

Energy Efficient Automation System for Smart Task Scheduling

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Abstract

Automation is a set of technologies that results in operation of machines and systems without significant human intervention and achieves performance superior to manual operation. The significant view of this paper is to achieve the security systems that are playing a predominant role in the automation system. Initially the image is captured using webcam and compared with the stored dataset using Principle Component Analysis (PCA) method. This system uses face recognition technology with the Eigen faces that provides access only to the authorized people to enter the restricted area. If unauthorized person access to enter the area with any other means, then the system automatically alerts the security department by sending SMS as an intruder alert through GSM module to the controller. The user can also control the electrical home appliances such as light, fan, loads through SMS alerts by ON or OFF commands.

KEYWORDS— Principle Component Analysis, Eigen Values, Face Recognition

I. Introduction

Home automation systems play a predominant role in different fields such as industrial areas, plants, hospitals etc... Therefore extraordinary care must be taken during the design to make them flawless. The idea behind this system is to automate their Industrials though universal access. Thus the system is based on wireless technology using GSM. This system provides ideal solution to the problems faced by Industrialist in day to day life. The system sends the feedback to user about the condition of the home appliance according to the user's needs and requirements. Monitoring and controlling the home appliances with the affordable cost is thought to be built and it should be mobile which provide remote access to the appliances. The Networked monitoring system [1] design for home automation uses many network devices and provides multiple communication interfaces to access local and remote areas through Internet or Bluetooth. Thus the system offers a complete flexible and reusable solution for various home applications. This system provides ideal solution to the problems faced by house owners in their daily life. The system architecture consists of a Raspberry pi B microprocessor, SD card, Motors, power supply, webcam etc...

II. Proposed Work

In the proposed Work, all controlling and monitoring devices are connected to the central controller board. The different modules are interfaced to the controller such as webcam, power supply, and motor drivers, face recognition system, GSM module, GPRS module, load etc..., The central controller is connected to the GSM

modem through serial port. The Webcam is connected through USB port to the controller unit. The GSM module and other modules send all the commands to the controller and its responses are sent as status of home appliances. The control unit sends the AT (Attention) commands to GSM MODEM and then it checks the messages from GSM.

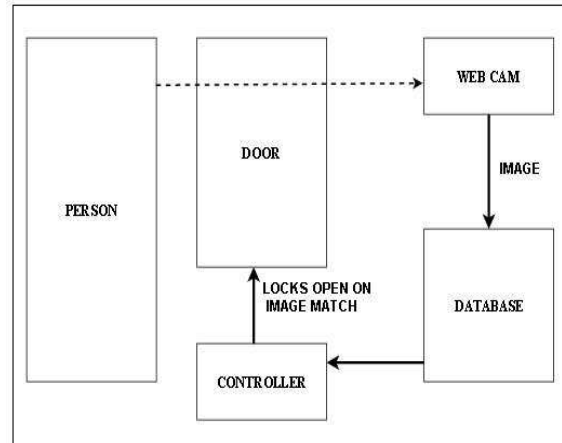


Figure 1: Block Diagram of Proposed Work

III. Implementation of Hardware Design

The implementation of hardware design as shown in figure 2 will tell about the proposed work implemented on hardware platform.

A. Specifications of Raspberry PI model B

Specifications of Raspberry are as follows:

- 1. Processor:** Broadcom BCM2387 chipset. 1.2GHz Quad-Core ARM Cortex-A53 802.11 b/g/n Wireless LAN and Bluetooth 4.1
- 2. GPU:** Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode. 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure
- 3. Memory:** 1GB LPDDR2
- 4. Operating System:** Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT
- 5. Dimensions:** 85 x 56 x 17mm
- 6. Power:** Micro USB socket 5V1, 2.5A [3]

