Palm Recognition System for Aiding Physically Impaired

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ABSTRACT

Physically Impaired feel difficult to operate electronic devices through the switches fitted to the wall or in case of some operation like, when watching TV it may require to increase or decrease volume or channel to be changed. This can be done through remote aid using palm recognition system as they need. In this paper, an attempt is made using web cam by capturing the image. The MATLAB 7.1 software is used to alter the captured image and to process it by setting the check threshold value and removing the color component of the images. In this work, the program is developed to remove the color images to their zero thresholds and making the red color equal to the threshold value of the palm. The captured image is divided into four quadrants and assigning each two quadrant to a particular function. First and second quadrant is assigned to control first bulb (Device1), later third and fourth quadrant is assigned to control second bulb (Device2). With the help of this module all electrically controlled devices can be controlled by just moving over palm.

Keywords

Biometrics, Palm Recognition, Edge Detection, Matlab.

1. INTRODUCTION

In the present day context to overcome the usage of mechanical switches which are used to operate the electronic devices by handicaps. To design and develop a palm based recognition and control in the real time using the Matlab. Palm print recognition uses the person's palm as a biometric for identifying or verifying who the person is.We have proposed a vision based gesture recognition using a simple system connected with a web camera. To detect hand, count fingers and find the direction in which user is pointing we have trained the neural network.

Cong Liang Chao et al. developed a new system for detection press palm strength of flyer of fly frame based on Zig-Bee wireless transmission technology, making the test system more accurate, stronger anti-interference ability, failure to reduce and prolong life. Actual operating results show that the test system to normal operation [1]. Pablo H. Hennings-Yeomans et al. were proposed an algorithm to select regions of the palm-print to train correlation filter classifiers. Using this selection and scoring of palm-print regions and training correlation filters, on highest-scoring sections of the palm-print produces very low EERs and identification accuracies is more than 99.9% [2].

Goh Kah Ong Michael et al. showed a low resolution contactless palm print and palm vein recognition system. The proposed system offers several advantages like low-cost, accuracy, flexibility, and user-friendliness. And also introduce the LRE method to obtain good contrast palm print and vein images. To obtain useful representation of the palm print and vein modalities, we propose a new technique called directional coding. This method

represents the biometric features in bit string format which enable speedy matching and convenient storage [3].

E. Stergiopoulou et al. researched on the hand gesture recognition system, which was implemented in Delphi which was tested by using a test set of hand images from five different people with varying morphology, slope and size. The test images, that are 180, represent all of the 31 feasible gestures at almost equal times. The system was tested 10 times for each one of the test images. The average computation time required for the recognition of a hand gesture is about 1.5 sec [4].

Nikhil S et al. developed the GRS and DSP processor. The Implementation of this processor rather than the currently prevalent practice of using desktop/laptop make the system robust and portable. Effective segmentation and gesture recognition techniques eliminated the usage of markers, gloves, training data, bulky computing devices and multiple cameras. Recognition of dynamic gestures coupled with static gestures can be developed using various techniques like optic flow, HMM and FSM. Segmentation and palm extraction techniques can be further improved to recognize multiple gestures from complex backgrounds using advanced techniques [5].

Chhaya Mehathi et al. address the problem of palmprint recognition from low-resolution videos of the palm captured in an unconstrained setup using low-end cameras. We proposed an efficient and robust method for feature level integration of information from multiple frames. We show that the EER of an authentication system reduces from 12.75% to 4.7% by integrating information from just 9 frames on a dataset of 600 samples from 100 palms. And also propose a method to detect and remove low quality captures, where the texture information is washed out [6].

Meenakshi Panwar proposed a simple yet powerful shape based approach for hand gesture recognition. Visually impaired people can make use of hand gestures for writing text on electronic documents like MS Office, notepad etc. Moreover, almost all deaf and dumb people communicate with each other by forming several hand shapes. Similarly, a visually impaired person would be able to work on computer through computer vision. The strength of this approach lies in the ease of implementation, as it does not require any significant amount of training or post processing and it provides us with the higher recognition rate with minimum computation time [7].

