Essence of Digital Image and its Processing for Farmers

Monika Bhatnagar*, Prashant Kumar Singh

*Corresponding author: Monika Bhatnagar
Dr. K. N. Modi University, Rajasthan, India
E-mail: monikabhatnagar12@gmail.com

Received: March 2, 2013, Accepted: March 24, 2014, Published: March 26, 2014.

ABSTRACT

With the growth and development of strong mobile communication system in India now a mobile phone has become a device which anybody and everybody can possess including the farmers of rural India. Therefore it is well understood that they can also gather information about their own cultivated crops using these mobile phones with the help of digital cameras. This paper presents the importance of these mobile camera captured digital images and how can they be processed to get knowledge for the use of the computer literate or computer illiterate farmer.

Keywords: Digital images, DIP, Classification.

INTRODUCTION

India is an agricultural country with the rural population constituting 69% of the total Indian population. Not only is India an agricultural country, it is also a fast growing country in the field of technology. This is clearly visible through the enormous growth of cellular mobile communication in the country even in the rural India. In rural area the use of mobile phone grew from less than 1 percent in 2000 to somewhere near 40 percent in 2012[1]. This shows that farmers also have an easy access to mobile phones. Moreover the competition in the mobile companies are giving better options with their handsets including features such as digital cameras with better resolutions in nominal cost. This aspect of mobile phones can be harnessed to use images of crops to identify whether they are ready for harvesting or not.

Therefore it is clearly visible that digital images can be of great use for getting this knowledge through the process of digital image processing. So this paper studies the essence of digital images and digital image processing to make it clear how they can be of great use to solve the problem of identifying harvest time of a crop.

Problem Definition

In India a lot of technological advances are being made at a very rapid pace touching the life of common people. This development does not remain untouched by rural India too. Some prominent examples of use of computer and communication system in the day to day life of a farmer are web portals exclusively for farmers, Kisaan call centers, and strong connections through cellular phones amongst them for buying and selling their agricultural goods. Moreover a lot of applications are being developed around the world. The primary idea of this paper is to find the way as to how a data that a farmer can easily collect with easily available hand held device be utilized to create an application with the help of which he can easily identify the time of harvesting his crop. The most easily available data for him would be an image of crop and the device would be a cellular phone. This data can be utilized using Digital Image Processing.

Literature Survey

A lot of studies have been done related to digital image processing around the world. But most of the studies are focussed towards much popular research areas such as photogrammetry, remote sensing, medical imaging and astronomy [8,11,13]. But the focus of digital image processing for use by farmers is not much identified or given importance. Therefore this research work puts its complete focus on digital image processing for farmers.

Why solely digital image?

Since the research work has the focus on the issues of a farmer the best offered knowledge or data that a farmer will have is his crop’s image. This image he will simply capture on his mobile with the assistance of a camera on his mobile phone. So the specified type of data or the information here during this case is a picture of his crop or in particular digital image of his crop. These digital images are going to be processed in line with the requirement of the farmer. However before it's understood what will be done to the image it's vital to grasp the idea and fundamentals of a digital image which will be followed by the fundamentals of digital image processing.

What is a digital image?

The term digital really represents the electronic type of data into consideration. A text will be handwritten communication or let it be a typewritten one on a computer system and is its electronic type. Similarly a digital image is a picture in its electronic type. A digital image could also be outlined as a 2 dimensional array of some m×n values where m could also be assumed as count of rows and n could also be...
assumed as count of columns [2]. The intersection of every m×n point may be a point known as pixel. The term pixel is derived from two words. The term pix is derived from picture and el is derived from element. However this array solely comes into image once either it’s displayed on a display device or it is printed on a paper. Once it is stored on any storage media it simply is a group of some numerical values and mathematical definitions that may be used later to represent the set of pixels or dots. Here since one more term dot is as well mentioned it is required to mention here the distinction between a pixel and a dot.

Just as a collection of pixels offer a picture its form on a monitor or display device, a collection of dots offer the image its form on a paper [3]. Therefore, PPI or Pixels Per inch may be defined as the unit of measure for showing a picture on a display device and DPI or Dots Per inch may be defined as the unit of measure for displaying a picture on a printing paper. Consequent clarification is of the distinction between the terms pixels and megapixels. As it is already acknowledged the pixels is that the simplest unit of a digital image.

