCT coefficient \( F_{n}(k) \) for \( k \) (\( n \leq k < m \)) is set to zero, which implies that the high frequency components of the input data are neglected. The equation for the two dimensional DCT coefficients can be derived from the above equation for the one dimensional DCT coefficients. When increasing the size of a two-dimensional image from \( p \times q \) pixels to \( m \times n \) pixels, the DCT coefficients for the enlarged image can be computed by the following equation:

\[ F_{mn}(u,v) = \sqrt{\frac{m \times n}{p \times q}} F_{pq}(u,v) \quad 0 \leq u < p \]
\[ 0 \leq v < q \]

where \( p \leq m \) and \( q \leq n \). Consequently, \( \frac{m \times n}{p \times q} \) is the \( k \)-

coefficient in this case.

The present invention may be embodied in optical disk drivers such as DVD players, digital broadcast receivers such as set-top boxes, and digital video devices such as HD TVs. More exemplary embodiments of the invention are described below.

FIG. 9 depicts a block diagram of a digital broadcast receiver in accordance with an embodiment of the invention. The broadcast receiver comprises a tuner 30, a demultiplexer 31, a
video buffer 32, an audio buffer 33, a data buffer 34, a decoder 35, and a microcomputer 35. The decoder 35 may include the zero appending unit 11, the k-coefficient multiplying unit 12, and the IDCT unit 13 depicted in FIG. 1.

The tuner 30 receives a required digital broadcast signal according to a command issued by the microcomputer 36. The demultiplexer 31 outputs video, audio, and data streams of a user-selected program or sub-channel to the video buffer 32, audio buffer 33, and data buffer 34, respectively. The decoder 35 decodes the video and audio stream temporarily stored in the video buffer 32 and audio buffer 33 to retrieve original audio and video signals of the selected program or sub-channel.

The digital broadcast signal received by the tuner 30 is a transport stream and the video data outputted from the demultiplexer 31 is a packetized elementary stream. The zero appending unit 11 appends zeros to the high frequency area in each of the macro blocks received from the video buffer 32.

For example, suppose that when an original image is encoded, the original image is divided into macro blocks of size 8 x 8 pixels and a DCT operation is performed on each of the macro blocks to produce a corresponding DCT coefficient block. The zero appending unit 11 appends rows and columns of zeros as required to the high frequency area of each DCT coefficient block \( (d_{1,1} \sim d_{n,m}) \).

The k-coefficient multiplying unit 12 calculates the k-coefficient and multiplies the zero-appended DCT coefficient block \( (a_{1,1} \sim a_{q,p}) \) by the k-coefficient to prevent the resulting
enlarged image from becoming distorted, as explained above with reference to FIG. 3.

The IDCT unit 13 performs an IDCT operation on the enlarged DCT coefficient block multiplied by the k-coefficient \(kd_1,1 - 0_{q,p}\) to produce an enlarged image block \(a'_1,1 - a'_{q,p}\).

Consequently, the digital broadcast receiver provides the capability of enlarging an input image to an arbitrary size without resulting in distortions in the enlarged image.

FIG. 9 depicts a block diagram of an optical disk drive in accordance with another embodiment of the invention, comprising an optical pickup 50 for receiving optical signals from an the optical disk 50, a digital signal processing unit 52, a parser 53, a video buffer 54, an audio buffer 55, a data buffer 56, a decoder 57, and a microcomputer 58. The decoder 57 may include the zero appending unit 11, the k-coefficient multiplying unit 12, and the IDCT unit 13 depicted in FIG. 1.

The optical pickup 51 converts the optical information received from the optical disk 50 to electric signals. The digital signal processing unit 52 processes the electric signals after converting the signals into digital binary signals. The parser 53 separates the digital data received from the digital signal processing unit 52 into video, audio, and data to be stored in the video buffer 54, audio buffer 55, and data buffer 56, respectively.

The decoder 57 decodes the video and audio data temporarily stored in the video buffer 54 and audio buffer 55 to retrieve original audio and video signals recorded on the optical disk 50.
The digital signal produced by the digital signal processing unit 52 is a program stream and the video data outputted from the parser 53 is a packetized elementary stream. The zero appending unit 11 appends zeros to the high frequency area in each of the macro blocks received from the video buffer 54.

Suppose that when an original video data is recorded on the optical disk 50, the original image is divided into image blocks of size 8 x 8 pixels and a DCT operation is performed on each of the image blocks. The data recorded on the optical disk 50 is the DCT coefficient blocks. The zero appending unit 11 appends rows and columns of zeros as required to the high frequency area of each received DCT coefficient block (d_{1,1} ~ d_{n,m}).

The k-coefficient multiplying unit 12 calculates the k-coefficient and multiplies the enlarged DCT coefficient block (a_{1,1} ~ a_{q,p}) by the k-coefficient to prevent the enlarged image from becoming distorted, as explained above with reference to FIG. 3.

The IDCT unit 13 performs an IDCT operation on the enlarged DCT coefficient block multiplied by the k-coefficient (kd'_{1,1} ~ 0_{q,p}) to produce an enlarged image block (a'_{1,1} ~ a'_{q,p}). The enlarged image blocks are combined to produce an enlarged complete image.

Consequently, the optical disk drive provides the capability of enlarging an input image to an arbitrary size without resulting in severe distortion in the enlarged image.

The method for resizing images in accordance with the present invention enables digital video processing devices such
as DVD players, digital broadcast receivers, or HD TVs to
enlarge an original image to an arbitrary size without resulting
in distortions in the enlarged image, thereby preventing
deteriorated image quality.

While the invention has been disclosed with respect to a
limited number of embodiments, those skilled in the art, having
the benefit of this disclosure, will appreciate numerous
modifications and variations therefrom. It is intended that the
appended claims cover all such modifications and variations as
fall within the true spirit and scope of the invention.
What is claimed is:

1. A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

   (a) receiving discrete cosine transformed image blocks of size $M \times N$, determining the size $P \times Q$ to which each of the discrete cosine transformed image blocks is to be enlarged, and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

   (b) computing a $k$-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the $k$-coefficient; and

   (c) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the $k$-coefficient to produce enlarged image blocks of size $P \times Q$.

2. The method of claim 1, further comprising the step of producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

3. The method of claim 1, wherein said $k$-coefficient is
proportional to $\sqrt{\frac{(P \times Q)}{(M \times N)}}$, the square root value of the size of
the zero-appended discrete cosine transformed image block
divided by the size of the discrete cosine transformed image
block.

4. The method of claim 1, wherein the numbers of the
append ed rows and columns of zeros depend on the size of an
enlarged image to be produced.

5. The method of claim 1, further comprising the step of
dividing the original image into image blocks of size $M \times N$ and
performing a discrete cosine transform (DCT) operation on each
of the image blocks.

6. The method of claim 5, wherein said size $M \times N$ of each
of the image blocks is chosen by a user.

7. The method of claim 1, wherein the size $P \times Q$ of each of
the zero-appended image blocks is determined based on the size
of the original image and the size of an enlarged image to be
produced.

8. The method of claim 5, wherein the number of rows of
each of the image blocks is determined by choosing a common
divisor of the numbers of rows of the original image and an
enlarged image to be produced and dividing the number of rows of
the original image by the chosen common divisor and the number
of columns of each of the image blocks is determined by choosing
a common divisor of the numbers of columns of the original image
and the enlarged image and dividing the number of columns of the
original image by the chosen common divisor.

9. A method for resizing an original image using the inverse discrete cosine transform (IDCT), wherein the original image is divided into image blocks and each of the image blocks is discrete cosine transformed, said method comprising the steps of:

(a) receiving discrete cosine transformed image blocks of size $M \times N$ from a digital broadcast;

(b) determining the size $P \times Q$ to which each of the discrete cosine transformed image blocks is to be enlarged and appending rows and columns of zeros to the high frequency area of each of the discrete cosine transformed image blocks so that the size of each of the discrete cosine transformed image blocks becomes the determined size $P \times Q$;

(c) computing a k-coefficient for the zero-appended discrete cosine transformed image blocks and multiplying each of the zero-appended discrete cosine transformed image blocks by the k-coefficient;

(d) performing inverse discrete cosine transform (IDCT) operations on the zero-appended discrete cosine transformed image blocks multiplied by the k-coefficient to produce enlarged image blocks of size $P \times Q$; and

(e) producing an enlarged image by combining the enlarged image blocks of size $P \times Q$.