Goh Kah Ong Michael et al. conducted an acclimatization and habituation tests to study the implementation of the contactless device from the user's perspective. They concluded that repeated usage improved the familiarity of using the system. If the users have more frequent interaction with the device, the acclimatization period can be reduced [8].

Goh Kaah Ong Michael et al. proposed a system, that works satisfactory in semi-controlled environment, further investigation should be conducted to verify its effectiveness under other types of open-environments. Apart from that, more users should be included into the database to test its feasibility to be used in medium to large organizations [9].

The objective of this approach is to control and operate the electrical devices using palm with the help of image processing so that the proposed device is economical, user friendly and reliable. To design and develop a palm based recognition and control in the real time using the MATLAB, the captured image is divided into four quadrants and assigning each two quadrant to a particular function. First and second quadrant is assigned to control first bulb (Device1), later third and fourth quadrant is assigned to control second bulb (Device2). The designed hardware is cost effective, easy to handle and can be operated with in no time.

2. IMAGE PROCESSING SYSTEM

Image formation using sensor and other image acquisition equipment denote the brightness of the light as two dimensional function F(x, y) where (x, y) denotes the spatial coordinates

when only the brightness of light is considered. There are three types of images namely binary, gray scale and colour image. Similar to one-dimensional time signal, sampling for images is done in the spatial domain, and quantization is done for the brightness values [1]. In the Sampling process [2], the domain of images is divided into N rows and M columns. The region of interaction of a row and a column is known as pixel. The value assigned to each pixel is the average brightness of the regions. The position of each pixel was described by a pair of coordinates (x_i, y_j). The resolution of a digital image is the number of pixels presented in the number of columns by number of rows. For example, an image with a resolution of 640×480 means that it display 640 pixels on each of the 480 rows. Resolution is one of most commonly used ways to describe the image quantity of digital camera or other optical equipment. Image involving only intensity are called gray scale images.

The division of an image into meaningful structures is known as image segmentation. It is often an essential step in image analysis, object representation, visualization and many other image processing tasks**.** In edge based segmentation, detected edges in an image are assumed to represent object boundaries and used to identify these objects. In the region based segmentation, an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique. The clustering techniques are sometimes used as a synonym for (agglomerative) segmentation techniques, which are primarily used in exploratory data analysis of high-dimensional measurement patterns.

2.1 Threshold Based Segmentation

Thresholding is probably the most frequently used technique to segment an image. The thresholding operation is a gray value remapping operation '*g'* defined by:

$$g(v) = \begin{cases} 0 \; if \; v < t \\ 1 \; if \; v \geq t \end{cases} \quad (1)$$

Where, '*v'* represents a gray value and *t* is the threshold value. Thresholding maps a gray valued image to a binary image. After the thresholding operation, the image has been segmented into two segments, identified by the pixel values 0 and 1 respectively. Let an image which contains bright objects on a dark background, thresholding can be used to segment the image, if the objects are not overlapping, then create a separate segment from each object by running a labeling algorithm on the threshold binary image, thus assigning a unique pixel value to each object. Many methods exist to select a suitable threshold value for a segmentation task. Histogram thresholding and slicing techniques are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.

Threshold segmentation can be extended to use multiple thresholds to segment an image into more than two segments. Several desired segments in an image can be distinguished by their gray values. All pixels with values between the second and third threshold are assigned to segment 2, *etc.* If *n* thresholds (t_1, t_2, . . . ,t_n) are used.

$$g(v) = \begin{cases} 0 & if \quad v \geq t1 \\ 1 & if \quad t1 \leq v \leq t2 \\ n & if \quad tn \geq v \end{cases} \quad (2)$$

After thresholding, the image has been segmented into *n*+1 segments identified by the gray values *0* to *n* respectively. Fig 1 is an example for segmentation by thresholding. On the left, an original image with bright objects (the pencils) on a dark background. Thresholding using an appropriate threshold segments the image into objects (segment with value 1) and background (segment with value 0).

