Design and Implementation of an Intruder Radio and Video Alert System

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Abstract— **Security is the ever growing concern of human society. That's why lots of different methods are developing day by day to provide better security in our day to day life. But as a matter of fact none of the security systems are helping that much to reduce burglary. There are various kinds of alarm system are used now a days like : triggering a siren, police siren, calling police, sending message to phone, calling in a cell phone etc. The purpose of the project is to add something new on this sector. This project is based on a voice recording and play back IC. This IC can be used to record some voice message which can include an alarming voice, or location of the house, or what was happened. Then the recorded voice will be played based on a microcontroller based sensing system. The microcontroller will activate a CCTV camera automatically when playing the message so that owner of the house can see the video on his/her TV. In case of owner are not in home; the message will be transmitted through a FM transmitter so that if he is in the range of the transmission, he will be alerted. If owner is not within the range, at least there is a hope that someone will hear the alarm on the radio, and save the house from burglary.**

Keywords— Intruder, Radio & video alert, Massage system, FM transmission

I. INTRODUCTION

With the development of the modern engineering, electronic systems are being employed for automation of every aspects of human work. To make the life more easy and comfortable automatic devices are evolving day by day. Security system is a part of that too. Now a day there is a lot of researches are going on for the development of the security system. At first there were only sensors which will detect abnormalities of one particular zone and raise an alarm. But with the available use of microcontroller, all the systems are combining with one another to give better security. Moreover the sensors are becoming wireless for convenient process of detection. Now, more than one alarm system can be activated at the same time. Some examples are like: activating an alarm along with calling the owner or calling the police or fire service in case of fire. Also these systems are becoming wireless day by day.

II. BACKGROUND

Based on the IEEE802.11 standard, wireless home network is known as Wi-Fi, which provides a medium for transferring media files [1]. However, it is high cost and high power consumption. Y. Zhao [2] has developed a low cost GSM/GPRS based wireless home security system which includes wireless security sensor nodes and a GSM/GPRS gateway [2-3]. It has the following features: (a) low cost, (b) low power consumption, (c) simple installation, (d) fast response and (e) simple user interface. In general, GSM modem acts as the interface between the users and the sensors nodes. There are 3 types of sensor nodes applied in the system which include the door security nodes, infrared sensor nodes, and fire alarm nodes. This architecture includes components such as filters, amplifiers, analog to digital converters and communication interfaces. The system used a wireless transceiver module to transfer data between gateway and sensor nodes. Every sensor node comprises a microprocessor and a wireless transceiver module. The function of the microprocessor is to receive and analyze the signal from the sensors' node as well as the current status of the nodes. This system also consists of a sleep timer and switch mode pump circuit, which reduces of the power consumption.

C.K. Ng [4] has developed a wireless security system where an alarm system is programmed in a graphical user interface (GUI). The system issued to monitor the RFID reader, RFID tag and the GSM terminal. The information obtained from the tag is sent to the server in a RF link that is exhibited in a GUI. If the laptop is stolen from the covered region, the alarm system will start to draw attention. Meanwhile, the laptop owner will be notified by an alert message. In addition, the alarm system will not be stopped until the laptop is put back in the covered region, or the program is stopped/terminated.

Nakrop Jinaporn [5] has developed a security system against asset theft by using radio frequency identification technology. The system consists of five main parts: (a) RFID reader and tag, (b) GUI, (c) database system, (d) CCTV and (e) wireless transmitter and receiver. The RFID reader is installed at the entrance of the campus and the tags are attached on/in student ID cards and their properties. The program of the developed system has the capabilities of investigating the identification process, database management and controlling function of the hardware.

GUI is used in a vehicle security system where t he information is controlled via the GUI [5-6]. The system is activated when the tag is read while the motorcycle is being located within the effective range. The system will automatically record this incident and exhibit the information on the monitor. Any theft occurrence will turn the monitor on automatically with the alarm signal which alerts other systems. When the burglar occurs, the CCTV will also be started for recording is immediately. The motorcycle engine is shut off automatically when the asset theft occurs however this requires a further investigation.

