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Criminal Identification using ARM 7

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ABSTRACT

An image capture system with embedded computing can extract information from images without need for an external processing unit, and interface devices used to make results available to other devices. Personal information of a person and photograph is mainly used in criminal records. For identification of any criminal some identification marks regarding that person, given by eyewitness are needed Identification is possible through various ways such as, finger print, eyes, DNA etc. Most important of all applications is face recognition. Face Detection is about providing security in terms of person Identification in any area. This project aims to create one more step towards solving this serious problem. The design is based on computer vision and embedded system application principles. This proposed system mainly consist of controller, GSM, GPS and camera interfacing. The cameras are placed in public places. If criminal's face gets detected in the camera, then connected computer will send signal to controller. Microcontroller will then send the location of criminal to predefined mobile number through GSM module. The choosing of an embedded platform is very unique and easy to implement. The project proposes an image capturing technique in an embedded system based on ARM 7 board. Considering the requirements of image capturing and recognition algorithm, ARM 7 processing module and its peripherals, implementing based on this platform, finally actualized. Security and surveillance are the two important aspects of human being. In this system we propose for face detection and recognition system will be capable of processing images very fast while acquiring very high true and positive face detection rate.

Keywords: Face Recognition, Criminal identification, MATLAB, ARM7, GSM, GPS etc.

INTRODUCTION

The identification of criminals and terrorist is primary issue for police, military and security forces. The terrorist activities and crime rate is increasing abnormally. To combat with these for identification of criminals & terrorists are a challenging task for all security departments. Security issue and protection of lives and public property are the primary concerns for all security departments. These departments are now-a-days using latest technology. This paper is an attempt to use data mining concept and will provide comprehensive data base of criminals and terrorist and will be great support for all above mentioned departments. To help the security forces data mining concepts proved to yield better results in this direction.

This system uses a combination of location detection and face recognition. Face is one of the most prominent biometric identification techniques, to identify criminals. Today whole world is suffering from increasing terrorist and criminal activities and causes a major threat to the security of a country and its civilians. To identify terrorist and criminals and record their details, security and law enforcement agencies should have the necessary technology when a suspect is apprehended. As human beings, have the inborn ability to recognize and distinguish between faces. However, this kind of intelligence is not available yet with computers. In order to emulate this kind of problem it needs training. Researchers and software developers have develop various applications in which different algorithms and mathematical modules are implemented for criminal/terrorist identification.

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Face detection is a computer technology that determines The locations and sizes of human faces in arbitrary images are determined by face detection algorithm which detects facial features and ignores anything else, such as trees, bodies and buildings etc[1][2]. This system recognizes faces from images with some near real-time variations and proved to be efficient system. The systems implements and verify the algorithm. The approach consist of weighting the difference between a mean image, which is obtained by averaging a predefined set of faces and a given face image. The training set is a group of face images from which the mean face is calculated. The weighting difference between set of eigenvectors and linear projection of image on low dimensional image space is obtained for weighted Face detection[3].

Face recognition:

Face recognition scheme of human identification is probably the most user friendly and non- intrusive authentication method available and is one of the most acceptable biometric techniques utilized in various real-world applications. The developing of face recognition system is quite difficult because the human face is quite complex, multidimensional and corresponding on environment changes. This research is focused on developing the versatile computational model of face recognition which is accurate, simple and fast when implemented in different environments. Here, the use of SIFT algorithm for face detection is recommended. This is most successful techniques that have been used to recognize faces in images. However, a major problem of this technique is dimensionality large and high computational cost .

LITERATURE REVIEW

For identification of terrorist/criminals with higher precision use of web-based multimodal biometrics system with a centralized database that uses face recognition and fingerprint identification.[4] This system makes use of the distance between nodal points to match face images for the principle Component Analysis based face recognition technique[5].

