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A Better Engineering design for safety environment

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Abstract

Security is an important concern in day to day life, far augmented when related to sensitive data, such as private information. In a smart home scenario, to ensure high confidentiality,this paper focuses on thedesign of a better engineering application using solar energy for the home security system. This design involvesbiometric systems such as voice and speech recognition. Additionally, the Graphical User Interface is designed for the user to monitorthe security status.This paper surveys the security threats existent in society environments with possible solutions to mitigate the threats. Lastly, this work attempts to integrate the solutions in a cohesive form to be applied to any society environment that wishes to keep better security of home environment. The solar energy is utilized as the power supply. The performance of this microcontroller based voice integrated design is evaluated in terms of accuracy and velocity in various environments.

Keywords: Security, voice recognition, microcontroller, solar

1. Introduction

With therecent advances in security technology, the biometric systems that are commonly used are voice and speech technologies. Along with technological advances, the idea of any biometric system is referring to the automatic identification of a person based on his/her physiological characteristics. Furthermore, the notion of delegating the challenging activities for privacy protection and convenience are due to only appropriate speech and specific voice to unlock security [1]. Hence, no key is required [2]. A smart home is a combination of highly sophisticated automatic systems to monitor the working of home doors, windows, temperature, multimedia, alarms, alerts and various tasks being monitored by computer systems [3].Several types of biometric systems are being used for real time identification. The most popular techniques are facerecognition, fingerprint matching and iris/retina scanning [4]. A biometric system can be either a verification system or an identification system.However, due to the digital data aggregation and transmission necessary for the proper operation of the smart security system, developers must concern themselves with the security risks involved: users would not prefer their private data; nor would wish attackers to take control of their security [5] and [6]. With the advent of smart security system, one must then concern themselves to accommodate with these problems and the devising of possible threat scenarios [7].An existing smart home uses ear recognition as authentication to monitor the home operation. A drawback of this system is that, the user need to have a smartphone every time for authentication. Moreover, it is not known how the ear authentication system is susceptible to scam [8]. By replacing passwords, biometric techniques can potentially prevent unauthorized access to or fraudulent use of Any Time Machines, cellular phones and desktop personal computer [9].

The other version of smart home security used multimodal biometric property using Bayesian framework [10]. One more different version of smart home security that is available is voice based biometric security system [11]. Also, there exists a home automation security system using GSM technologies [12]. However, there occur many challenges to home automation security [13].

The most commonly used security systems are finger print based and voice based biometric system using microcontrollers [14]. Speech is generated in 3 basic ways

namely, voiced sounds, fricative sound and plosive sounds. Voice is the generic name given to sounds. If it includes meaningfullanguage content, then it is called as speech. They are produced by the excitation of an acoustic tube called the vocal tract, which is terminated on one end by the lips and on the other end by the glottis, manifesting as a longitudinal compression wave. On conversion to a digital form, a speech signal will be a one dimensional time varying signal.In the unvoiced fricative sounds, the energy is concentrated high up in the frequency band, and quite disorganized in its appearance. In plosive sounds, much of the speech sound actually consists of silence until strong energy appears at many frequency bands, as an 'explosion'. The rest of the paper is organized as follows: Section 2 describes the proposed security system. Section 3 discusses the experimental results and discussions. Section 4 concludes the paper.

2. Proposed Method

Theproposed system includes the design of software coding and hardware electronic and mechanical systems. Also, the design of solar panel with microcontrolleris included in the design of the security system. A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar module can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions.

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

Microcontrollers are used in automatically controlled products and devices. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

2.1 Laser alarm system

Laser alarm system which is designed as a part of security system, would sense any unauthorized people. The users who do not know the password are considered as intruder by the microcontroller of this system. The unauthorized access will activate the alarm once the intruder tried to sneak in or break in. When user gives right password to voice recognition, the controller auto gate will open for them. The auto gate is driven by stepper motor and the gate is built in small scale.

2.2 Detector electronic design

The detector circuit is designed using Arduino and Voice Recognition modules. Arduino is an open-source physical computing platform based on a simple input output board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer, and the UNO is one of them. The Easy VR 2.0 is a multi-purpose speech recognition module designed to add versatile, robust and cost effective speech and voice recognition capabilities to almost any application. The module includes a set of built-in Speaker Independent Commands for ready-to-run basic controls.