I. PROPOSED DESIGN BLOCK

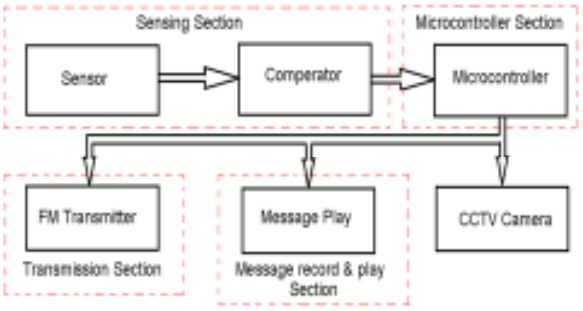

Fig 2.1: Block diagram of the project

A. IR LED and IR sensor

IR LED emits infrared radiation. This radiation illuminates the surface in front of LED. Surface reflects the infrared light. This reflected light is made incident on reverse biased IR sensor. When photons are incident on reverse biased junction of this diode, electron-hole pairs are generated, which results in reverse leakage current. Amount of electron-hole pairs generated depends on intensity of incident IR radiation. More intense radiation results in more reverse leakage current. This current can be passed through a resistor so as to get proportional voltage. Thus as intensity of incident rays varies, voltage across resistor will vary accordingly. This voltage can then be given to OPAMP based comparator shown in fig 2.1.

IR LED is used as a source of infrared rays. It comes in two packages 3mm or 5mm. 3mm is better as it is requires less space. IR sensor is nothing but a diode, which is sensitive for infrared radiation. This infrared transmitter and receiver is called as IR TX-RX

B. Microcontroller (PIC16F84)

PIC16F84 is a CMOS Flash/EEPROM-based microcontroller developed by Microchip. It is an 8 bit microcontroller having 18 pins. It is really a suitable microcontroller for automotive, industrial, appliances low power remote sensors, electronic locks and security applications

C. Voice record and playback IC (APR9600)

The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly amplify system design. The device is ideal for use in portable voice recorders, toys and many other consumer and industrial applications.

APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

D. CCTV Camera

Closed-circuit television (CCTV) is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It differs from broadcast television in that the signal is not openly transmitted, though it may employ point to point (P2P), point to multipoint, or mesh wireless links. Though almost all video cameras fit this definition, the term is most often applied to those used for surveillance in areas that may need monitoring such as banks, casinos, airports, military installations, and convenience stores.