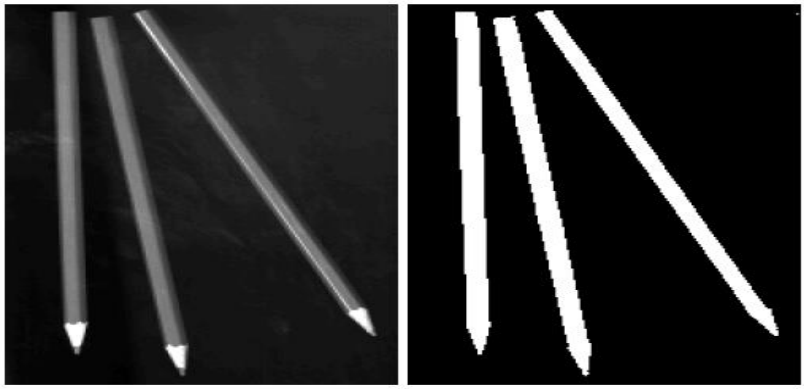

Fig 1: Segmentation by Thresholding.

2.2 Edge Detection

In image processing, image segmentation is the process of partitioning a digital image into multiple segments or sets of pixels. Brightness thresholding and edge detection are the two most common image segmentation techniques. In brightness thresholding technique, all the pixels are brighter than the specified brightness levels are taken as 1 and rest are left 0. Edge detection algorithms are used to detect the edges of objects in the image. In derivative based edge detection the algorithm find the first or second derivative on each pixel in the image. Fig 2 shows graphical procedure for derivative based edge detection algorithm. Taking derivative on each and every pixel of the image consumes a lot of computer resources and hence it is not practical. Therefore an operation called kernel operation is recommended. A kernel is a small matrix sliding over the image matrix containing coefficients which are multiplied to corresponding image matrix elements and their sum is put at the target pixel.

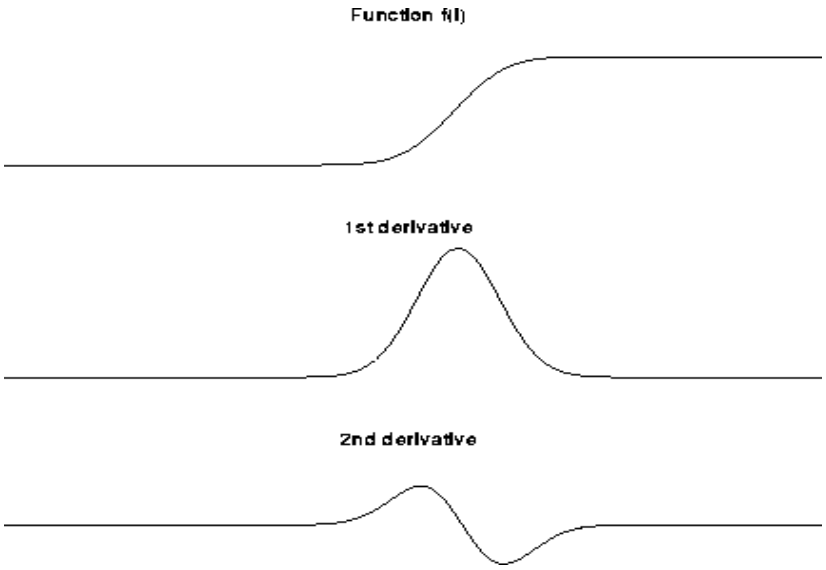

Fig 2: Derivative Based Edge Detection

3. HARDWARE DESIGN

The hardware design of palm recognition system consist of micro controller and other hardware components like RS-232, ULN2003, MAX232 and 16F873A PIC, SERIAL PORT.

3.1 PIC Microcontroller (16F873A)

The PIC 16F873A microcontroller consists of 35 single-word instruction. In its instructions, all are single-cycle instructions except for program branches which are two-cycle instructions. The operating speed of PIC 16F873A is 20 MHz clock and 200 ns instruction cycle. The Flash Program Memory is up to 8K x 14 words, Data Memory is up to 368 x 8 bytes and EEPROM Data Memory is up to 256 x 8 bytes.

