A Smart Visitors' Notification System with Automatic Secure Door Lock using Mobile Communication Technology

Marwa Khalid **Sadia Majeed**
Software Engineering Fatima Jinnah Women University Rawalpindi, Pakistan

Abstract
This paper presents the development of an automated security system to automate the entry of visitors, providing more flexibility of managing their record and securing homes or workplaces. Face recognition is part of this system to authenticate the visitors. A cost effective and SMS based door security module has been developed and integrated with the GSM network and made part of this system to allow communication between system and owner. This system functions in real time as when the visitor's arrived it will detect and recognizes his face and on the result of face recognition process it will open the door for authorized visitors or notifies and allows the owner's to take further action in case of unauthorized visitor. The proposed system is developed and it is successfully ensuring security, managing records and operating gate without physical interaction of owner.

Index Terms
SMS, E-mail, GSM modem, authenticate, face recognition, authorized.

1. Introduction

Advancement in technology in the last years has made life more comfortable and efficient. The need to control devices from a particular location or any remote location is necessary because it saves lot of time. Therefore we have kept it in mind and made our system. The system we have proposed is an approach to automate the entry of visitors in home or offices or to handle visitor's records. The proposed System "A smart visitors' notification system with automatic secure door lock using mobile communication technology" implements the most emerging applications of modern era, "the GSM technology". The system has software and hardware module. The software module keeps records of visitor's arrival and their recorded message. System owner who is administrator of the system can easily login to system and can view visitor's record and listen their recorded messages. The hardware module consists of circuit which is designed to open a gate and send or receive command via GSM modem. The system allows the owner to efficiently and effectively manage and control the entry of people to their offices, homes or anywhere.

Following are the main objectives of our system:

- To effectively automate the entry of unauthorized visitor through Short Message Service (SMS) and by sending the image of unauthorized visitor using E-mail(electronic mail) To automate the entry of authenticate users using face recognition
- To eliminate physical presence to interact with visitors and manage their record of arrival and messages
- Managing information security issues by focusing on critical factors and maintaining Confidentiality, Integrity and Availability
- Minimize the power as well as time wastage
- Provide the security in homes/ workplaces.

The next section is about the work related to our system which we have studied; section 3 is about the methodology and design of our security system. Section 4 is about implementation and results and finally section 5 is about conclusions and the future work.

2. Related Work

This section provides an overview of what we have studied in other research papers related to the security achieved in systems using GSM, and the face recognition techniques used for security purposes.

Gui et al.[1]introduced a "Mobile-Based Home Automation System". The System is developed to operate the home appliances through mobile phone using GSM technology. This system consists of; home server, modem and a java enabled mobile phone. This system is only limited to the mobile phones having java capabilities. Kale et al. [2] proposed an "Intelligent Home Security System using illumination sensitive background model". This system provides tracking and detection of intruder, as this system is based on providing home security. For this purpose a face recognition technique is used to identify the intruder and on finding him, an image of the intruder is sent on the owner mail id for further action. The implementation of this system also include the comparison of different approaches for object tracking and then used an illumination-sensitive background modeling approach for the proposed security system. Maheswari et al. [3] proposed "An Arm Based Door Phone Embedded System for Voice and Face Identification and Verification by Open CV and Qt GUI Framework". This system uses human voice and face to identify a person. Firstly, the user is supposed to pronounce a password through MIC that is

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present on ARM board, and then an image of the user is captured and compared with the database using an USB camera. If the user image is matched then the system displays the user ID, buzzer beeps and the password of the user is sent to the owner's mobile through GSM module. Teymourzadeh et al. [4] introduced a "Smart GSM Based Home Automation System". SMS based control for home appliances using the GSM architecture without accessing the local network is implemented. Four appliances were operated using this system and 98 % perfect results were found. Sikandar et al. [5] proposed a "SMS Based Wireless Home Appliance Control System (HACS) For Automating Appliances and Security". System is designed in such a way that GSM is sending SMS from sender to receiver which allows remotely sending of information to owner. This system has Appliance control subsystem, which uses SMS and the security alert subsystem is for intruder attack handling. The system controls through SMS to change the condition of the home appliance. For the security, on the detection of intruder attack the system send automatically generation of SMS. Krishnan et al. [6] introduced a "GSM Based Home Automation System using Arduino Shield". This is a low cost, security based home automation system. Arduino is used to connect appliances. Wireless is mode of communication between Arduino and cell phone .Devices can be increased according to demand or need of customer.

3. Project Work

In this section we discussed the design and methodology of our system.

A. Block Diagram of our Proposed System

Figure 1 is a block diagram of our proposed system. Laptop or PC is connected to microcontroller through RS-232 USB to serial converter. This microcontroller is connected to GSM modem. The receiver pin (RX) of microcontroller is connected to transmit pin (TX) of GSM modem. Similarly the transmit pin of microcontroller is connected to receive pin of GSM modem. This GSM modem is used to communicate to the mobile phone by sending or receiving SMS. Laptop or PC is also connected to mobile phone through web for sending visitors' image. PC's webcam is used for the real time input image of visitor. Similarly the PC's microphone and speaker is used to record or listen the voice messages of visitor's.