10. The method of claim 9, wherein the number of rows of each of the enlarged image blocks is determined by choosing a
common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.

11. The method of claim 10, wherein the numbers of rows and columns of each of the enlarged image blocks are made to be the integers closest to the values determined by the division operations.

12. The method of claim 9, wherein the number of rows of each of the enlarged image blocks is determined by dividing the number of rows of the enlarged image to be produced by the number of rows of the original image and multiplying the quotient by the number of rows of each of the image blocks and the number of columns of each of the enlarged image blocks is determined by dividing the number of columns of the enlarged image to be produced by the number of columns of the original image and multiplying the quotient by the number of columns of each of the image blocks.

13. The method of claim 9, wherein the size $P$ and $Q$ of each enlarged image block are determined to respective integers closest to values resulted from division of the enlarged image size by the number of the image blocks.

14. A method for resizing an original image using the
inverse discrete cosine transform (IDCT), wherein the original
image is divided into image blocks and each of the image blocks
is discrete cosine transformed, said method comprising the steps
of:

(a) receiving discrete cosine transformed image blocks of
size M \times N from a data stream reproduced from a storage medium;

(b) determining the size P \times Q to which each of the
discrete cosine transformed image blocks is to be enlarged and
appending rows and columns of zeros to the high frequency area
of each of the discrete cosine transformed image blocks so that
the size of each of the discrete cosine transformed image blocks
becomes the determined size P \times Q;

(c) computing a k-coefficient for the zero-appended
discrete cosine transformed image blocks and multiplying each of
the zero-appended discrete cosine transformed image blocks by
the k-coefficient;

(d) performing inverse discrete cosine transform (IDCT)
operations on the zero-appended discrete cosine transformed
image blocks multiplied by the k-coefficient to produce enlarged
image blocks of size P \times Q; and

(e) producing an enlarged image by combining the enlarged
image blocks of size P \times Q.

15. The method of claim 14, wherein said step (a) converts
the program stream reproduced from the storage medium into a
packetized elementary stream and extracts the discrete cosine
transformed image blocks from the packetized elementary stream.
16. The method of claim 14, wherein the number of rows of each of the image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the original image by the chosen common divisor and the number of columns of each of the image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the original image by the chosen common divisor.

17. The method of claim 14, wherein the size $P \times Q$ of each of the zero-appended image blocks is determined based on the size of the original image and the size of the enlarged image to be produced.

18. The method of claim 14, wherein the number of rows of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of rows of the original image and the enlarged image to be produced and dividing the number of rows of the enlarged image to be produced by the chosen common divisor and the number of columns of each of the enlarged image blocks is determined by choosing a common divisor of the numbers of columns of the original image and the enlarged image to be produced and dividing the number of columns of the enlarged image to be produced by the chosen common divisor.
ABSTRACT OF DISCLOSURE

A method for resizing images using the inverse discrete cosine transform (IDCT). The method enables digital video processing devices such as DVD players, digital broadcast receivers, or HD TVs to enlarge an original image to an arbitrary size without resulting in distortions in the enlarged image, thereby preventing deteriorated image quality.
**FIG. 1**

Original Image

\[ \text{DCT (M x N)} \]

Zero Appendix (P x Q)

\[ \text{k-coefficient (kP x kQ)} \]

IDCT (kP x kQ)

Enlarged Image

**FIG. 2**

Image Block

<table>
<thead>
<tr>
<th>a_{1,1}</th>
<th>a_{1,2}</th>
<th>a_{1,3}</th>
<th>\cdots</th>
<th>a_{1,m}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a_{2,1}</td>
<td>a_{2,2}</td>
<td>a_{2,3}</td>
<td>\cdots</td>
<td>a_{2,m}</td>
</tr>
<tr>
<td>a_{3,1}</td>
<td>a_{3,2}</td>
<td>a_{3,3}</td>
<td>\cdots</td>
<td>a_{3,m}</td>
</tr>
<tr>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>\ddots</td>
<td>\vdots</td>
</tr>
<tr>
<td>a_{n,1}</td>
<td>a_{n,2}</td>
<td>a_{n,3}</td>
<td>\cdots</td>
<td>a_{n,m}</td>
</tr>
</tbody>
</table>

DCT (M x N)

DCT coefficient block

low freq. zone

<table>
<thead>
<tr>
<th>d_{1,1}</th>
<th>d_{1,2}</th>
<th>d_{1,3}</th>
<th>\cdots</th>
<th>d_{1,m}</th>
</tr>
</thead>
<tbody>
<tr>
<td>d_{2,1}</td>
<td>d_{2,2}</td>
<td>d_{2,3}</td>
<td>\cdots</td>
<td>d_{2,m}</td>
</tr>
<tr>
<td>d_{3,1}</td>
<td>d_{3,2}</td>
<td>d_{3,3}</td>
<td>\cdots</td>
<td>d_{3,m}</td>
</tr>
<tr>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>\ddots</td>
<td>\vdots</td>
</tr>
<tr>
<td>d_{n,1}</td>
<td>d_{n,2}</td>
<td>d_{n,3}</td>
<td>\cdots</td>
<td>d_{n,m}</td>
</tr>
</tbody>
</table>

high freq. zone
FIG. 3

zero-appended DCT coefficient block

| k'd_{1,1} | k'd_{1,2} | k'd_{1,3} | \cdots | k'd_{m,1} | 0_{1,m+1} | 0_{1,m+2} | \cdots | 0_{1,p} |
|-----------|-----------|-----------|\cdots|-----------|-----------|-----------|\cdots|-----------|
| k'd_{2,1} | k'd_{2,2} | k'd_{2,3} | \cdots | k'd_{m,2} | 0_{2,m+1} | 0_{2,m+2} | \cdots | 0_{2,p} |
| k'd_{3,1} | k'd_{3,2} | k'd_{3,3} | \cdots | k'd_{m,3} | 0_{3,m+1} | 0_{3,m+2} | \cdots | 0_{3,p} |
| \vdots    | \vdots    | \vdots    | \cdots | \vdots    | 0_{n,m+1} | 0_{n,m+2} | \cdots | 0_{n,p} |
| 0_{n+1,1} | 0_{n+1,2} | 0_{n+1,3} | \cdots | 0_{n+1,m} | 0_{n+1,m+1} | 0_{n+1,m+2} | \cdots | 0_{n+1,p} |

IDCT (P x Q)

enlarged image block

| a'_{1,1} | a'_{1,2} | a'_{1,3} | \cdots | a'_{1,m} | a'_{1,m+1} | a'_{1,m+2} | \cdots | a'_{1,p} |
|-----------|-----------|-----------|\cdots|-----------|-----------|-----------|\cdots|-----------|
| a'_{2,1} | a'_{2,2} | a'_{2,3} | \cdots | a'_{2,m} | a'_{2,m+1} | a'_{2,m+2} | \cdots | a'_{2,p} |
| a'_{3,1} | a'_{3,2} | a'_{3,3} | \cdots | a'_{3,m} | a'_{3,m+1} | a'_{3,m+2} | \cdots | a'_{3,p} |
| \vdots    | \vdots    | \vdots    | \cdots | \vdots    | \vdots    | \vdots    | \cdots | \vdots    |
| a'_{n,1} | a'_{n,2} | a'_{n,3} | \cdots | a'_{n,m} | a'_{n,m+1} | a'_{n,m+2} | \cdots | a'_{n,p} |
| a'_{n+1,1} | a'_{n+1,2} | a'_{n+1,3} | \cdots | a'_{n+1,m} | a'_{n+1,m+1} | a'_{n+1,m+2} | \cdots | a'_{n+1,p} |
| \vdots    | \vdots    | \vdots    | \cdots | \vdots    | \vdots    | \vdots    | \cdots | \vdots    |
| a'_{q,1} | a'_{q,2} | a'_{q,3} | \cdots | a'_{q,m} | a'_{q,m+1} | a'_{q,m+2} | \cdots | a'_{q,p} |
**FIG. 4**

zero-appended DCT coefficient block

<table>
<thead>
<tr>
<th>$k\tilde{d}_{1,1}'$</th>
<th>$k\tilde{d}_{1,2}'$</th>
<th>$k\tilde{d}_{1,3}'$</th>
<th>$\cdots$</th>
<th>$k\tilde{d}_{8,1}'$</th>
<th>$0_{1,9}$</th>
<th>$0_{1,10}$</th>
<th>$0_{1,11}$</th>
<th>$0_{1,12}$</th>
<th>$0_{1,13}$</th>
</tr>
</thead>
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$IDCT (P \times Q)$