Many research on automated face recognition has been done from 1970. Since then many algorithms and techniques have been designed and implemented, each one trying to provide better efficiency and accuracy than the earlier one. It is also expected exhaustive use of biometric analysis in many practical applications and with advancing technology each day. In this paper a feature based algorithm for face recognition and efficiency of Scale-invariant feature transform (SIFT) are explained[6][7]. Overview of the SIFT algorithm, the experiment conducted to carry out the research finding accuracy and efficiency of the algorithm are included in this paper. Use of the experimental data and application of inferential and descriptive statistics on the obtained data, strong results are obtained that gives explored analysis of SIFT algorithm and its accuracy.

SYSTEM ARCHITECTURE :

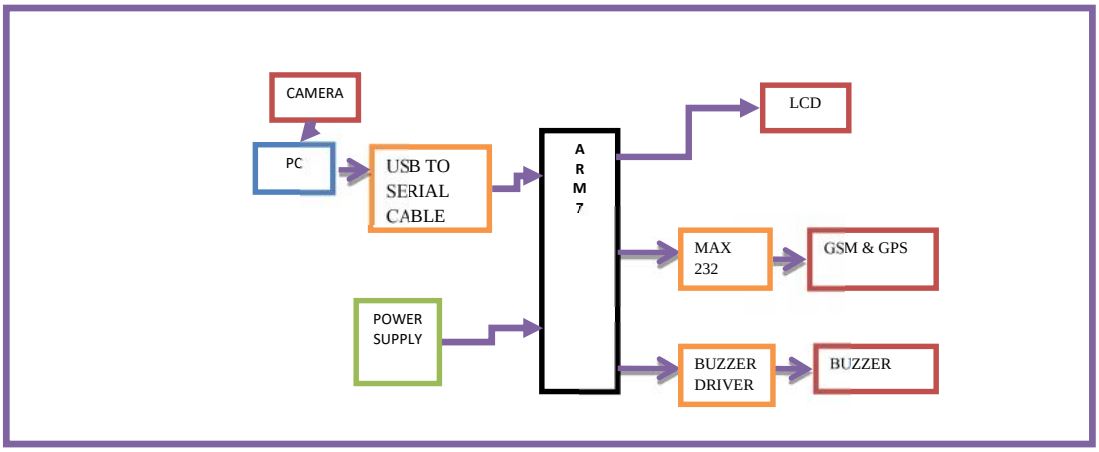

Fig 1: Block diagram of the system

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This system is mainly divided into two parts. One is controller and other is face detection through MATLAB. The controller side is having two wireless modem, GSM and GPS. If criminal's face is detected in camera then GSM modem will send message of that location to authorized mobile number. For face detection, here digital cameras are used which are connected to a computer system. The computer is having database stored in which all criminals' photos are saved. If database is matched with any of the face caught by camera then signal is sent to controller.

SIFT algorithm:

SIFT algorithm is broadly divided in 5 procedures for ease of computation.

1. Finding the Extrema:

For this purpose Laplacian of Gaussian is found for the image with various σ values. LoG acts is a way for a blob detection dependent on the various sizes because of change in υ. But LoG calculation is a bit costly and intense, so SIFT algorithm uses Difference of Gaussians or DoG. DoG is obtained after taking difference of Gaussian blurred image with two different . These DoG images are then used for local extrema detection.

2. Key-point detection:

On finding the key-points locations , they are needed refined for more accurate results. Taylor series expansion of scale space is utilized for this purpose and if extrema intensity is found to be less than a threshold value, it is rejected.

3. Assigning the Orientation

In this step orientation is assigned to each key-point to get invariance in the image rotation. A key-point neighborhood is taken depending on the scale, and the gradient magnitude and direction calculation for that region is done. An orientation histogram is created having 36 bins that cover 360 degrees. The highest peak as well as peak above 80% both are taken for orientation calculation.

4. Getting a key-point descriptor

A neighborhood of about 16x16is taken around the key-point is and divided into 16 sub-blocks of 4x4.An 8 bin orientation histogram is created for each 4x4 sub-block . So we get a total of 128 bin values. It is represented as a vector to form key-point descriptor.