I. DESIGN CIRCUITS

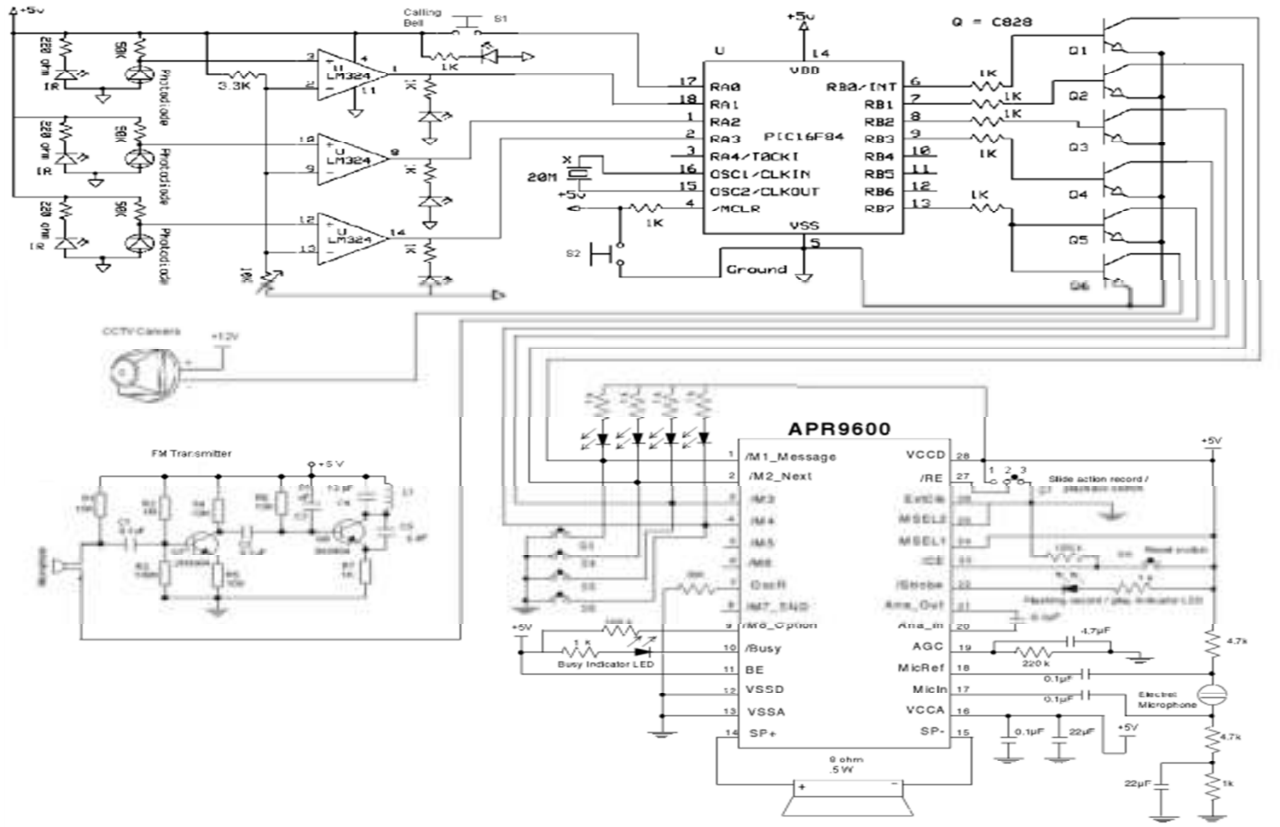

Fig 3.1: Proposed circuit for security system

The sensors will detect the abnormalities and generate appropriate signal. The comparator will compare the signal with a reference signal and will give input to the port A of microcontroller. The microcontroller will output through port B according to the input in port A which will operate the C828 transistors. The message pin will become low when C828 transistor will operate and will play the desired voice message. The voice message will be transmitted by FM transmitter for radio reception. The CCTV camera will show the current affairs going on.

A. Sensing Section

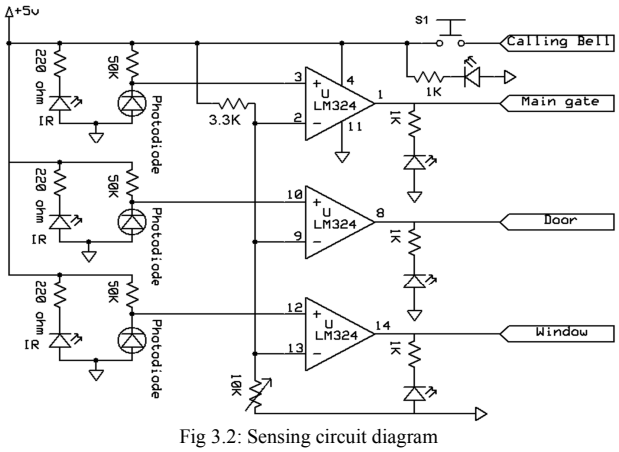

Fig 3.2: Sensing circuit diagram

In this section three IR transmitter (TX) and receiver (RX) pair is used for security of different areas of the house. In this project three areas to be secured are main gate, front door and window. A 220Ω resistor is connected to the IR TX to limit the current flow through it and for RX the value of the resistor is 50KΩ. The TX and RX are placed face to face so the reception is clear. In working condition when infrared ray transmitted by the TX falls on to the RX the voltage drop across the RX is approximately 1V. When anything comes between the TX and RX the RX can no longer receive the ray and its drop rises to nearly 1.7V. This difference of voltage is compared to a reference voltage with the help of a comparator, in this case LM324. The reference voltage is given from a 10KΩ variable resistor. The reference voltage is kept between 1V to 1.7V. Depending on the distance between the TX and RX this voltage can be adjusted. Therefore when something blocks the way of transmission, the comparator gives a +5V

output to its respective pin. Here output of pin 1, pin 8 and pin 14 is appointed as the interruption from the main gate, front door and window respectively. The calling bell system is appointed by applying a +5V output through a push button switch S1. All the four outputs are parallely connected to four different indicating LED's to ensure the correct operation of the sensing system.