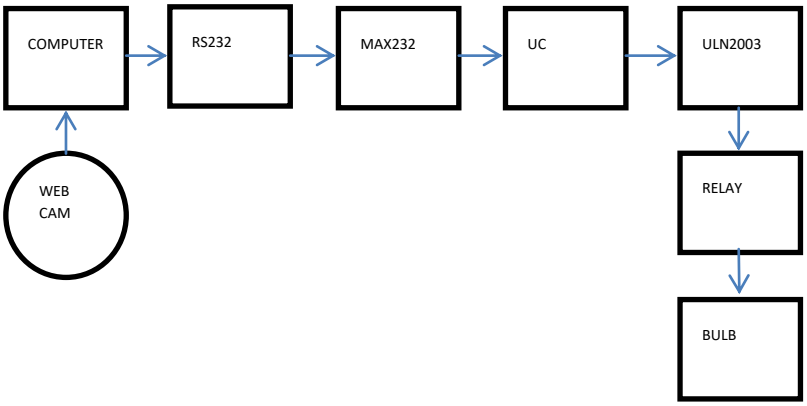

Fig 3: Proposed Functional Diagram of Palm Recognition System

3.1.1 MEMORY UNIT

There are three memory blocks in each of these PIC micro MCUs. The program memory and data memory have separate buses, so that concurrent access can occur. The data memory is partitioned into multiple banks which contain the general purpose registers and the special function registers.

3.1.2 I/O PORTS

Some pins of I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

3.1.3 PORT-A and TRISA Register

The PORT-A is a 6-bit wide bi-directional port. The corresponding data direction register is TRISA. Setting a TRISA bit (=1) will make the corresponding PORT-A pin an input. Clearing a TRISA bit (=0) will make the corresponding PORT-A pin an output.

3.1.4 PORT-B and TRISB Register

PORT-B is an 8-bit wide, bi-directional port. The corresponding data direction register is TRISB. Setting a TRISB bit(=1) will make the corresponding PORT-B pin an input. Clearing a TRISB bit (=0) will make the corresponding PORT-B pin an output.

3.1.5 PORT-C and TRISC Register

PORT-C is an 8-bit wide, bi-directional port. The corresponding data direction register is TRISC. Setting a TRISC bit(=1) will make the corresponding PORT-C pin an input. Clearing a TRISC bit (=0) will make the corresponding PORT-C pin an output.

3.1.6 ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The Analog-to-Digital (A/D) converter module has five inputs for the 28-pin devices and eight for the other devices. The analog input charges a sample and hold capacitor. The output of the sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation.

3.2 RS-232 CABLE

Program objective is to develop software using 'C' language to link two PCs using RS232 C communication cable in duplex mode. The serial port is used to interface the parallel port. In most cases, any device you connect to the serial port will need the serial transmission converted back to parallel port and can be done using a UART.

3.3 ULN2003

The UTCULN2003 is a high-voltage, high-current darlington drivers comprised of seven NPN darlington pairs. It's output current is 500mA MAX, high sustaining voltage output 50V MIN, output clamp diodes and inputs compatible with various types of logic. It can be used in Relay, Hammer, Lamp and Display drivers.

4. SOFTWARE IMPLEMENTATION

4.1 MATLAB

Matlab is a popular mathematical programming environment used extensively in algorithm development, data visualization, data analysis, and numeric computation. Additionally, Matlab may be called as ActiveX object from still higher level languages like Visual Basic, etc.,

4.2 Palm Recognition Algorithm

Software implementation uses the following algorithm as shown in Fig 4 in order to analyze the palm image.

STEP 1: Start.

STEP 2: Set the camera pixels in the range 320*240 to read the image.

STEP 3: Set the camera to take snap shot for every 5 sec.

STEP 4: Colored images are made into gray images by setting green and blue threshold value to zero.

STEP 5: The red colored images are set in between 0 to 170.

STEP 6: This captured image is divided in to four quadrants.

STEP 7: Each quadrant is assigned with a specific operation. First and second quadrant is assigned to control first bulb, the third and fourth quadrant is assigned to control second bulb as an example of electronic devices.

STEP 8: End.