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COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT AND DESIGN APPLICATIONS

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Method for Resizing Images using the Inverse Discrete Cosine Transform

the specification of which is attached hereto. If not attached hereto, the specification was filed on _________________ as United States Application Number _________________ and amended on _________________ (if applicable) and/or the specification was filed on _________________ as PCT International Application Number _________________ and was amended on _________________ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representative or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

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<th>Prior Foreign Application(s)</th>
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<td>02-63600 Republic of Korea October 17, 2002 Yes No</td>
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I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional applications(s) listed below.

<table>
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<tr>
<th>Application(s)</th>
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<th>(Filing Date)</th>
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<td>All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More than 12 Months (6 Months for Designs) Prior to the Filing Date of This Application:</td>
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<td>I hereby claim the benefit under Title 35, United States Code, §120 of any United States and/or PCT application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States and/or PCT application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.</td>
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<td>(Status - patented, pending, abandoned)</td>
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I hereby appoint the practitioners at CUSTOMER NO. 2292 as my attorneys or agents to prosecute this application and/or an international application based on this application and to transact all business in the United States Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the practitioners, unless the inventor(s) or assignee provides said practitioners with a written notice to the contrary.

Send Correspondence to:

BIRCH, STEWART, KOLASCH & BIRCH, LLP or CUSTOMER NO. 2292
P.O. Box 747 • Falls Church, Virginia 22040-0747
Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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<tr>
<td>Jung Yong KANG</td>
<td></td>
<td>Feb. 14, 2023</td>
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Residence (City, State & Country)
Kyunggi-do, 463-500, Korea

MAILING ADDRESS (Complete Street Address including City, State & Country)
312-1401, Kachi-Maeul, Gumi-dong, Boondang-gu, Sungnam-si, Kyunggi-do, 463-500, Korea

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Residence (City, State & Country)

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## PATENT APPLICATION FEE DETERMINATION RECORD

Effective January 1, 2003

### CLAIMS AS FILED - PART I

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* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" in THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" in THIS SPACE is less than 3, enter "3."

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.
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</table>

* MAY BE USED FOR ADDITIONAL CLAIMS OR AMENDMENTS
IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: KANG, Jung Yong
Appl. No.: NEW
Filed: February 27, 2003
For: METHOD FOR RESIZING IMAGES USING THE INVERSE DISCRETE COSINE TRANSFORM

LETTER

Assistant Commissioner for Patents
Washington, DC 20231

February 27, 2003

Sir:

Under the provisions of 35 U.S.C. § 119 and 37 C.F.R. § 1.55(a), the applicant(s) hereby claim(s) the right of priority based on the following application(s):

<table>
<thead>
<tr>
<th>Country</th>
<th>Application No.</th>
<th>Filed</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOREA</td>
<td>2002-0063600</td>
<td>October 17, 2002</td>
</tr>
</tbody>
</table>

A certified copy of the above-noted application(s) is(are) attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By Joseph A. Kolasch, #22,463

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

Attachment
This is to certify that the following application annexed hereto
is a true copy from the records of the Korean Intellectual
Property Office.

Application Number
10-2002-0063600

Date of Application
2002년 10월 17일
OCT 17, 2002

Applicant(s)
주식회사 휴맥스

2003 년 02 월 07 일

COMMISSIONER
【서지사항】
명세서 등 보정서
특허청장
2003.01.08
주식회사 휴맥스
1-1998-000063-1
출원인
박래봉
9-1998-000250-7
2001-062813-4
10-2002-0063600
2002.10.17
이산 여환 역변환을 이용한 이미지 크기 재설정 방법
【제출원인】
1-1-02-0341505-60
2002.10.17
명세서등
【보정할 서류】
【보정할 사항】
【보정대상항목】
【보정방법】
【보정내용】별지와 같음
【취지】
특허법施行규칙 제13조·실용신안법 시행규칙 제8조의 규정
에 의하여 위와 같이 제출합니다. 대리인
박래봉 (인)
【수수료】
【보정료】
0 원
【추가심사청구료】
0 원
【기타 수수료】
0 원
【합계】
0 원
【보정대상항목】 청구항 9

【보정방법】 정정

【보정내용】

제 8항에 있어서,

상기 확대된 엽의 크기의 이미지 블록(P X Q)은, 확대하고자 하는 이미지의 크기를
오리지널 이미지를 분할한 블록(M X N)의 개수로 나눈 값으로 결정되는 것을 특정으로
하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【보정대상항목】 청구항 10

【보정방법】 정정

【보정내용】

제 8항에 있어서,

상기 확대된 엽의 크기의 이미지 블록(P X Q)는, 산술에 의해 결정된 값의 가장 근
접한 정수 값으로 선택 결정하는 것을 특정으로 하는 이산 여현 역변환을 이용한 이미지
크기 재설정 방법.
【서지사항】
서지사항 보정서
특허청장
2002.11.27

주식회사 휴맥스
1-1996-000063-1
출원인

박래봉
9-1996-000250-7
2001-062813-4
10-2002-0063600
2002.10.17

이상 여원 역변환을 이용한 이미지 크기 재설정 방법

【제출원인】
1-5-2002-0079838-16
2002.11.16
특허출원서

【보정할 서류】

【보정할 사항】

【보정대상항목】

【보정방법】

【보정내용】

【첨부서류】

【취지】

【수수료】
【보정료】
0 원
【기타 수수료】
0 원
【합계】
0 원
【서지사항】
특허출원서
특허
특허청장
0001
2002.10.17
이산 여현 역변환을 이용한 이미지 크기 재설정 방법
Method for resetting image size using inverse discrete cosine transform

주식회사 휴맥스
1-1998-000063-1

박래봉
9-1998-000250-7
2001-062813-4

강종용
KANG, Jung Yong
651121-1025716
463-500
경기도 성남시 분당구 구미동 까치마을 312-1401
KR
특허법 제42조의 규정에 의하여 위와 같이 출원합니다. 대리인
박래봉 (인)

【수수료】
【기본출원료】 20 면 29,000 원
【가산출원료】 14 면 14,000 원
【우선권추정료】 0 건 0 원
【심사청구료】 0 항 0 원
【합계】 43,000 원
【감면사유】 중소기업
【감면후 수수료】 21,500 원
【참부서류】

1. 요약서·영세서(도면) 1통
【요약】
본 발표는, 이산 역변환(IDCT)을 이용한 이미지 크기 재설정 방법에 관한 것으로, 디브이디 플레이어, 디지털 방송수신기, 또는 고성명 텔레비전 등과 같은 디지털영상 기기에서, 이산 역변환(IDCT)을 이용하여, 오리지널 이미지의 크기를 보다 다양한 형상의 크기로 확대할 수 있게 되며, 또한 다양한 형상의 크기로 확대된 이미지의 왜곡 발생을 억제할 수 있게 되어 해상도 저하를 효율적으로 방지시킬 수 있게 되는 매우 유용한 발명인 것이다.