Basically the Laser Alarm System and Easy VR 2.0 are inputs to the Arduino UNO, the movement detector will do his detecting all the time. Once someone never gives any password to Easy VR 2.0 and triggered the Laser Alarm System. The Arduino UNO will get input as HIGH and triggers the alarm. Only the user can turn off the security and open the auto gate. Arduino UNO will interfaces with GUI and gives a better overall condition to user. The exact location of Laser Alarm System that triggered will show in the GUI.
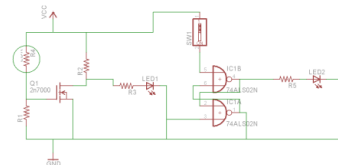

Figure 1. Electronic circuit design for detector

The electronic design of the detector circuit is shown in Figure.1. The LDR is R4 and it pairs with R1 to perform voltage divider. Once laser beam keep on strikes the LDR, its resistance is less compared to R1. Hence the 2n7000 MOSFET will conduct and LED1 stays LOW. If laser beam being interrupted, the LDR will increase its resistance and R1 get little voltage. Hence the 2n7000 will not conduct and LED1 stay HIGH.The NOR is gate flip flop that able to temporary store the HIGH data in pin 3. The reset switch is pin 5. LED2 will stay HIGH when LED1 is HIGH. Even LED1 back to LOW, the LED2 will still stay HIGH to keep warning user about interrupt of Laser Alarm System.

2.3 Mechanical Design of the proposed system

The mechanical design of the proposed system is shown in Figure.2. In Figure.2, a stepper motor that is being used in the design of the security system can be seen. A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The motors rotation has several direct relationships to these applied input pulses. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied.

One of the most significant advantages of a stepper motor is its ability to be accurately controlled in an open loop system. Open loop control means no feedback information about position is needed. This type of control eliminates the need for expensive sensing and feedback devices such as optical encoders. The position is known simply by keeping track of the input step pulses.
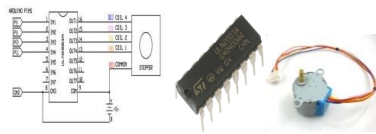
(a) Set up of stepper motor (b) ULN2003A driver pins(c)5v bipolar Stepper motor

Figure 2.   Mechanical Design

2.4 Block Diagram of the Proposed System

The block diagram of the proposed smart security system is shown in Figure.3. The microcontroller used in this proposed system is atmega328 attached on Arduino Uno. The Easy Voice Recognition module is connected in serial way (Tx and Rx). The detector circuit acts as input into microcontroller once security has been interrupted. The AND gate will act like an enable switch that can either turn on the detector circuit or turn off the detector circuit. When user gives correct password, the microcontroller will sends the signal to stepper motor to turn on the gate and turn off the detector circuit. The electric appliance also will be turn on and it supported with solar energy. The status of the LED and 12 volt electric fan are the output. The Graphical User Interface (GUI) gets information from the microcontroller to turn on and off the electric appliances.
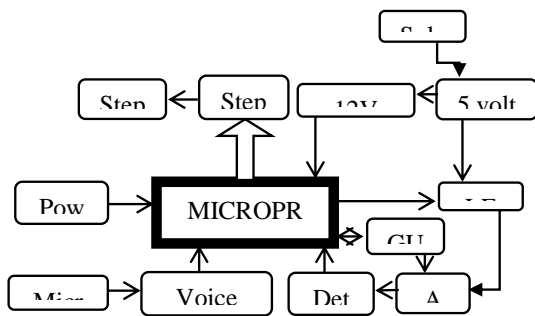

Figure 3.   Block Diagram of proposed smart security system

The 12 volts solar panel is successfully utilized. The 5 volt voltage regulator is used to regulate the voltage, so that is can be used to give the supply to electric fans, light, stepper motor and others. Due to characteristic of small signal MOSFET BC107, it will conduct when 12 volts DC to drain, source to ground without base voltage. So the 12 volts fan is powered by 5 volts that regulated with voltage regulator.