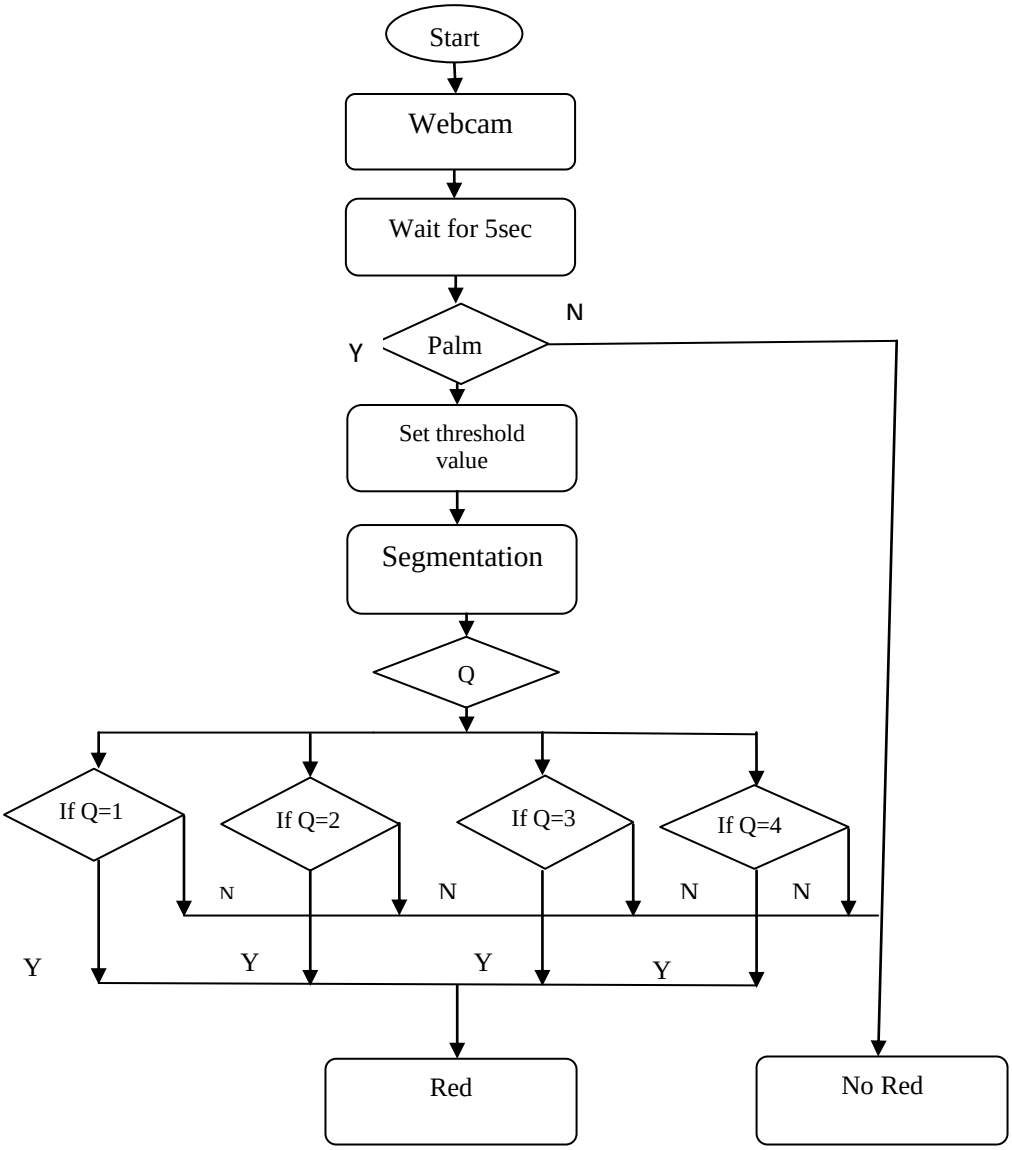

Fig 4: Flowchart for Palm Recognition System to Control Electronics Devices

5. RESULT ANALYSIS

Fig 5 shows the output for top right that is first quadrant. Fig 6 depicts the output for top left that is second quadrant. The first and second quadrant is assigned to control first bulb (device1). Fig 7 shows the output for bottom left that is third quadrant. Fig 8 depicts the output for bottom right that is fourth quadrant. The third and fourth quadrant is assigned to control second bulb (device2).