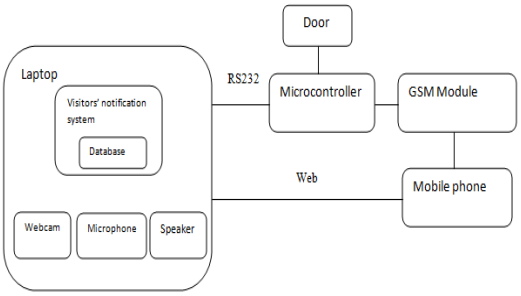

Fig. 1. Block diagram of our proposed system

B. Working of our Proposed System

The proposed system works as follow: When visitor will press bell, the webcam captures the live input real-time image of visitor, then the system detects the face and face recognition process takes place. System recognizes a face from previous stored database. Principal Component Analysis (PCA) technique is used for the recognition and identification of face. A GSM modem is used for the sending and receiving of SMS to/from owner's mobile. This GSM modem operations are controlled by a microcontroller. This microcontroller is interfaced with the system using a RS-232 USB to serial converter. So if the visitors' face is matched with the existing database then the system will send a command from system to microcontroller. By interpreting the command, door will be opened automatically. After some seconds, door will be closed automatically. If face is not recognized then the system sends an image of visitor to the owner's email id through web and simultaneously a command is generated and passed to the microcontroller. According to the given command, the microcontroller will activate the GSM Modem. When the GSM modem is activated, an SMS is sent to the owner's mobile phone indicating that an unauthorized visitor has been arrived. After viewing visitor's image, if the owner's wants the visitor to come in, he will send back a positive command from his mobile phone. When GSM Modem will receive the command, the number is scanned and received command has been processed by microcontroller and then door will be automatically opened if the owner's doesn't want to open the door, he will send negative command and door will remain close and also a recorded message will be played indicating the visitor to record his message, if he wants to. The visitors' recorded message will be saved in system's database.

The given flow chart in fig.2 depicts the complete working of system.

C. Hardware Development

Figure 3 shows the circuit diagram of our proposed system

Fig. 2.Flow chart of our proposed system

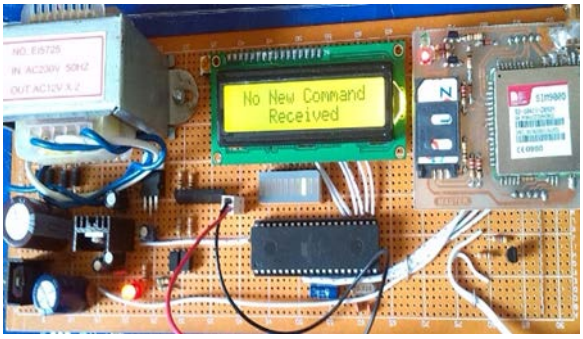

Fig. 3.Circuit diagram of our proposed system

Figure 4 shows the block diagram of our proposed system's circuit.

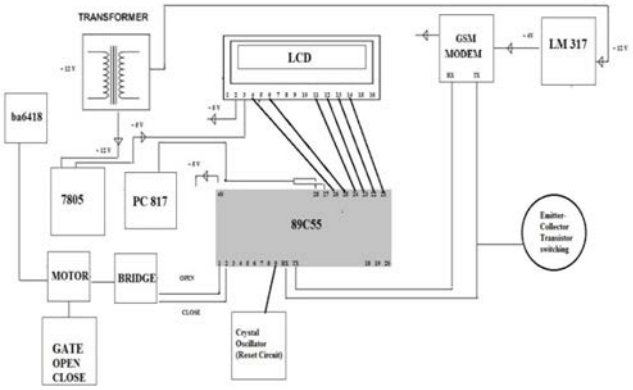

Fig. 4.Block diagram of our proposed system's circuit

The important components used in the proposed system's circuit are:

(1)Transformer: The transformer is used for power supply which steps down voltage supply according to given requirement and provide 12 volts to operate the Circuit. It provides 12v to LM 317 and 7805 IC.

(2)Ba6418: It is a reversible motor driver which can operate motor in forward, stop, break and reverse mode, according to command send from microcontroller.

(3)PC 817: It is an optocoupler. It connects different circuits. This optocoupler is used to combine door circuit with GSM circuit. The connection is in form of light signal.

(4)7805 IC: It is a regulator IC which takes input from transformer and provides voltage to microcontroller and LCD for working.

(5)LM 317: It is a regulator IC which takes input from transformer and provides voltage to GSM.

(6)GSM Modem: A SIM900 GSM modem is also used which connects computer to GSM.

(7)LCD: It displays data on screen.