B. Microcontroller Section

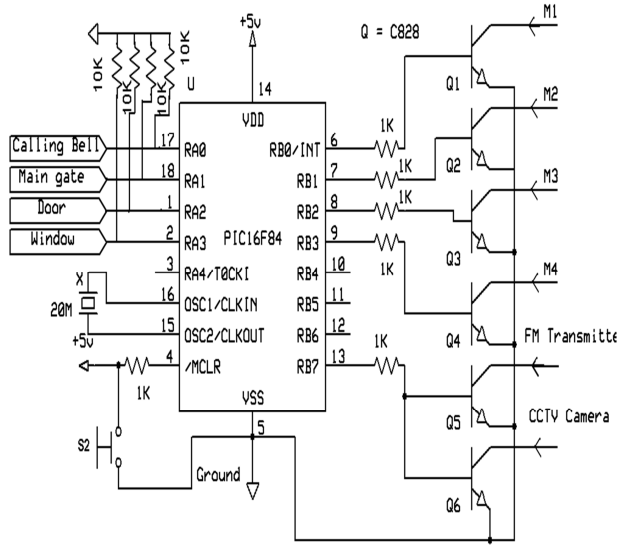

Fig 3.3 : Microcontroller circuit diagram

PIC16F84 is the microcontroller used in this project. VDD pin is provided by +5V dc supply and VSS is grounded. /MCLR pin is kept high through 1KΩ resistor. It can be grounded through a push button switch S2 in order to reset the microcontroller. A 20MHz crystal is connected between the pin15 and pin16 to provide the clock speed. The four I/O pins of PIC16F84:- RA0, RA1, RA2 and RA3 are used to read the outputs from the sensing section i.e. outputs corresponding to calling bell, main gate, front door and window respectively. According to the input to these pins the microcontroller will give an output of +5V (logic 1) to the pins RB0, RB1, RB2, RB3 and RB7. The logic sequences are

1. When RA0=1, RB0=RB7=1, RB1=RB2=RB3=0; for only ten seconds.
2. when RA1=1, RB1=RB7=1, RB0=RB2=RB3=0; until S2 is pressed to reset
3. when RA2=1, RB2=RB7=1, RB0=RB1=RB3=0; until S2 is pressed to reset
4. when RA3=1, RB3=RB7=1, RB0=RB1=RB2=0; until S2 is pressed to reset

All the output pins are connected to six npn transistor C828. RB0, RB1, RB2and RB3 are connected to the Base of transistor Q1, Q2, Q3 and Q4 respectively through 1KΩ whereas RB7 is connected to the base of both transistor Q5 & Q6. All the Emitters of the transistors are connected directly to the ground. Therefore all the transistors will act as a switch which will connect their respective loads (connected with the collector) to the ground. The transistors Q1, Q2, Q3 and Q4 will provide the ground connection for massage pin M1, M2, M3 and M4 of APR9600. Transistor Q5 will provide ground connection only for the microphone of FM transmitter and Q6 will provide that for the ground connection of CCTV camera.

C. Message Record and Playback Section

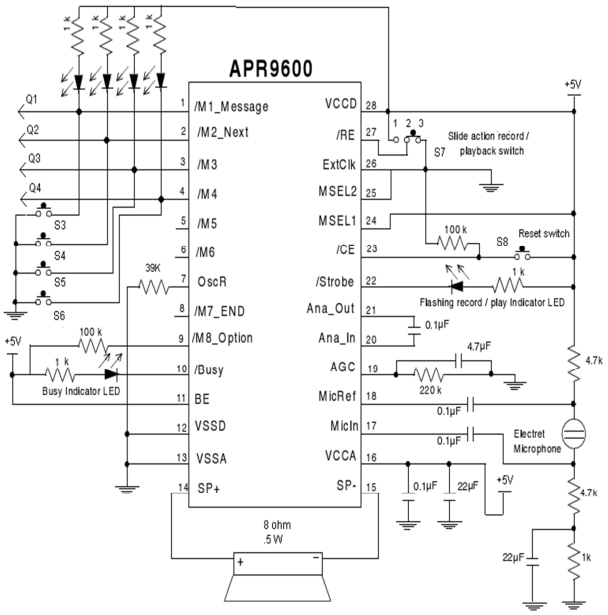

Fig 3.4: Message record and playback circuit diagram

The circuit diagram needed for this project is given above. As can be seen the analog and digital biasing pin VCCA (pin 16) and VCCD (pin 28) is provided with +5V dc. /RE(pin 27) is connected to a sliding switch S7. When the switch is in between position 1 & 2, the IC will be in playback mode. When it is put between position 2 & 3, the IC will be in recording mode. ExtClk (pin 26) is connected to the ground; therefore internal clock will be used.