Megapixel is the unit of measurement of the resolution of a camera and determines its image sensing capability. This implies that greater the value of megapixel of a camera better will be the image. For this reason currently each day camera corporations everywhere are coming up with higher and better megapixel values in their camera.

Now we are introduced with a new term resolution. Resolution could also be explained as the measure of clarity of a picture displayed in terms of dpi when we consider of an image printed on a paper and ppi in case of screen displayed image.

When the concept of digital pictures saw its initial existence, the digital pictures were displayed in grayscale. Greyscale pictures are primarily thought to be black and white coloured pictures. However the reality was that grayscale pictures contained gray color made due to combination of black and white color. A greyscale image may be a 8-bit image. Therefore, the pixel in every case will be appointed intensity starting from zero to 255 that is named its color depth. Therefore, a grayscale image could have 256 completely different shades of colours in black, white or gray.

However just in case of this analysis work the image taken will be a color image supporting the natural colours. Therefore, some understanding regarding the colour pictures is the primary demand for this case. A real color image uses either of 2 basic models of colour i.e RGB color model or CMY color model looking on the kind of image output needed [4]. If the output is meant to be a display device the colour model used is RGB and if the print of a picture is to be taken out on a paper the colour model used is CMY. RGBjust in case of RGB Model stands for red, inexperienced and blue colours. These colours correlate to the 3 colours the tissue layer of human eye perceives. CMY in of CMY color model stands for cyan, magenta and yellow and that they will be fashioned from RGB model by varied combination of red, green and blue color. Red and green mix to make yellow, green and blue to make cyan, and blue and red produce magenta. the mix of red, green, and blue fully intensify to produce white. On the other hand, cyan and yellow combine to offer green, cyan and magenta combined to offer blue, magenta and yellow combined to offer red and if all the 3 colours cyan, magenta and yellow are combined in full intensities they're going to generate black color.

A true color image consists of twenty four bits. So the pixel throughout this case are going to be appointed intensity starting from zero to around sixteen million colours as its color depth which is a result of every eight bit of the 3 colours generating 256 colours. This may be explained as 8×8×8=256×256×265= approx 16 million. This can be the explanation for a proof of natural colour of a digital image that relates them to real world.

Now it is needed to know how an image can be showed on a monitor or display device. Generally, a digital image is going to be shown on a display device with one pixel of image is displayed in every pixel on the device. If the monitor is about to show 1024 x 768 pixels, a picture containing 600 x 400 pixels can take up about 2 thirds of the screen once displayed. If the monitor had a display space of 800 x 600 pixels, this image would seem larger, seizing over 3 quarters of the screen, though the image itself can have constant number of pixels [3]. So pictures will seem of completely different sizes on different display devices. However the issue of concern is the device’s display resolution.

After the clear understanding of the fundamentals of digital images, there ought to be a brief detail on the type of digital images. The digital images are roughly classified into two types viz. scalar images or the bit-mapped images and vector images.

If the information of the image stores the outline of the colour of every pixel they are available under the class of scalar or bit-mapped images. The file size of image in this case is directly proportional to the size of the display of that particular image. So, larger display size means that larger file size is in scalar pictures. A significant downside with bitmapped pictures is that if the scale of the image is scaled to larger size it leads to pixilation. Pixilation is the property that if once the image is tried to pull larger than existing size the pixels within the ensuing image are going to be traced from adjacent pixels of existing image by the computer system in conjunction with the prevailing pixels. The resultant image may be a blurred and distorted image of original image. Quite common samples of scalar images are JPEG and GIF images.

On distinction to formation pictures if the information of the image stores the outline of lines and curves the kind of image comes beneath the class of vector pictures. These pictures will be scaled to larger size with no distortion and don't have the problem of pixilation. Quite common samples of vector pictures are Adobe Illustrator files (.ai) and CorelDraw files (.cdr).

The type of image into consideration during this research space is a scalar image particularly of the format JPEG.