5. Matching the key-points

This is done with the identification of their nearest neighbors. But if, the second closest-match is found very near to the first. due to presence of noise or some other reasons then, ratio of closest-distance to second-closest distance is considered. If greater than 0.8, it's are rejected. This will eliminate about 90% of false matches and also discard only 5% correct matches.

Fig 2 : MATLAB screen to store database

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In this screen camera needs to be adjusted for capturing an image.

A name is given in space provided and click on database push button. This will save the image with given name database for any further use. Image saved will be available in below box till the next image is saved.

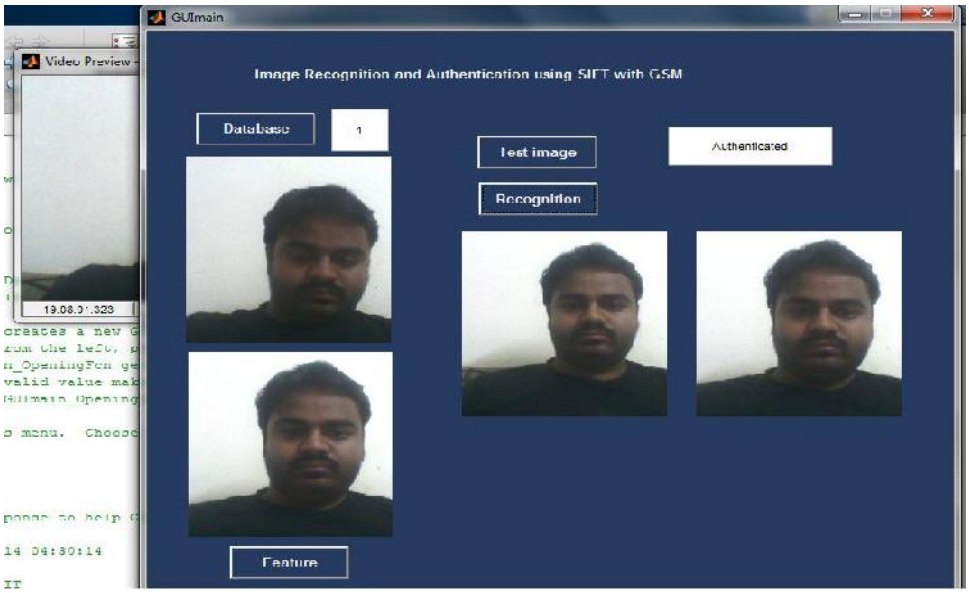

Fig 3: MATLAB screen for face recognition

If on comparing test image features with all database images features a matching image is found a message - "Authenticated "will be displayed.

A message or a serial communication character is sent to controller to initialize GSM and send message to registered mobile number. Also image from database that is matched is displayed next to test image. All these things are simultaneously displayed. At remote place the watchdog timer is also added to get recovery from software upset i.e. system gets hanged. A watchdog timer contains a timer that expires after a certain interval unless it is restarted. A watchdog timer has an output that pulses should the timer expire, but the idea is that the timer will never expire. The timer is preloaded frequently by software before the count reaches to zero. If the system gets hanged preloading of timer will fail and eventually count will reach to zero and pulse output of timer will reset the system. It starts the software from beginning. An ideal mode is also used for power optimization.