As 4 fixed message is needed to play, MSEL1 is provided with +5V, MSEL2 is grounded and /M8_option (pin 9) is pulled high through 100KΩ resistor. /CE is connected to ground through 100KΩ resistor to enable the chip and to +Vcc through a push button switch S8 for resetting purpose.

All the pins from 10-22 are connected as per schematic. The output pins for the speaker are connected to a .5W, 8Ω speaker.

Oscr of nearly 6 KHz and a message recording and playback duration is 44 second.

As message pins are needed to be grounded for pin is connected to the ground through 39KΩ resistor. It will provide a sampling frequency triggering; M1, M2, M3 and M4 pins are connected to the collectors of Q1, Q2, Q3 and Q4 transistors respectively. Therefore with appropriate base current these transistors will trigger the message pins. The message pins are also connected with four push button switch S3, S4, S5 and S6 for grounding to ease the process for recording. Four indicators LED's are connected with the message pins to indicate which pin is triggered.

The operation of APR9600 is such that in playback mode if the trigger pin is grounded once the message will be played once. And if the trigger pin is held low continuously the message will be repeatedly played. Again in recording mode, it will record message as long as the trigger pin is held low. Recording will end if the trigger pin is not held low. Therefore the above configuration will provide an excellent operation of the APR9600 IC.

D. FM Transmission Section

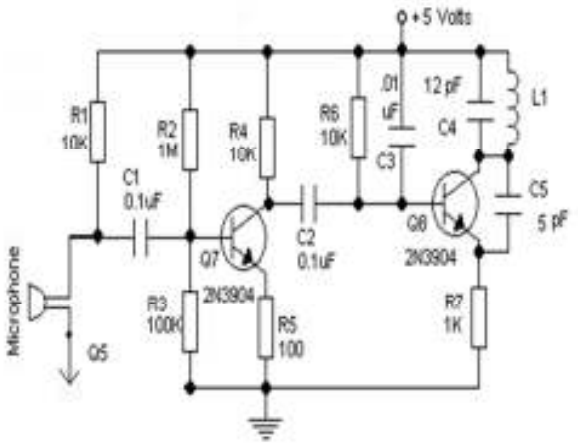

Fig 3.5 : FM transmitter circuit diagram

This miniature transmitter is easy to construct and its transmissions can be picked up on any standard FM receiver. It has a range of up to 30 feet or more. The range can be increased by designing a suitable antenna and connect it with the transmitter. It is great for room monitoring, baby listening, nature research, etc. It consists of two 2N3904 npn transistors. The first transistor Q7 amplifies the signal received from the microphone. Second transistor varies the frequency of the tank circuit according to the voice signal. L1 is 4.5 turns of #18 gauge hookup wire close wound around a non-conductive 3mm diameter form. The microphone is grounded through transistor Q5. Therefore though power will exist in the circuit all the time, the transmission will only occur when RB7 is logic 1.

E. Power Supply section

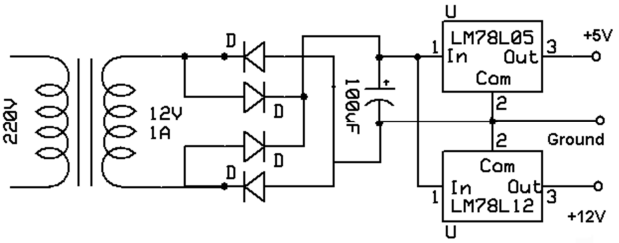

Fig 4.6: Power supply circuit diagram

Figure 4.6 represents the power supply circuit for the whole project. Required supplies for the project is +5V and +12V. These voltages are provided by two regulators IC's L7805CV and L7812CV. The input to these IC's are fed from a 220V/12V ac transformer of 1A rating. The 12V ac is rectified through diode and filtered by a 100uF capacitor to give nearly 15V dc as a supply to the regulator IC's.