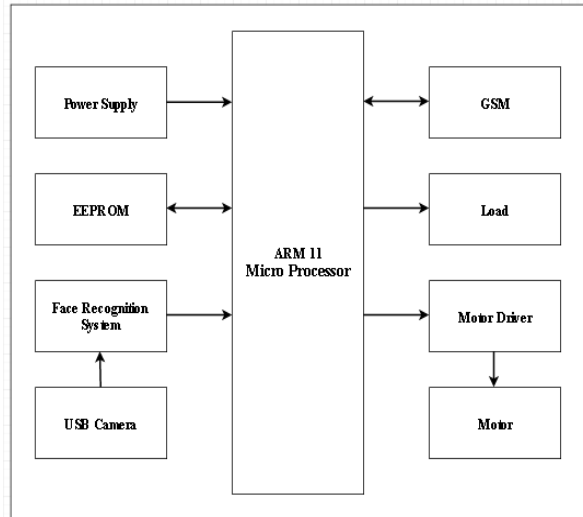


Figure 2: Implementation of Hardware Design

B. GSM Communication

GSM modem is a wireless modem, it just sends and receives data through radio waves and works with a GSM wireless network. A wireless modem behaves just like a dial-up mode, which sends and receives data through a fixed telephone line. GSM modem connected to controller unit, it communicates through AT commands. All these modems use a set of AT commands that are defined such as follows

AT + CMGF =1
 AT + CMGS = “mobile number”
 AT + CMGR =1

C. Webcam

Webcam is an image capture device as shown in figure 3 connected to a raspberry pi board through USB port. For other applications it can be connected to a network Ethernet or Wi-Fi. The most popular use of this device is, for permitting a computer to act as a videophone or a video conferencing station, and also as a video telephony.



Figure 3: Structure of Webcam

IV. Face Recognition System

Face recognition [2] can be used in different applications such as crowd surveillance, video content indexing, personal identification (ex. driver’s license), and entrance security. Face recognition is categorized into face classification, sex determination or face identification. The main idea behind using Principal Component Analysis PCA for face recognition is to express the large 1-D vector of pixels constructed from 2-D facial image into the compact principal components of the feature space. PCA is mostly used as a tool in exploratory data analysis and for making predictive models i.e., Face recognition etc, it is the simplest form of the true

Eigen vector based multi variety analyses. Thus it uses an orthogonal transformation to convert a set of M face images into a set of K uncorrelated variables called Eigen faces. Therefore, this can be called as Eigen face projection. Eigen faces are in fact the Principal Components of the training set of face images generated after reducing the dimensionality of training set. Eigen face is calculated by identifying the eigenvectors of the covariance matrix derived from a set of facial images (vectors). PCA Eigen face method does not work on images directly; it first converts them to matrix i.e. in vector form as shown in figure 4.

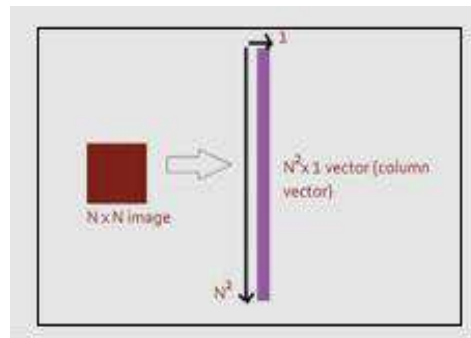


Figure 4: Conversion of Image into Vector Form

A. Steps to recognize the unknown image:

- Convert face image in training set to face vectors
- Normalize the face vectors
- Reduce the dimensionality of the training set
- Calculate the Eigen vector from covariance matrix
- To select the best Eigen face, such that $K < M$
- Convert lower dimensional K Eigen vector to original face dimensionality
- Represent each face image a linear combination of all K Eigen vectors

The Principal Component Analysis (PCA) is one of the most successful techniques that have been used in image recognition and compression. The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature space (independent variable). PCA can do prediction, redundancy removal, feature extraction, data compression etc.