【대표도】
도 1

【사인어】
이산 역변환, 이산 역변환, 확대계수, 고주파 영역, 제로 값
【명세서】

【발명의 명칭】
이산 여현 역변환을 이용한 이미지 크기 재설정 방법 {Method for resetting image size using inverse discrete cosine transform}

【도면의 간단한 설명】

도 1은 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법이 적용되는 장치의 구성을 개념적으로 도시한 것이고,

도 2 및 도 3은 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 과정을 도시한 것이고,

도 4는 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 과정에 대한 실시예를 도시한 것이고,

도 5 및 도 6은 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법에 의해 확대된 이미지의 실시예들을 도시한 것이고,

도 7 및 도 8은 본 발명에 따른 확대계수 산출 방법을 설명하기 위해 도시한 것이다.

도 9는 본 발명이 적용되는 디지털 방송수신기에 대한 구성을 도시한 것이고,

도 10은 본 발명이 적용되는 광디스크 장치에 대한 구성을 도시한 것이다.

※ 도면의 주요부분에 대한 부호의 설명
본 발명은, 이산 여현 역변환(IDCT: Inverse Discrete Cosine Transform)을 이용한 이미지 크기 재설정 방법에 관한 것으로, 더욱 상세하게는 오리지널 (Original) 이미지의 크기를 임의의 크기로 확대하기 위한 이미지 크기 재설정 방법에 관한 것이다.

일반적으로 오리지널 이미지의 크기는, 픽셀 도메인(Pixel Domain)에서 임의의 크기로 확대되거나, 또는 주파수 도메인(Frequency Domain)에서 임의의 크기로 확대될 수 있는 데, 예를 들어 상기 오리지널 이미지의 크기를 픽셀 도메인에서 확대하는 방법에서는, 각각 인접된 픽셀들간의 상관성을 일일이 연산한 후, 그 상관성을 갖는 새로운 픽셀들을 생성하고, 상기 인접된 픽셀들 사이에 간섭시키게 되므로, 상기 상관성 연산을 위한 복잡한 연산 알고리즘이 필요하게 됨은 물론, 새로운 픽셀의 간섭으로 인해 확대된 이미지의 해상도가, 오리지널 이미지의 해상도에 비해 상대적으로 크게 저하되는 등의 단점이 있다.

반면, 상기 오리지널 이미지의 크기를 주파수 도메인에서 확대하는 방법에서는, 오리지널 이미지를 소정 크기, 예를 들어 '8 x 8' 픽셀 크기의 2차원 이미지 블록
데이터(Image Block Data)로 분할한 후, 이산 여현 변환(DCT)을 수행하여, 주파수 영역과 고주파 영역을 갖는 2차원 이미지 블록의 DCT 계수로 변환하게 된다.

한편, 상기 저주파 영역에는 영상 정보량이 많이 편중되고, 고주파 영역에는 영상 정보량이 극히 적게 존재하는 특성을 가지게 되는데, 이와 같은 특성을 이용하여, 상기 이산 여현 변환된 이미지 블록 중, 가로 및 세로의 고주파 영역에, 제로(Zero) 값을 '8 X 8'의 정수배에 해당하는 개수만큼 추가 기록한 후, 이산 여현 역변환(IDCT)을 수행하여, 상기 '8 X 8' 픽셀 크기의 정수배, 예를 들어 '16 X 16' 또는 '24 X 24' 픽셀 크기의 이미지 블록으로 확대하게 된다.


그러나, 상기와 같은 참고 문헌에 제시하고 있는 주파수 도메인에서의 이미지 크기 확대 방법은, '8 X 8' 픽셀 크기의 정수 배에 해당하는 크기로만 이미지 확대가 가능하기 때문에, 보다 다양한 형상의 크기로 이미지를 확대할 수 없게 되는 문제점이 있다.

또한, 상기 다양한 크기의 형상으로 이미지를 확대하는 경우, 그 확대된 이미지의 왜곡을 방지할 수 있는 효율적인 방안이 아직 마련되어 있지 않은 설정이다.
【발명이 이루고자 하는 기술적 과제】
본 발명은, 상기와 같은 문제점 및 실정을 감안하여 창작된 것으로서, 오리지널 이미지의 크기를 보다 다양한 형상의 크기로 확대할 수 있도록 함과 아울러, 다양한 형상의 크기로 확대된 이미지에 왜곡이 발생하지 않도록 하기 위한 이산 여현 역변환을 이용한 이미지 크기 재설정 방법을 제공하는 데, 그 목적이 있는 것이다.

【발명의 구성 및 작용】
상기와 같은 목적을 달성하기 위한 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법은, 이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N) 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 제로(Zero) 값을 독립적으로 추가하는 1단계; 상기 제로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 승산하는 2단계; 및 상기 확대계수가 수정된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여, 확대된 임의 크기의 이미지 블록(P X Q)을 출력하는 3단계를 포함하여 이루어지는 것을 특징으로 하며,

또한, 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 크기 재설정 방법은, 이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N)을, 디지털 방송을 통해 수신하는 1단계; 상기 수신된 소정 크기의 이미지 블록 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 제로(Zero) 값을 독립적으로 추가하는 2단계; 상기 제로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 승산하는 2단계; 및 상기 확대계수가 수정된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여,
행하여, 확대된 담의 크기의 이미지 블록(PxQ)을 출력하는 3단계를 포함하여 이루어지는 것을 특징으로 하며,

<21> 또한, 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법은, 이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N)을, 광디스크로부터 제생되는 데이터 스트림을 통해 수신하는 1단계; 상기 수신된 소정 크기의 이미지 블록 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 제로(Zero) 값을 독립적으로 추가하는 2단계; 상기 제로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 승산하는 2단계; 및 상기 확대계수가 승산된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여, 확대된 담의 크기의 이미지 블록(PxQ)을 출력하는 3단계를 포함하여 이루어지는 것을 특징으로 한다.

<22> 이하, 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법에 대한 바람직한 실시예에 대해, 첨부된 도면을 참조하여 상세히 설명한다.

<23> 도 1은, 본 발명에 따른 이산 여현 역변환을 이용한 이미지 크기 재설정 방법이 적용되는 장치의 구성의 개념적으로 도시한 것으로, 예를 들어 오리지널 이미지를 입력의 크기로 확대하는 이미지 스케일러(Image Scaler)와 같은 장치에는, 이산 여현 변환부 (10), 제로 값 추가부(11), 확대계수 승산부(12), 그리고 이산 여현 역변환부(12)가 포함 구성될 수 있다.

<24> 한편, 상기 이산 여현 변환부(10)에서는, 도 2에 도시한 바와 같이, 오리지널 이미지를 소정 크기의 2 차원 이미지 블록 데이터(a1,1~aN,M)로 분할한 후, 이산 여현 변환

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(DCT(M × N))을 수행하여, 저주파 영역과 고주파 영역을 갖는 2 차원 이미지 블록의 DCT 계수\((d_{1,1} \sim d_{n,m})\)로 변환 출력하게 된다.

그리고, 상기 제로 값 추가부\((11)\)에서는, 상기 이산 여현 변환된 2 차원 이미지 블록 데이터의 DCT 계수\((d_{1,1} \sim d_{n,m})\) 중, 가로 및/또는 세로의 고주파 영역에, 임의 개수만큼 제로 값\('0'\)을 추가하게 되는 데, 상기 가로 및/또는 세로의 고주파 영역에 추가되는 제로 값의 개수는, 상기 2 차원 이미지 블록 데이터\((a_{1,1} \sim a_{n,m})\)의 정수배와는 무관하게, 최종적으로 확대하고자 하는 이미지의 크기에 따라 다양한 임의 개수로 추가된다.

또한, 상기 확대계수 추가부\((12)\)에서는, 도 3에 도시한 바와 같이, 상기와 같이 제로 값이 추가된 2 차원 이미지 블록 데이터의 DCT 계수\((a_{1,1} \sim 0_{q,p})\)에, 확대계수\((k)\)를 각각 승산하여, 확대된 이미지의 왜곡이 발생되지 않도록 하는데, 상기 확대계수\((k)\)는, 상기 제로 값이 추가되기 이전의 2 차원 블록 데이터의 행과 열의 값과, 상기 제로 값이 추가된 이후의 2 차원 블록 데이터의 행과 열의 값에 근거하여 산출된다.