**What is digital image processing?**

The studies of computer sciences where digital computers are used to process digital images is known as digital image processing [5]. Amongst several ways available an image can be captured or converted into digital form. They can easily get captured using digital cameras or converted with the help of scanners. As mentioned earlier these images get stored with the help of some numerical values and can delineate into a 2 dimensional array of pixels stored in bits. Usually, digital
Digital Image Processing could also be outlined as a way to change a picture into its digital form so that some operations can be performed on it, in order to get an improved image as a result or some helpful data will be extracted from it for the sake of knowledge. The digital image processing helps in providing improvement in sharpness, clarity and details associated with options of interest towards data extraction and advance analysis [6].

Digital image process is a particularly broad subjective space that uses procedures that are sometimes mathematically complicated. However the key activity for digital image process is extremely straightforward. The digital image is provided as input to a computer system with a sophisticated program which constitutes either a single mathematical equation or a set of it that is meant only for processing input digital image to get some other output images. This output will be an image or set of images which might be additionally analyzed for some other additional data. Within these pictures how the analysis will be done is uncountable. The visual impact of raw data can make feature differentiation difficult. These features can be made differentiable with the help of some kind of digital image processing operations.

From the figure it is clearly visible that the primary input to a digital image method is digital image that is a picture of the type $m \times n$ number of pixels. This image is transferred into next level of process referred to as pre-processing. Pre-processing is the stage where any kind of noise or unnecessary element is discarded from the image that may be result of transmission or storing [7,8].

After the image is pre-processed, it goes all the way through the component of feature extraction. During this stage the specified features are extracted from the image. The additional process will occur on these extracted features [9,10]. Now based on the selection of technique used for further classification or the required output, a feature or set of features can be extracted such as edge, color, texture, moment, standard deviation, average contrast etc.

Once the feature extraction stage is done it can pass to either of the next two phase viz. classification and image enhancement. Images may get attached to different kinds of noise. Image enhancement involves the method to improve the quality of digital image where the reason for decline is unknown. If the source of decline is known the method used is called image restoration [11]. But in both the above mentioned cases the input and an output is an image.

Image enhancement is the process of laying emphasis only on some desired image features for further analysis or its display [11]. Examples of techniques of image enhancements
are magnifying, contrast and edge enhancement, sharpening, pseudo-coloring, noise filtering etc. Although the image enhancement is counted to be an important phase of digital image processing, it actually makes no increase in the natural information content of the data. It only emphasises on some specified image characteristics for later on manual analysis. Therefore image enhancement is often said to be an interactive and application dependent process.

If the selection of next method is classification then some a lot of steps proceed.

Classification could also be outlined as method of labeling of a pixel or set of pixels based on their specific characteristics into a class or many classes [12]. The goal of the classification method is to classify all pixels of the very digital image into one class or several different classes. Classification is one of the most popular techniques of data mining. Classification may also use multiple features apart from a single feature in consideration for a group of pixels. It may be broadly defined into two different types viz. supervised classification and unsupervised classification [13].

Supervised classification starts with creation of training data which constitutes a set of classes of one’s desired features of the image. Then classification starts with comparing another set of images known as test data to check if they have same set of desired features as training data. This phase of classification is known as signature analysis where the feature for comparison can be simple as mean or range of reflectance or can be as complex as combining two or more factors together. These features and signature analysis form the basis of classification. Example of supervise learning are use of Support Vector Machines, Fuzzy Logic, Artificial Neural Network etc.

In contrast with supervised classification, the unsupervised classification does not contain a pre-defined group of informational classes. But the classes are grouped together on the basis of some natural characteristics of images under consideration. The supervised classification deals with classification where classes chosen are user dependent but the classification in unsupervised one is done by the computer program itself. Examples of unsupervised classification is clustering algorithm such as K-Means and K-Mediod.

Once the classification is completed, the image process method moves towards its final innovative conclusion such that the output of classification is given with some visual or informational effects with their accuracy checked. Then they're given to user in one among the assorted formats like pictures, knowledge or reports for straightforward interpretation by a computer literate or illiterate user. Thus a brief explanation on the working of digital image processing is given.

What comes next is the brief explanation on the interdisciplinary aspect of DIP.