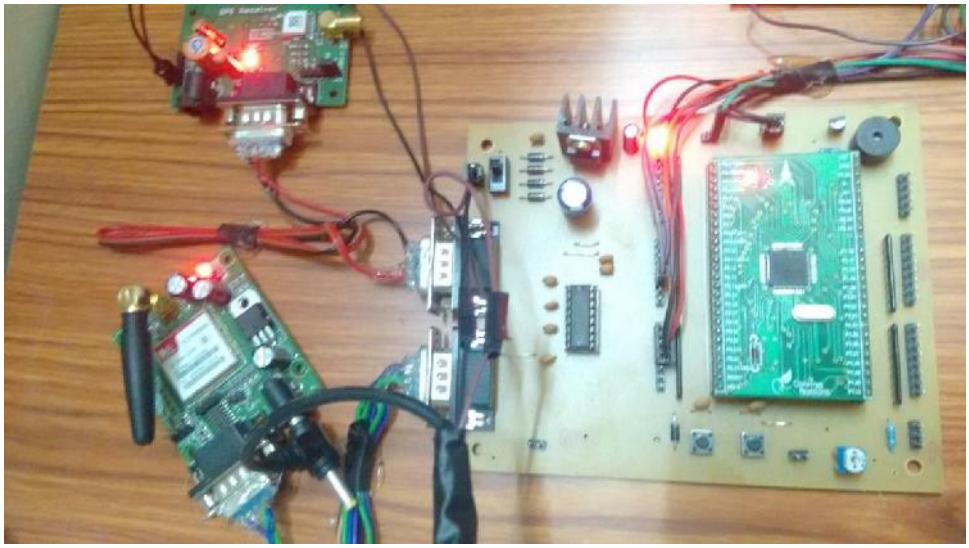

Fig 4: Designed Hardware ARM7, GSM & GPS

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COMPONENTS OF THE SYSTEM

A. Microcontroller:

The ARM7 is a general purpose microprocessor, that provides a high performance and very low power consumption at the same time. The ARM controller uses Reduced Instruction Set Computer (RISC) principles. The instruction set and decode mechanism are very much simpler than Complex Instruction Set Computers (CISC). As a result of all this a high instruction throughput and good real-time interrupt response from is achieved along with small and cost-effective core of processor. All parts of the processing and memory systems operate continuously due to pipeline techniques used. In this pipeline architecture at a time when one instruction is being executed, the next instruction to be executed gets decoded, and a third instruction is fetched from memory. The ARM7 processor also utilizes an architectural strategy called Thumb. It's an unique strategy that makes it ideal for large-volume applications having memory restrictions, or some other applications in which code density proves to be an obstacle. Basic idea of Thumb instruction is a super-reduced instruction set.

B. Global Positioning System (GPS)

The Global Positioning System (GPS) is a satellite-based navigation system. This system provides location along with time information anywhere on or near the Earth.

An unobstructed line of sight to four or more GPS satellites is required for precise locating. The system has proven critically useful to military, and commercial users around the world. A GPS tracking device accurately calculates geographical location through the information received from GPS satellites. The Global Positioning System is a system consisting of a network of a minimum of 24, but currently 30, satellites orbiting around earth placed by the U.S. Department of Defense [9][10].

Fig 5 : GPS Module

C. GLOBAL SYSTEM FOR MOBILE (GSM):

This is a modem which is very flexible plug and play quad band GSM modem. It has direct and easy integration to RS232 serial communication. It provides support to various features like Voice, Data, SMS, GPRS and in TCP/IP stack.[11]

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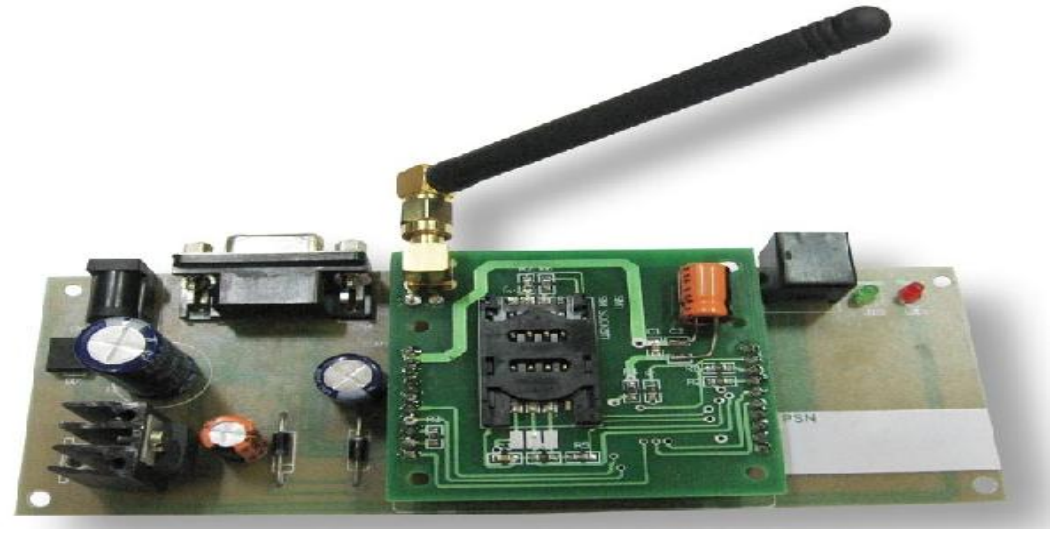