한편, 상기 이산 여현 역변환부\((13)\)에서는, 도 3에 도시한 바와 같이, 상기 확대계수\((k)\)가 각각 승산된 2 차원 블록 데이터의 DCT 계수\((kd'_{1,1} \sim 0_{q,p})\)를, 통상적인 이산 여현 역변환\((IDCT)\)을 수행하여, 임의의 크기로 확대된 2 차원 이미지 블록 데이터\((a'_{1,1} \sim a'_{q,p})\)로 변환 출력하게 된다.

따라서, 상기 오리지널 이미지의 크기를, 보다 다양한 형상의 크기로 확대할 수 있게 되며, 또한 다양한 형상의 크기로 확대된 이미지에 왜곡이 발생하는 것을 방지할 수 있게 되는 데, 이에 대한 구체적인 실시예를 설명하면 다음과 같다.
예를 들어, 상기 이산 여현 변환부(10)에서는, 오리지널 이미지를 '8x8' 픽셀 크기의 2차원 이미지 블록 데이터(a1,1~a8,8)로 분할한 후, 이산 여현 변환(DCT(8 x 8))을 수행하여, 저주파 영역과 고주파 영역을 갖는 2차원 이미지 블록의 DCT 계수(d1,1~d8,8)로 변환 출력하게 된다.

그리고, 상기 세로 값 추가부(11)에서는, 상기 이산 여현 변환된 2차원 이미지 블록 데이터의 DCT 계수(d1,1~d8,8) 중, 가로 및 세로의 고주파 영역에, 각각 5개의 세로 값과, 2개의 세로 값을 추가하게 되는데, 상기 가로 및 세로의 고주파 영역에 추가되는 세로 값의 개수는, 상기 2차원 이미지 블록 데이터(a1,1~a8,8)의 정수배와는 무관하게, 최종적으로 확대하고자 하는 이미지의 크기에 따라 결정된다.

또한, 상기 확대계수 추가부(12)에서는, 도 4에 도시한 바와 같이, 세로 값이 추가된 2차원 이미지 블록 데이터의 DCT 계수(a1,1~a10,13)에, 확대계수(k)를 각각 승산하게 되고, 상기 이산 여현 역변환부(13)에서는, 상기 확대계수(k)가 각각 승산된 2차원 블록 데이터의 DCT 계수(ka1,1~ka10,13)를, 이산 여현 역변환(IDCT)을 수행하여, '13 X 10' 픽셀 크기로 확대된 2차원 이미지 블록 데이터(a'1,1~a'10,13)로 변환 출력하게 된다.

따라서, 도 5에 도시한 바와 같이, '8 X 8' 픽셀 크기의 2차원 이미지 블록 데이터를, '8 X 8' 픽셀 크기의 정수 배와는 무관한 '13 X 10' 픽셀 크기의 이미지 블록 데이터로 확대할 수 있게 된다.

또한, 본 발명에서는 상기와 같은 이산 여현 변환(DCT), 세로 값 추가(Zero Appendix), 확대계수(k-Coefficient) 승산, 그리고 이산 여현 역변환(IDCT) 과정을 통해, 도 6에 도시한 바와 같이, '8 X 8' 픽셀 크기의 2차원 이미지 블록 데이터를, '8
'X 8' 픽셀 크기의 경우 배와는 무관한 '15 X 8' 픽셀 크기의 다양해 이미지 블록 데이터로 확대할 수도 있게 된다.

한편, '720 X 480' 크기의 SD(Standard Density)급 오리지널 이미지를 '1080' 수직 라인의 HD(High Density)급 이미지로 확대하는 경우, 예를 들어 '1890 X 1080' 크기의 이미지로 확대하는 경우, 상기 이산 여현 변환부(10)에서는, 상기 오리지널 이미지를 'M X N= 8 X 8' 크기의 이미지 블록으로 분할하여 90 X 60의 블록을 이산 여현 변환 동작을 수행한 후, 이를 '1920 X 1080' 크기의 이미지로 변환하기 위해 각 블록을 'P X G = 21.3 X 18' 크기로 확대해야 하므로, 근사값은 'P X G = 21 X 18'이 되도록, 상기 제로 값 추가부(11)에서는, 상기 이산 여현 변환된 '8 X 8' 크기의 이미지 블록의 고주파 영역에 가로 13 개의 제로와 세로 10 개의 제로를 추가한 후, 역 이산 여현 변환 동작을 수행하여 '1890 X 1080'의 확대된 이미지를 생성하게 된다.

또한, '720 X 480' 크기의 오리지널 이미지를 '1280 X 720' 크기의 이미지로 확대하는 경우, 상기 이산 여현 변환부(10)에서는, 상기 오리지널 이미지를 'M X N= 8 X 8' 크기의 이미지 블록으로 분할하여 90 X 60의 블록을 이산 여현 변환 동작을 수행한 후, 이를 '1280 X 720' 크기의 이미지로 변환하기 위해 각 블록을 'P X Q = 14.2 X 12' 크기로 확대하여야 하므로, 근사값은 'P X G = 14 X 12'가 되도록, 상기 이산 여현 변환된 '8 X 8' 크기의 이미지 블록의 고주파 영역에 가로 6 개의 제로와 세로 4 개의 제로를 추가하여, 역 이산 여현 변환 동작을 수행하여 '1260 X 720' 크기의 이미지를 생성하게 된다.

즉, 상기 제로 값 추가부(11)에서는, 상기 확대된 이미지 블록(P X Q)의 크기들, 오리지널 이미지의 크기와 확대하고자 하는 이미지의 크기를 참조하여, 제로 값이 추가
된 임의의 크기로 결정하게 되는 데, 상기 이미지 블록(P X Q)의 크기가 정수 값을 갖지 않는 경우, 가장 근접한 정수 값을 선택 결정하게 된다.

또다른 실시예로서 DCT를 위한 블록 사이즈의 조정이 가능할 경우에는 확대할 이미지 사이즈와 오리지널 이미지 사이즈의 공약수 중 하나의 값을 선택하여 각 블록의 갯수를 설정할 수도 있다.

즉, 1280 X 720 이미지를 1920 X 1080으로 확대할 경우, 상기 이산 여현 변환부 (10)에서, 1280과 1920의 공약수 중 하나인 160과, 720과 1080의 공약수 중 하나인 72를 선택하여, 오리지널 이미지를 분할한 블록의 개수가 160 X 72가 될 수 있도록 M X N = 8 X 10' 크기의 이미지 블록으로 분할하여 이산 여현 변환 동작을 수행한 후, 이를 '1920 X 1080' 크기의 이미지로 변환하기 위해 각 블록을 'P X Q = 12 X 15' 크기로 확대하도록, 상기 이산 여현 변환된 '8X10' 크기의 이미지 블록의 고주파 역역에 가로 4 개의 세로 5 개의 세로를 추가하여, 역 이산 여현 변환 동작을 수행하여 '1920 X 1080' 크기의 이미지를 생성하게 된다.

또한, 오리지널 이미지를 분할하지 아니하고, 이산 여현 변환한 후 고주파 영역에 원하는 이미지 사이즈 만큼 제로를 삽입하여 역 이산 여현 변환을 수행함으로서 원하는 이미지 사이즈로의 확대를 할 수도 있다.

한편, 상기 확대계수 송산부(12)에서, 제로 값이 추가된 이미지 블록에 대한 확대계수(k)를 산출하는 방법에 대해 예를 들어 상세히 설명하면 다음과 같다.