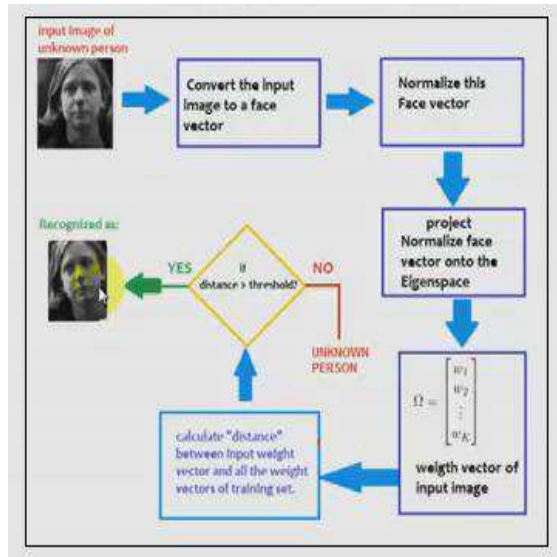


Figure 5: Process of Recognition System

V. Analytical Results

The Analytical Results will tell about the proposed design when it works on a Raspberry Pi model. Figure 6a and 6b show the mapping of messages ON or OFF with a unique ID of an authorized person i.e., Image capturing process [4] and Reconfiguration Process of Captured Image.

- It Provides Confidence percentage of matching the unknown image with the original stored image
- It gives the frame timing in milliseconds
- It gives the ID provided to the user, it may indicate as a user name.

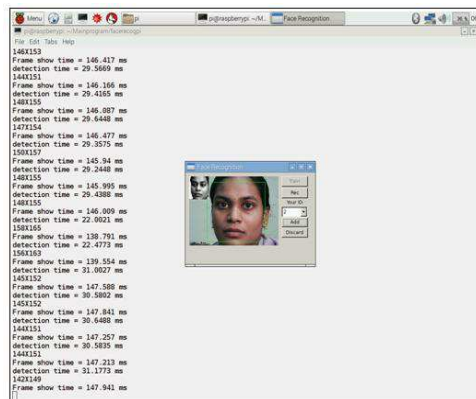


Figure 6a: Image Capturing Process

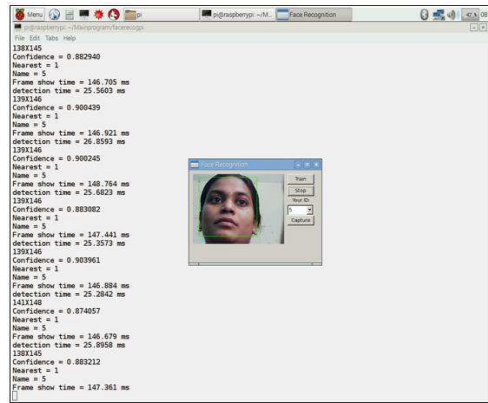


Figure 6b: Reconfiguration Process of Captured Image

VI. Hardware Results

This system uses face recognition technology with the Eigen faces that provides access only to the authorized people to enter the restricted area as shown in the figure 7. If unauthorized person access to enter the area with any other, then the system automatically alerts the security department by sending SMS as an intruder which alerts through GSM module to the controller. The user can also control the electrical home appliances such as light, fan, loads through SMS alerts by ON or OFF commands.

Control home appliances through commands:

- fon : Fan ON
- foff : Fan OFF
- mon : Motor ON
- moff : Motor OFF
- lon : Light ON
- loff : Light OFF

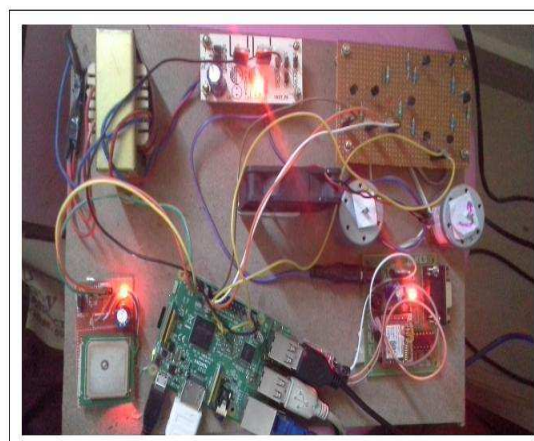


Figure 7: Hardware Setup of PCA for Face Recognition System

VII. Conclusion

Home Automation system consists of face detection, GSM module and a

controller module. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. To achieve the security systems requirements, image analysis has to be performed. Face recognition deals with unique facial characteristics of human beings. It can be applied in various challenging fields like security systems, identity authentication. It involves the techniques of image processing and pattern recognition. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

References

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