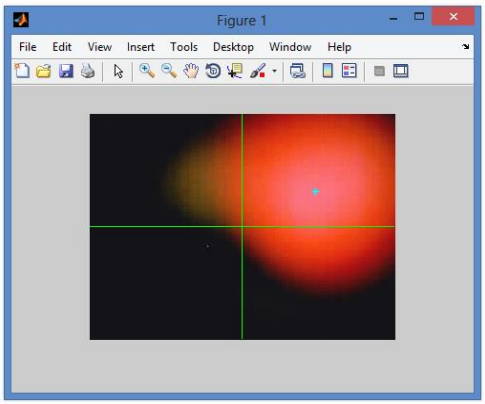

Fig 5: Outputs in First Quadrant (Top Right)

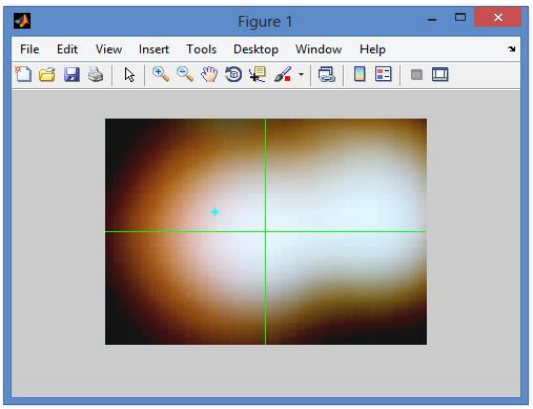

Fig 6: Outputs in the Second Quadrant (Top Left)

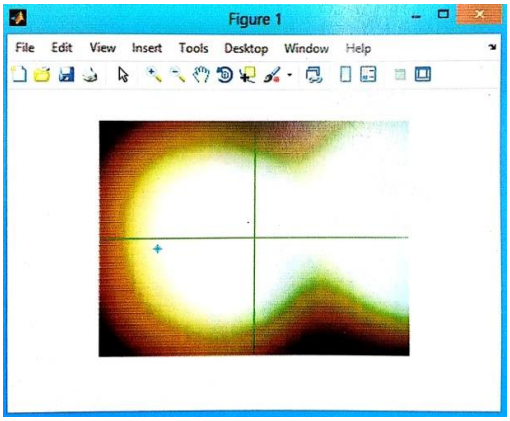

Fig 7: Outputs in the third Quadrant (Bottom Left)

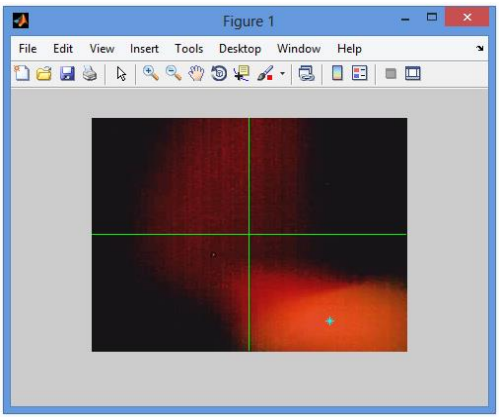

Fig 8: Outputs in the fourth Quadrant (Bottom Right)

6. CONCLUSION

The proposed palm recognition concept can be extended to utilize many complex appliances. Using palm recognition system the electronic devices can be controlled there by usage of mechanical switch can be overcome with absolute zero noise by physically impaired. The designed hardware is cost effective, easy to handle and can be operated with in no time. The proposed palm recognition system can be used for home telemetry with displays, control of robots using image processing and control of security systems.

ACKNOWLEDGMENT

The authors would like to graciously thank National Remote Sensing Centre (NRSC), Hyderabad, INDIA for providing the data product for the study. Thanks to the Survey of India (SOI) for providing the Topographic Maps for this study and Karnataka State Remote Sensing Application Centre (KSRSAC), Bangalore. Acknowledgements are due towards beloved students Avinash M S USN: 4GL10EC402, Shashi Kumar C G USN: 4GL10EC412, Arpitha C B USN: 4GL10EC001 and Bhavana C M USN: 4GL10EC002. Special thanks to teaching and non-teaching faculty of GEC, Kushalnagar for their encouragement and guidance.

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