먼저, 이미지 확대를 설명하는 데 있어서, 2 차원적인 설명은 보잡도가 매우 크므로, 1 차원적인 설명을 통해 2 차원적인 방법의 타당성을 설명할 수 있다. 이는 아래와
같은 2 차원식의 1 차원 변환을 통해 쉽게 확인할 수 있다. 2차원 DCT 변환은 아래와 같은 식으로 표현이 가능하다. 이 수식은 DCT를 활용하는 대표적인 예 중 하나인 MPEG-2에서 사용되는 수식과 동일하다.

\[ F(u, v) = \frac{2c(u)c(v)}{\sqrt{MN}} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} f(m, n) \cos \left( \frac{(2m+1)u\pi}{2M} \right) \cos \left( \frac{(2n+1)v\pi}{2N} \right), \quad u = 0, 1, \ldots, M - 1 \]
\[ v = 0, 1, \ldots, N - 1 \]

\[ c(k) = \begin{cases} 1 & k = 0 \\ \sqrt{2} & \text{otherwise} \end{cases} \]

위의 수식은 아래와 같이 전개할 수 있다.

\[ F(u, v) = \sqrt{\frac{2}{M}} \sum_{m=0}^{M-1} \left( \frac{2}{N} \sum_{n=0}^{N-1} f(m, n) \cos \left( \frac{(2n+1)v\pi}{2N} \right) \right) \cos \left( \frac{(2m+1)u\pi}{2M} \right), \quad u = 0, 1, \ldots, M - 1 \]
\[ v = 0, 1, \ldots, N - 1 \]

위의 수식은 1 차원 DCT를 표현하는 아래의 수식이 N point에 대하여 처리되고 그 결과를 다시 M point의 1차원 DCT로 처리하는 것과 동일한 결과를 나타낸다는 것을 표현하고 있다.

\[ F(k) = \sqrt{\frac{2}{N}} \sum_{n=0}^{N-1} f(n) \cos \left( \frac{(2n+1)k\pi}{2N} \right), \quad k = 0, 1, \ldots, n - 1 \]

\[ c(k) = \begin{cases} 1 & k = 0 \\ \sqrt{2} & \text{otherwise} \end{cases} \]

따라서, 아래에서는 1차원 DCT 처리에 대한 예를 통해 설명하고자 한다. 상기 수식에 의하면, 원 신호 f(k)에 대한 주파수 도메인의 변환 결과는 F(k)이고, 상기 F(k)를 구하는 과정은 아래와 같은 행렬 연산과 같이 표현될 수 있다.
위의 표현을 살펴보면 각각의 $f(k)$에 대하여 해당되는 주파수 성분별 cosine 계수를 곱하여 $F(k)$를 얻어내는 것으로, $N=8$과 10에 대한 예를 도 7에 도시하여 보았다. 도 7에서 각각의 $k$에 해당되는 그림은 위의 행렬식에서 $f(k)$에 대하여 곱해지는 행렬의 각 열에 해당되는 값을 나타낸다.

그리고, 원 입력신호가 $N=8$ 인 경우, 이를 $N=10$으로 확대하는 예를 도 8에 도시하였다. 확대라는 의미를 도 8을 통해서 살펴보면 동일한 형상(shape)에 대하여 더 많은 샘플링(sampling)이 행해지는 과정이라는 점을 이해할 수 있다.

또한, 확대 과정에 대한 DCT 계수의 조작을 추정하기 위해 원래의 신호와 확대된 신호 각각에 대한 DCT 연산에 대하여 살펴보면, $N=10$ 인 신호에 대하여 DCT 변환을 하는 것과, $N=8$ 인 신호에 대하여 DCT 변환을 하는 것은, 각각 도시된 값들에 대해, 각각의 $k$에 대한 계수를 곱하는 것을 의미한다.

이는 $k=0$ 와 7 사이의 값인 경우, $N$ 값이 8 이나 10 에 관계없이, 같은 슬로프(Slope)의 코사인 계수들을, 같은 슬로프의 신호에 곱하는 것임을 쉽게 이해할 수 있다.
다만, N=8과 N=10 사이에서의 차이는, 근거나 더하는 값의 개수가 8과 10의 차
이면이 존재한다. 이를 통해 유추하면, N=10에 대한 DCT 계수는 N=8에 대한 DCT 계수
에 대해 N 값에 대한 비례 값이 됨을 알 수 있다.

위의 같은 비례 관계에서 원 계수 산정시 곱해지는 행렬C(N)의 값을 고려한다면 예
대한 C(N)가 N에 대하여의 상관관계를 지니고 있으므로 아래와 같은 표현이 가능하다.

\[ F_{10}(k) \propto \frac{10}{8} F_8(k) \]

따라서, 이러한 관계들을 통해 임의의 N=n.m(>n)으로 확대하는 경우에 대하여 아래
와 같은 관련성을 유추해낼 수 있다.

\[ F_n(k) = \sqrt{n} F_n(k), \quad 0 \leq k < n \]

즉, k가 n보다 크거나 같고 m보다 작은 경우에 대해서는, 그 값을 0으로 한다는 것
은 그 k값에 해당되는 고주파 성분을 무시한다는 의미로 이해할 수 있으며, 상기와 같은
1차원 DCT 계수에 대한 검토를 통해 2차원 계수의 경우, 아래와 같은 관계식을 유추해
낼 수 있다. P X Q 크기의 영상을 그 보다는 큰 임의의 m X n 크기의 영상으로 확대하는
경우, DCT 계수의 변환은 다음 식으로 표현될 수 있다.

\[ F_{mn}(u,v) = \sqrt{\frac{m \times n}{p \times q}} F_{pq}(u,v), \quad 0 \leq u < p, 0 \leq v < q \]
한편, 본 발명은 디브이디 플레이어(DVD Player)와 같은 광디스크 장치, 또는 셋탑 박스(Set Top Box)와 같은 디지털 방송 수신기, 그리고 고선명 텔레비전(HD-TV) 등과 같은 디지털 방송 기기에 적용할 수 있는 데, 이에 대해 상세 설명하면 다음과 같다.

도 9는, 본 발명이 적용되는 디지털 방송 수신기에 대한 구성을 도시한 것으로, 예를 들어 셋탑 박스와 같은 디지털 방송수신기에에는, 튜너(30), 디믹스(31), 비디오 버퍼(32), 오디오 버퍼(33), 데이터 버퍼(34), 디코더(35), 그리고 마이크(36) 등이 포함 구성될 수 있으며, 상기 디코더(36)에는, 도 1을 참조로 전술한 바 있는 제로 값 추가부(11), 확대계수 숭산부(12), 이산 여성 역변환부(13)가 포함 구성될 수 있다.

한편, 상기 튜너부(30)에서는, 상기 마이크(36)의 동작 제어에 따라 디지털 방송신호를 동조 수신하게 되고, 상기 디믹스(31)에서는 상기 튜너부를 통해 동조 수신되는 디지털 방송신호 중 사용자가 원하는 방송 채널의 서비스를 선택하여, 비디오 및 오디오, 그리고 데이터를 각각 분리한 후, 상기 비디오 버퍼(32)와 오디오 버퍼(33), 그리고 데이터 버퍼(34)로 출력하게 된다.

그리고, 상기 디코더(35)에서는, 상기 비디오 버퍼와 오디오 버퍼에 임시 저장된 비디오 데이터와 오디오 데이터를 원래의 비디오 및 오디오 신호로 디코딩하게 된다.

한편, 상기 튜너부(30)에 의해 동조 수신되는 디지털 방송신호는, 트랜스포트 스트림(TS: Transport Stream)이고, 상기 디믹스(31)에 의해 분리 출력되는 비디오 데이터는, 패킷 타이즈드 엣리먼트 스트림(PES: Packetized Elementary Stream)으로, 상기
디코더의 제도 값 추가부(11)에서는, 상기 비디오 버퍼를 거쳐 입력되는 메크로 블록 (Macro Block) 중 고주파 영역에 제도 값을 추가하게 된다.

예를 들어, 디지털 방송의 암코딩 과정에서 '8 X 8' 크기로 분할된 2 차원 이미지 블록 데이터의 DCT 계수\(d_{1,1} \sim d_{n,m}\) 중, 가로 및/또는 세로의 고주파 영역에, 임의 개수만큼 제도 값을('0')을 추가하게 된다.

그리고, 상기 확대계수 추가부(12)에서는, 도 3을 참조로 전출한 바와 같이, 제도 값이 추가된 2 차원 이미지 블록 데이터의 DCT 계수\(a_{1,1} \sim a_{q,p}\)에 대한 확대계수\(k\)를 산출 및 승산하여, 확대된 이미지의 왜곡이 발생되지 않도록 한다.