2.5 Solar panel interfacing circuit

Electronic switch is using to switch on electric appliance by microcontroller signal. In Figure.4, the voltage signal (yellow wire) is 5 volts and represents the microcontroller signal. When it is applied to the base of MOSFET, the drain and source will short and eventually short to ground and turn off the fan. In Figure.4a, the yellow wire represents 5 volts and it disconnected from the base of MOSFET, fan is on. The yellow wire in Figure.4b, represent 5 volts from output of microcontroller is connected to the base of MOSFET, fanis stopped.
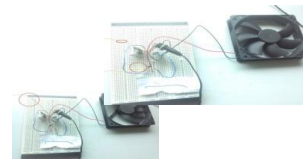
(a) Power supply is on for fan   (b) Power supply is off for fan

Figure 4.   Solar panel interfacing circuit - Power supply to Fan

3. Results and Discussion

The experimental result of the proposed system is discussed in this section. The experimental setup for voice control system is shown in Figure.5.
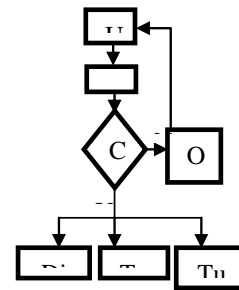

Figure 5.   Flow chart of Voice control system

The authorized user is allowed to use the voice control system by entering the system using password. Upon verifying the password, the system allows the user to control the home appliances that are registered with this security system.The voice and speech must meet the required condition to reach the final circuit of the design. This work is experimented with opening the gate, disable the detector and turn on electric appliances.

3.1 Experimental results: Accuracy Test of the proposed system

The proposed system is experimented for the Accuracy of the voice recognition by the system. The results of the accuracy test aregiven in Table 1.

Table 1   Experimental results of Accuracy test

VC	Testing in complete silent environment										Testing in random public area										
	Experiment Trial					Total Responses					Experiment Trial					Total Responses					
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	
'OPEN'	1	1	0	1	0	0	1	1	1	0	6	0	0	0	1	0	0	0	1	0	0	2

The experimental results of the proposed system for Accuracy test in various environments are shown in Table 1. From the table, the responses of the system to the voice

command are shown. The test was conducted in two different environments, silent zone and random public zone. From the table, the total responses obtained for the voice command in complete silent zone is 6. So, the accuracy is computed using Accuracy= Total responses obtained / number of trails or voice command attempts. In complete silent area = 6/10 x 100% = 60% of accuracy is produced. In random public area = 2/10 x 100% = 20% of accuracy is produce.

3.2 Results of Voice Recognition Easy VR

In this section, there arefour different conditions for the Easy VR to be experimented. Easy VR must be able to provide correct result for all 4 different conditions. From this project, it could be seen that the voice recognition module involved is able to differentiate voice and speech. The results of the four different conditions are shown in Figure 6a-d. To obtain the security system, for example,opening the gate, the registered password for this experiment is 'OPEN'. Furthermore this particular word must be pronounced by the specific user who had already been set as authorized person in the system.

(a) Correct user but wrong password   (b)Unauthorized user but correct password

(c) Unauthorized user and wrong password   (d) Correct user and correct password

Figure 5.   Experimental results

In an experimental condition in Figure 5(d), the ' Command = OPEN' will be displayed in serial monitor of the GUI.Table 2 summarizes the results of Voice Recognition Easy VR according to different working conditions.

Table 2   Results of Voice Recognition Easy VR

No.	User (pronouncer)	Password	Result (the gate)
1	Correct	Wrong	OFF
2	Wrong	Correct	OFF
3	Wrong	Wrong	OFF
4	Correct	Correct	ON

From Table 2, it is clearly known that, when the user of the security system is authorized only, the system allows the user to proceed. Only when the right user gives the right password, the GUI works for the home security system. For all other conditions in Table 2, the security system does not work.

4. Conclusion

This proposed system has utilized the biometrics for security system. The biometric technology such as voice and speech is a new technology for most of the researches because it has only been implemented in public in short recent years ago. This study can be applied for many applications and solutions of biometrics technology in security systems. It has many advantages which can improve human daily life such as: improved security and effectiveness, reduced fraud and password administrator costs, ease of use and live with more comfortability. Even though the biometrics security system still has many concerns such as information privacy, physical privacy and religious objections, users cannot deny the fact that this new technology will change human lives for the better.

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