**Interdisciplinary Aspect of Digital Image Processing**

Digital Image processing tasks work with the tasks of different disciplines [14]. If it gets involved in measurement then it becomes part of metrology sciences. The task of pattern recognition of image processing performs similar tasks as speech recognition. Image processing is extremely common in the fields such as neural networks, genetic algorithm, artificial intelligence and visual perception. Computer vision is an upcoming field where tasks are performed to get knowledge and information from the images. Digital Image processing also plays an important role in the field of computer vision. Therefore, it has become a vital component in areas where images are prime source of information e.g. photogrammetry, remote sensing, medical imaging and astronomy. Thus it can be said that the image processing has become important part of many interdisciplinary area of research and is contributing towards the gain of knowledge in specific area.

**Conclusion and Future Work**

Thus, the research paper presents a brief explanation on how the digital images and digital image processing can be beneficiary for the farmers of rural India. As the part of future work still DIP needs to be implemented on a cellular phone to show its importance. Once it is implemented the farmers can be benefitted with their simple hand held device known as a cellular phone.

**REFERENCES**

1. Balwant Singh Mehta , “Capabilities, costs, networks and innovations: impact of mobile phones in rural India”, Capturing the Gains 2013,April 2013, ISBN : 978-1-909336-90-2, pp 1-6.
2. Ian T. Young 9, Jan J. Gerbrands Lucas, J. van Vliet, “Fundamentals of Image Processing”, Reading, Delft University of Technology, pp-1-4, Version 2.3 © 1995-2007.
3. Melanie Cofield , "Digital Imaging Basics", Reading, The University of Texas at Austin, pp 5-8, Summer 2005.
4. Huiyu Zhou, Jiahua Wu, Jianguo Zhang, “Digital Image Processing –Part II”, Ventus Publishing ApS, pp 8-26, ISBN 978-87-7681-542-4, © 2010.
5. Rama Chellappa, “Digital Image Processing (Ieee Computer Society Press Tutorial)”, pp 10-25, Ieee Computer Society, 1992, ISBN 10: 0818623624 / ISBN 13: 9780818623622
6. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, pp 5-20, 3rd Edition, 2007, ISBN: 013168728X0020.
7. Dipti Deodhare, NNR Ranga Suri R. Amit, “Preprocessing and Image Enhancement Algorithms for a Form-based Intelligent Character Recognition System”, International Journal of Computer Science and Application, Volume II Number II, pp 131-144, Technomathematic research Foundation 2005.
8. Thomas Hesseltine, Nick Pears and Jim Austin, ”Evaluation of image pre-processing techniques for eigenface based face recognition”, The Proceedings of the Second International Conference on Image and Graphics, SPIE vol. 4875, pp. 677-685 (2002).
9. Arnulf B. A. Graf & Christian Wallraven, “Multi-class SVMs for Image Classification using Feature Tracking”, Technical Report No. 099, Max Planck Institute for Biological Cybernetics, pp 1-6, August 2002.
10. Robert M. Haralick, K. Shanmugam, Ithshak Dinstein, “Textural Feature for Image Classification”, IEEE Transactions on System, Man and Cybernetics, pp 610-621, November 1973.
11. Floyd F. Sabbins Jr., "Remote Sensing : Principals and Interpretation", pp 9-21, W.H. Freeman and Company, Second Edition 1987, ISBN: 07167 1793X.

12. Hu Min, Yang Shuangyuan, “Overview of Image Mining Research”, published in The 5th International Conference on Computer Science & Education Hefei, China. August 24–27, 2010, DOI 978-1-4244-6005-2/10/ ©2010 IEEE-classification

13. Aykut Akgun, A.Hüsnu Eronat and Necdet Turk, "Comparing Different Satellite Image Classification Methods: An application in Ayvalik District, Westrn Turkey", XXth International Society for Photogrammetry and Remote Sensing Congress Technical Commission IV, ISPRS Archives – Volume XXXV Part B4, July 12-23, 2004.

14. Bernd Jähne, "Digital Image Processing", pp 15-25 Springer Publications, Volume 1,6 Edition 05-Dec-2005 .

Citation: Monika Bhatnagar, et al (2014) Essence of Digital Image and its Processing for Farmers. J. of Computation in Biosciences and Engineering. V1I2.

Copyright: © 2014 Monika Bhatnagar. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.