또한, 상기 이산 여현 역변환부(13)에서는, 상기 확대계수\(k\)가 각각 승산된 2 차원 블록 데이터의 DCT 계수\(kd'_{1,1} \sim d'_{q,p}\)를, 이산 여현 역변환(IDCT)을 수행하여, 임의의 크기로 확대된 2 차원 이미지 블록 데이터\(a'_{1,1} \sim a'_{q,p}\)로 변환 출력하게 된다.

따라서, 상기 셋탑 박스와 같은 디지털 방송수신기에서는, 디지털 방송을 통해 수신되는 이미지의 크기를, 보다 다양한 형상의 크기로 확대할 수 있게 되며, 또한 다양한 형상의 크기로 확대된 이미지에 왜곡이 발생하는 것을 방지할 수 있게 된다.

도 10은, 본 발명이 적용되는 광디스크 장치에 대한 구성을 도시한 것으로, 예를 들어 디브이디 플레이어와 같은 광디스크 장치에는, 디브이디와 같은 광디스크(50)에 기록된 신호를 독출 재생하기 위한 광필름(51), 디지털신호 처리부(53), 파서(53), 비디오 버퍼(54), 오디오 버퍼(55), 데이터 버퍼(56), 디코더(57), 그리고 마이크(58) 등이 포
한편, 상기 디코더(57)에서는, 광디스크(50)에 기록된 신호를 고주파 신호로 독출하게 되고, 상기 디지털신호 처리부(52)에서는 상기 고주파 신호를 이진(Binary) 신호의 디지털 신호로 변환 처리하게 되며, 상기 파서(53)에서는 상기 디지털 신호를, 비디오 및 오디오, 그리고 데이터를 각각 분리한 후, 상기 비디오 버퍼(54)와 오디오 버터(55), 그리고 데이터 버퍼(56)로 출력하게 된다.

그리고, 상기 디코더(57)에서는, 상기 비디오 버퍼와 오디오 버퍼에 임시 저장된 비디오 데이터와 오디오 데이터를 원래의 비디오 및 오디오 신호로 디코딩하게 되는 데, 상기 디지털신호 처리부(52)를 거쳐 출력되는 디지털 신호는, 프로그램 스트림(PS: Program Stream)이고, 상기 파서(53)에 의해 분리 출력되는 비디오 데이터는, 패킷 타이즈드 엘리먼트리 스트림(PES)으로, 상기 디코더의 제로 값 추가부(11)에서는, 전술한 바와 같이, 상기 비디오 버퍼를 거쳐 입력되는 매크로 블록(Macro Block) 중 고주파 영역에 제로 값을 추가하게 된다.

예를 들어, 디브이디와 같은 광디스크에 데이터를 기록하는 과정에서 '8X8' 크기로 분할된 2차원 이미지 블록 데이터의 DCT 계수(\(d_{1,1} \sim d_{n,m}\)) 중, 가로 및/또는 세로의 고주파 영역에, 임의 개수만큼 제로 값 (')0')을 추가하게 된다.

그리고, 상기 확대계수 추가부(12)에서는, 도 3을 참조로 전술한 바와 같이, 제로 값이 추가된 2차원 이미지 블록 데이터의 DCT 계수(\(a_{1,1} \sim 0_{q,p}\))에 대한 확대계수(\(k\))를 산출 및 송신하여, 확대된 이미지의 왜곡이 발생되지 않도록 한다.
또한, 상기 이산 역변환부(13)에서는, 상기 확대계수(k)가 각각 송신된 2 차원 블록 데이터의 DCT 계수(kd',1,1~0q,p)를, 이산 역변환(IDCT)을 수행하여, 임의의 크기로 확대된 2 차원 이미지 블록 데이터(a',1,1~a'q,p)로 변환 출력하게 된다.

따라서, 상기 디브이디 플레이어와 같은 광디스크 장치에서는, 광디스크로부터 독출 재생되는 이미지의 크기를, 보다 다양한 형상의 크기로 확대할 수 있게 되며, 또한 다양한 형상의 크기로 확대된 이미지에 왜곡이 발생하는 것을 방지할 수 있게 된다.

이상, 전술한 본 발명의 바람직한 실시에는, 예시의 목적을 위해 개시된 것으로, 당연히라면, 이하 첨부된 특허청구범위에 개시된 본 발명의 기술적 사상과 그 기술적 범위 내에서, 또다른 다양한 실시예들을 개량, 변경, 대체 또는 부가 등이 가능할 것이다.

【발명의 효과】.

상기와 같이 이루어지는 본 발명에 따른 이산 역변환을 이용한 이미지 크기 제설정 방법은, 디브이디 플레이어, 디지털 방송수신기, 또는 고성명 텔레비전 등과 같은 디지털 영상 기기에서, 이산 역변환(IDCT)을 이용하여, 오리지널 이미지의 크기를 보다 다양한 형상의 크기로 확대할 수 있게 되며, 또한 다양한 형상의 크기로 확대된 이미지에 왜곡 발생을 억제할 수 있게 되어, 상호간 저항을 효율적으로 방지시킬 수 있게 되는 매우 유용한 발명인 것이다.
【특허청구범위】

【청구항 1】

이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N) 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 세로(Zero) 값을 독립적으로 추가하는 1단계;

상기 세로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 승산하는 2단계; 및

상기 확대계수가 승산된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여, 확대된 임의 크기의 이미지 블록(P X Q)을 출력하는 3단계를 포함하여 이루어지는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 2】

제 1항에 있어서,

상기 확대계수(k)는, 상기 이산 여현 변환된 이미지 블록의 크기(M X N)를, 상기 확대된 이미지 블록의 크기(P X Q)로 재산한 후, 그 값에 루트(Root) 연산을 수행한 값에 비례하는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 3】

제 1항에 있어서,

상기 세로 값은, 상기 이산 여현 변환된 이미지 블록의 가로 및 세로의 배수와는 무관하게, 최종적으로 확대하고자 하는 이미지의 크기에 따라, 임의 개수만큼 추가되는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.
【청구항 4】

제 1항에 있어서,

오리지널 이미지를 소정 크기의 이미지 블록(M X N)으로 분할한 후, 이산 여현 변환(DCT)을 수행하는 단계를 더 포함하여 이루어지는 것을 특징으로 하는 이산 여현 변환을 이용한 이미지 크기 재설정 방법.

【청구항 5】

제 4항에 있어서,

상기 소정 크기의 이미지 블록(M X N)은, 사용자의 선택에 의해 결정되는 것을 특징으로 하는 이산 여현 변환을 이용한 이미지 크기 재설정 방법.

【청구항 6】

제 1항에 있어서,

상기 확대된 임의 크기의 이미지 블록(P X Q)은, 오리지널 이미지의 크기와 확대하고자 하는 이미지의 크기 증, 어느 하나 이상에 의해 결정되는 것을 특징으로 하는 이산 여현 변환을 이용한 이미지 크기 재설정 방법.