Crystal Oscillator (RESET circuit**):** This will reset the hardware to its initial state.

(8)RS 232: RS-232 USB to serial converter is used for serial communication transmission of data between the laptop/PC and the circuit.

(9)Microcontroller: AT89C55 microcontroller is used in this circuit. All the coding is embedded in microcontroller. It takes commands from system via RS-232 USB to serial converter. It will interpret the command and according to the command it will open the door or will activate the GSM Modem. The number to whom SMS will be sent is also saved in microcontroller. The delay to close the door after 10 seconds is also embedded in it.

D. Software Development

The proposed system's software is developed in Visual Studio software tool using C# language. All the records of visitor's arrival along with their image and arrival date/time will be stored in system's database. Visitor's recorded message will be also saved in database. System owner can listen the recorded message of visitor and can view the saved records of visitor's.

4. Implementation and Results

This section includes the implementation details of our system.

E. Face Recognition and Gate Opening for Authorized Visitor

Figure 5 shows the face recognition process. The visitor should stand in front of camera. Her face will be detected and matched with the stored database template. If face is recognized, then her record will be stored in system's

database with her image and arrival date/time and also a command will be sent to microcontroller to open the door.

Fig. 5.Face recognition for authorized visitor

Figure 6 shows that when gate is opened the result is also displayed on LCD.

Fig. 6.Gate is opened for authorized visitor

F. Face Recognition and Gate Opening for Unauthorized Visitor

Figure 7 shows the face recognition process. The visitor should stand in front of camera. His face will be detected and matched with the stored database template. If face is not recognized, then his record will be stored in database along with his image and arrival date/time. Similarly, his image will be sent to owner's mobile phone via web a command will be sent to microcontroller to activate GSM modem.

Fig. 7.Face recognition for unauthorized visitor

When the microcontroller received command, it will interpret the command and according to command it will activate GSM modem and an SMS is sent to owner's mobile phone. Figure 8 shows the result of sending a SMS is displayed on LCD.

Fig. 8.Sending SMS to owner's mobile phone

Figure 9 shows the SMS and email as received by owner in his mobile phone. After viewing visitor's image, if the owner wants the visitor to come in he will sent command from his mobile phone. When the command is received, the microcontroller interprets command and according to that command door will be opened automatically.

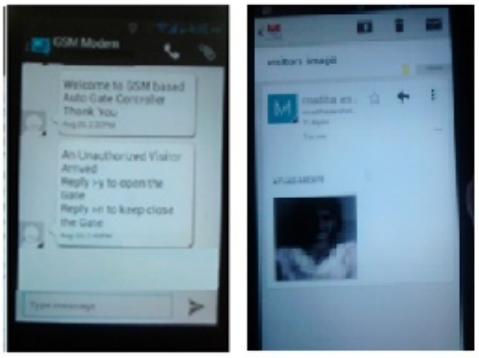

Fig. 9.SMS and Email as received by owner

Figure 10 show that when gate is opened the result is also displayed on LCD and a confirmation SMS is also sent to owner's mobile phone.

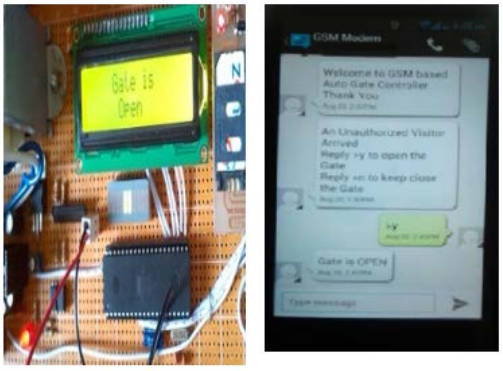

Fig.10.The gate is opened automatically

5. Conclusion and future work

Security is one of the biggest issues in today's world. For providing security in real time environment, "A smart visitors' notification system with automatic secure door lock using mobile communication technology" has been developed and describes in this paper. This system functions in real time as when the visitor's arrived it will detect and recognizes his face and on the result of face recognition process it will open the door for authorized visitors or notifies and allows the owner's to take further action in case of unauthorized visitor.

Basically it's a secure, remotely controlled solution for automation of door locks at homes, offices and etc. Face recognition module has been developed and made part of this system to authenticate the visitors. Face recognition technique is user friendly as compared to other biometric techniques. For face identification and recognition, Principal Component Analysis (PCA) technique is used. A cost effective and SMS based door security module has been developed and integrated with the GSM network and made part of this system to allow communication between system and owner. The microcontroller received user commands (sent from mobile phone) through modem and according to that commands it controls the door. This design makes mobile phone, a portable remote controller for automation of work places. It is stated that our system is not limited to automation of home and offices, as it can also be used in industries and in other real time environments.

Future work of system is based upon improving the process of SMS and MMS sending by replacing web and GSM network with arduino shield and also based upon improving the robustness and reliability of face detection and recognition process.

6. Copyright Forms

Acknowledgment

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