F. CCTV Camera section

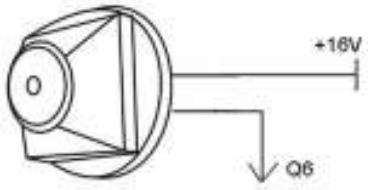

Fig 3.6: CCTV camera circuit

The input of the CCTV camera is +16V which is provided from the output of L7812CV. It is grounded through transistor Q6. Figure 4.7 represents the supply connection system for the CCTV camera.

II. RESULT AND ANALYSIS

A. Sensing section

Fig 5.1: Output from the LM324

The sensors are working fine. Whenever the voltage across IR sensors rises more than the reference voltage (≈1.5V), the operational amplifier LM324 gives an output of 3.5V which is enough to trigger the microcontroller. The output of the S1 switch is 5V. Figure 5.1 represents the output from the LM324 measured by a multi meter.

B. Microcontroller section

Fig 5.2: Output from the microcontroller

All the outputs from the microcontroller port B is of a value 4.58V. This voltage is enough to provide the base current of npn transistor C828 and triggers the message pins. Figure 5.2 represents the output voltage from the microcontroller pins.

C. Message record and playback section

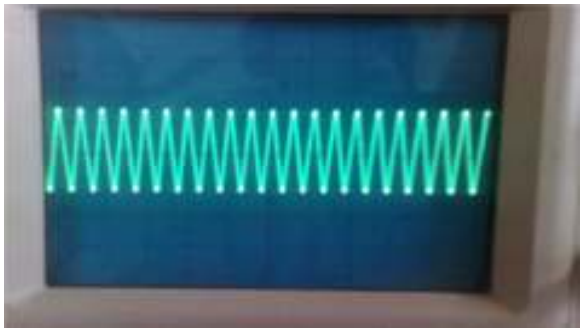

Fig 5.3: Output signal from APR9600 (carrier)
[x-axis = 5µs, y-axis= .5V pp]

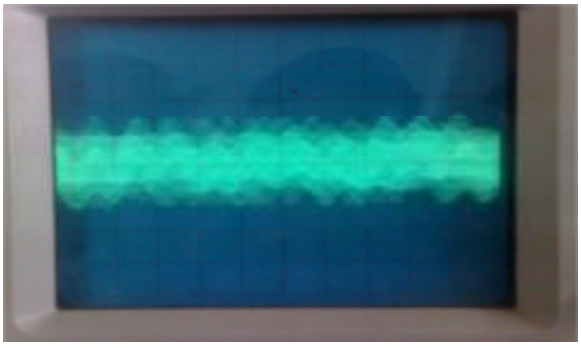

Fig 5.4: Output signal from APR9600 (carrier + message)
[x-axis = 1ms, y-axis= 1V pp]

The triggering of the message pins is accurate. The output of the IC APR9600 through the SP+ and SP- pin is given in the figure below. It is seen that the played message contains a carrier signal of approximately .7V having a frequency near 400 KHz. Figure 5.3 and 5.4 represents the output from the APR9600 measured by a oscilloscope showing the carrier output and the total massage output which have the carrier merged with it respectively.

D. FM transmission section

The transmission frequency of the FM transmitter can be varied from nearly 96MHz to 104MHz. The transmitted frequency is not shown in the oscilloscope as it malfunctions whenever I connect the probe to it. But the transmission is good and clear. Though it has a short range, the transmission is clear. Connecting a well configured antenna may increase the range. Now the range is only 30 feet approximately.

III. CONCLUSION

This paper is based on the security system with video and audio alert system. Intruder radio alert system is the beginning of a new trend in the security system. It will surely increase the level of security of our home and our friends next door. As radio transmission is faster the response against a burglary in progress will be faster than other security systems. More over a large number of people will know about the incident in no time will make the burglars afraid of doing any crime. It's a extremely good quality security system in very low cost.

IV. REFERENCES

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