【청구항 7】

제 4항에 있어서,

상기 소정 크기의 이미지 블록(M X N)은, 오리지널 이미지의 크기와 확대하고자 하는 이미지의 크기의 각 행 및 열의 공약수 중 하나로 오리지널 이미지를 재산 한 값으로 결정되는 것을 특징으로 하는 이산 여현 변환을 이용한 이미지 크기 재설정 방법.
【청구항 8】

이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N)을, 디지털 방송을 통해 수신하는 1단계;

상기 수신된 소정 크기의 이미지 블록 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 제로(Zero) 값을 독립적으로 추가하는 2단계;

상기 제로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 송신하는 2단계; 및

상기 확대계수가 송신된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여, 확대된 임의 크기의 이미지 블록(P X Q)을 출력하는 3단계를 포함하여 이루어지는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 9】

제 1항에 있어서,

상기 확대된 임의 크기의 이미지 블록(P X Q)은, 확대하고자 하는 이미지의 크기를 오리지널 이미지를 분할한 블록(M X N)의 개수로 나눈 값으로 결정되는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 10】

제 1항에 있어서,

상기 확대된 임의 크기의 이미지 블록(P X Q)는 산술에 의해 결정된 값의 가장 근접한 정수 값으로 선택 결정하는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.
【청구항 11】

제 8항에 있어서,

상기 확대된 임의 크기의 이미지 블록(P X Q)은, 상기 이산 여현 변환(DCT)된 이미지 블록(M X N)의 크기와 확대하하기 하 이상의 크기 중, 적어도 어느 하나 이상에 의해 결정되는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 12】

이산 여현 변환(DCT)된 소정 크기의 이미지 블록(M X N)을, 광디스크로부터 재생되는 데이터 스트림을 통해 수신하는 1단계;

상기 수신된 소정 크기의 이미지 블록 중, 가로 및 세로의 고주파 영역에 임의 개수만큼 제로(Zero) 값을 독립적으로 추가하는 2단계;

상기 제로 값이 추가된 이미지 블록 전체에 대한 확대계수(k)를 산출하여, 상기 이미지 블록 전체에 각각 송신하는 2단계; 및

상기 확대계수가 송신된 이미지 블록 전체에 대한 이산 여현 역변환(IDCT)을 수행하여, 확대된 임의 크기의 이미지 블록(P X Q)을 출력하는 3단계를 포함하여 이루어지는 것을 특정으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

【청구항 13】

제 12항에 있어서.

상기 1단계는, 광디스크로부터 재생되는 프로그램 스트림을 패킷라이즈드 엘리먼트 리 스트림으로 변환한 후, 그 패킷라이즈드 엘리먼트리 스트림에서, 상기 이산 여현 변
환(DCT)된 소정 크기의 이미지 블록\((M \times N)\)을 추출하는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

[청구항 14]

제 12항에 있어서,

상기 소정 크기의 이미지 블록\((M \times N)\)은, 광디스크에 데이터를 기록하는 과정에서 임의의 크기로 결정되는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법.

[청구항 15]

제 12항에 있어서,

상기 확대된 임의 크기의 이미지 블록\((P \times Q)\)은, 상기 이산 여현 변환(DCT)된 이미지 블록\((M \times N)\)의 크기와 확대하고자 하는 이미지의 크기 중, 적어도 어느 하나 이상에 의해 결정되는 것을 특징으로 하는 이산 여현 역변환을 이용한 이미지 크기 재설정 방법
【도 1】

Original Image

DCT (M x N)

Zero Appendix (P x Q)

k-coefficient (kP x kQ)

IDCT (kP x kQ)

Magnified Image
【도 2】

(2차원 Image Block Data)

\[
\begin{array}{cccc}
  a_{1,1} & a_{1,2} & a_{1,3} & \cdots & a_{1,m} \\
  a_{2,1} & a_{2,2} & a_{2,3} & \cdots & a_{2,m} \\
  a_{3,1} & a_{3,2} & a_{3,3} & \cdots & a_{3,m} \\
  \vdots & \vdots & \vdots & \ddots & \vdots \\
  a_{n,1} & a_{n,2} & a_{n,3} & \cdots & a_{n,m} \\
\end{array}
\]

DCT \((M \times N)\)

(2차원 Image Block의 DCT 계수)

\[
\begin{array}{cccc}
  d_{1,1} & d_{1,2} & d_{1,3} & \cdots & d_{1,m} \\
  d_{2,1} & d_{2,2} & d_{2,3} & \cdots & d_{2,m} \\
  d_{3,1} & d_{3,2} & d_{3,3} & \cdots & d_{3,m} \\
  \vdots & \vdots & \vdots & \ddots & \vdots \\
  d_{n,1} & d_{n,2} & d_{n,3} & \cdots & d_{n,m} \\
\end{array}
\]
【도 3】
( 확대됨 Image Block에 대한 추정 DCT 계수 )

| \( k_{d1,1} \) | \( k_{d1,2} \) | \( k_{d1,3} \) | \( \ldots \) | \( k_{d1,m} \) | \( a_{1,m1} \) | \( a_{1,m2} \) | \( \ldots \) | \( a_{1,p} \) |
| \( k_{d1,2} \) | \( k_{d2,2} \) | \( k_{d2,3} \) | \( \ldots \) | \( k_{d2,m} \) | \( a_{2,m1} \) | \( a_{2,m2} \) | \( \ldots \) | \( a_{2,p} \) |
| \( k_{d1,3} \) | \( k_{d2,3} \) | \( k_{d3,3} \) | \( \ldots \) | \( k_{d3,m} \) | \( a_{3,m1} \) | \( a_{3,m2} \) | \( \ldots \) | \( a_{3,p} \) |
| \( \vdots \) | \( \vdots \) | \( \vdots \) | \( \ldots \) | \( \vdots \) | \( \vdots \) | \( \vdots \) | \( \ldots \) | \( \vdots \) |
| \( k_{d1,n} \) | \( k_{d2,n} \) | \( k_{d3,n} \) | \( \ldots \) | \( k_{dn,m} \) | \( a_{n,m1} \) | \( a_{n,m2} \) | \( \ldots \) | \( a_{n,p} \) |
| \( a_{n1,1} \) | \( a_{n1,2} \) | \( a_{n1,3} \) | \( \ldots \) | \( a_{n,m} \) | \( a_{n,m1} \) | \( a_{n,m2} \) | \( \ldots \) | \( a_{n,p} \) |

IDCT(\( P \times Q \))

( 확대됨 Image Block Data )

| \( a_{1,1} \) | \( a_{1,2} \) | \( a_{1,3} \) | \( \ldots \) | \( a_{1,m} \) | \( a_{1,m1} \) | \( a_{1,m2} \) | \( \ldots \) | \( a_{1,p} \) |
| \( a_{2,1} \) | \( a_{2,2} \) | \( a_{2,3} \) | \( \ldots \) | \( a_{2,m} \) | \( a_{2,m1} \) | \( a_{2,m2} \) | \( \ldots \) | \( a_{2,p} \) |
| \( a_{3,1} \) | \( a_{3,2} \) | \( a_{3,3} \) | \( \ldots \) | \( a_{3,m} \) | \( a_{3,m1} \) | \( a_{3,m2} \) | \( \ldots \) | \( a_{3,p} \) |
| \( \vdots \) | \( \vdots \) | \( \vdots \) | \( \ldots \) | \( \vdots \) | \( \vdots \) | \( \vdots \) | \( \ldots \) | \( \vdots \) |
| \( a_{n,1} \) | \( a_{n,2} \) | \( a_{n,3} \) | \( \ldots \) | \( a_{n,m} \) | \( a_{n,m1} \) | \( a_{n,m2} \) | \( \ldots \) | \( a_{n,p} \) |
| \( a_{n1,1} \) | \( a_{n1,2} \) | \( a_{n1,3} \) | \( \ldots \) | \( a_{n,m} \) | \( a_{n,m1} \) | \( a_{n,m2} \) | \( \ldots \) | \( a_{n,p} \) |

33-27
【도 4】(회전된 Image Block의 대칭 추정 DCT 계수)

<table>
<thead>
<tr>
<th>kd' 1,1</th>
<th>kd' 1,2</th>
<th>kd' 1,3</th>
<th>---</th>
<th>kd' 1,8</th>
<th>a' 1,9</th>
<th>a' 1,10</th>
<th>a' 1,11</th>
<th>a' 1,12</th>
<th>a' 1,13</th>
</tr>
</thead>
<tbody>
<tr>
<td>kd' 2,1</td>
<td>kd' 2,2</td>
<td>kd' 2,3</td>
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<td>kd' 2,8</td>
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<td>kd' 3,1</td>
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<td>a' f,1</td>
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<td>a' f,13</td>
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IDCT (P x Q)

(회전된 Image Block Data)
【도 5】

( 2 차원 Image Block Data )

Zero Appendix
k-coefficient
IDCT( P x Q )

( 확대된 Image Block Data )
【도 6】
(2차원 Image Block Data)

Zero Appendix
k-coefficient
IDCT (P x Q)

(확대된 Image Block Data)