Fig 6 : GSM Module

D. MAX 232:

MAX232 is an IC, initially developed by Maxim Integrated Products, in 1987. This IC is used to convert signals received from an RS-232 serial port to make signals suitable for use in TTL digital logic circuits. The MAX232 is a dual transmitter/receiver and usually converts the RX, TX, CTS and RTS signals. The receivers down convert RS-232 inputs (typically of range ± 25 V), to standard 5 V TTL levels.

E. LCD Display (16x2):

It is a 2 line display with 16 characters per line. In this project LCD is working in 4-bit mode i.e., the data transferred to the LCD must be in 4-bit data form. One Port of controller is connected to data pins of LCD. Other port defines control pins (Rs, R/W and En). LCD has of 3 control lines namely RS,R/W & EN and uses eight data lines (D0- D7). Supply voltage (Vcc) and contrast control (Vee) are other important pins while (Vss) is ground pin.

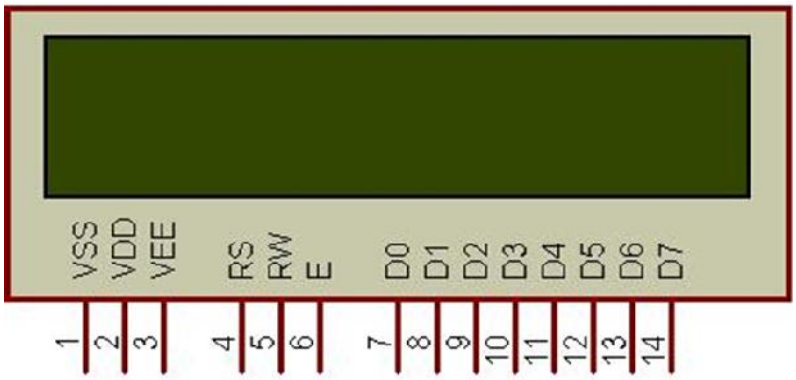

Fig 7 : 16*2 LCD pin diagram

CONCLUSION

This research paper is based on identifying criminals using face recognition; hence in this research we have successfully created a system to identify criminals using face recognition. We have used a new algorithm based on the SIFT algorithm to recognize face and detect and match the images. This newly designed mehod is computationally more feasible in the practical environment, and less intense in terms of calculatons. It also

provides dynamic training when adding criminals to the database. A feature vector instead of pixels is specially introduced so as to minimize the computational cost of the algorithm used. To test the recognition rates we conducted experiments for each component. To find the accuracy of each search component, we have considered the recognition rate of identifying both male and female criminals with in top 10 matches in each experiment.

FUTURE SCOPE

As a future development, we suggest making this whole sysytemsatellite based to increase its functional area or range of operation. To increase the accuracy and efficiency of system tsting with a larger database of face images, with large variation is recommended. The system was not tested for special cases like face alterations by doing plastic surgery. This method can further be improved using more significant features of face. Lowering the cost using some cheaper microcontroller and also implementing using RTOS will make it more industrially usable.

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