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GSM Based Automated Home Security and Automation System

Ankur Jyoti Borthakur[1], Bipasha Das[2]

[1]*B.Tech, Electronics and Communication Engineering Department,*
[2]*B.Tech, Civil Engineering Department,*
*Sikkim Manipal Institute of Technology, Sikkim Manipal University*

Abstract: *The rapid advancement of technology in recent years has brought about the dawn of the technically advanced intruder. However, the security systems in an average household are obsolete if present at all. With the increase in high tech burglaries at an alarming rate, it was felt that the security of an average household is severely compromised. The main driving force behind this system was born out of the necessity to improve this dismal scenario. The principal objective of this microcontroller based home security and automation system is to prevent intrusion from trespassers or burglars inside a confined perimeter and also control different electronic appliances. The system employs an array of sensors to detect intrusion and thereby triggers a security notification to the system user as well as to the concerned authorities. In this project, I present the design and implementation of a low-cost, low power-consumption GSM based security and automation system. In conventional systems, generally only one type of sensor is employed, thereby leading to failure due to malfunction or false triggering but in this project the failure factor has been reduced many fold due to deployment of multiple sensors. Moreover, for the notification purpose GSM technology has been used. The system detects any kind of intrusion inside the confined perimeter and immediately generates a notification and sends it to the pre-set user's phone number in the form of an SMS. The system has an added feature which is to detect leakage of LPG and many other combustible gases as well as smoke and notifies about the same to the user via text message.*
Keywords: *GSM module, intrusion detection, Gas sensor, SMS notification, home security, microcontroller, Sensor array, low-cost, energy-efficient*

I. INTRODUCTION

This project is based on two ATMEGA 328 Microcontrollers, a SIM 900A GSM module, four PIR sensors, an Ultrasound sensor, a Gas Sensor, TTP223B Digital capacitive Touch Sensor, RFID reader, four Audio Detection Sensors, four single channel opto-coupler based relays .The connections between the components is illustrated in the diagram below. The entire system is installed in the required confined space. The ultrasound sensors, the PIR sensors and sound sensor module which are rigged up on a redundant circuit act as the eyes and ears of the system. While the Ultrasound sensor and the PIR sensor work to detect an intrusion the Gas sensor monitors the space for combustible gas. Upon detection of a breach, the system will immediately trigger an alarm notification which will be sent to the user's cell phone. Also, the system will send a notification message to the appropriate authorities. Similarly, if the Gas sensor picks up traces of combustible gas in the space the system will notify the user. In this case, the authorities are not notified (unless specified by the user) as the gas leakage may be handled by the user. Moreover the user can send SMS to the system in pre-set format to the system to on or off any particular gadget controlled by the system.

A.   Illustrative Diagram of the System
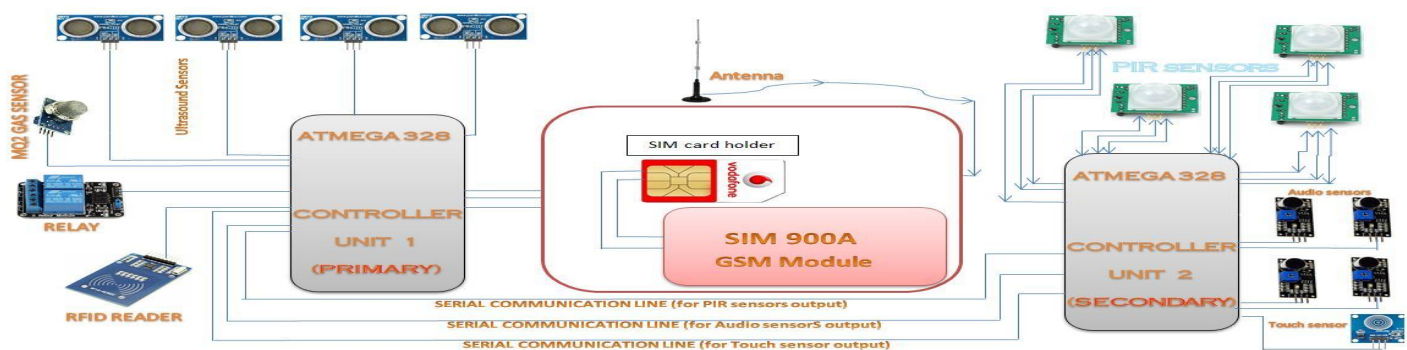
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B.   Atmega328

Atmega328 Microchip 8-bit is an AVR RISC-based microcontroller. It packs in 32KB ISP flash memory with read-while-writecapabilities, 1KB EEPROM and 2KB SRAM. In a single clock cycle, this Microcontroller achieves an impressive throughput of 1MIPS (Million Instructions per second) per MHz with proper balancing of power consumption and processing speed.
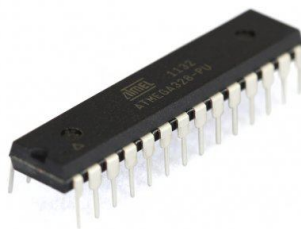

Fig1: ATMEGA328 Microcontroller

C.   SIM900A GSM Module

The SIM900A is a complete Dual-band GSM/GPRS SOC which is designed especially for allowing designers to benefit from small dimensions and cost-effective solutions. This device features an industry-standard interface and the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and low power consumption. With a tiny dimension of 24mm x 24mm x 3 mm, this SOC can fit almost in all the space requirements in applications, especially for slim and compact demand of design. Moreover the ease of use is a very useful feature of SIM900A. It can be controlled by AT Commands which is a pre-set set of instructions for every individual function that can be performed by the SIM900A GSM modem.

Fig 2: Simcom SIM900A Module

D.   HC-SR04 Ultrasonic Sensor

An ultrasonic transducer is a piezoelectric device that converts AC into ultrasound, as well as the reverse, sound into AC. The HC-SR04 is an ultrasonic sensor which is a pair or two ports, one transmitter and one receiver. The transmitter transmits and the receiver receives the reflected ultrasonic wave and the distance is calculated by correlating the time required for the sound wave to reach back the receiver from the point of being transmitted. The induction angle of HC-SR04 is 15° and detection range is 2-200cm with accuracy up to 3mm.
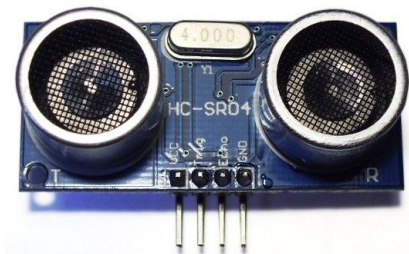

Fig3: HC-SR04 Ultrasonic Sensor

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E.   HC-SR501 PIR Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) radiating from objects in its field of scope. All objects with a temperature above absolute zero (-273 K) emit heat energy in the form of radiation. Usually this radiation is invisible to the naked human eye because it radiates at infrared wavelengths, but it can be detected by this electronic device specifically designed for such purposes. HC-SR501 is based on infrared detection technology, automatic control module using German made LHI778 probe designed for high sensitivity, high reliability, low voltage operating mode widely used in various auto sensing electrical equipment especially for battery-operated automatic controlled devices.

Fig4: HC-SR501 PIR Sensor

F.   MQ2 Gas Sensor

MQ2 flammable gas and smoke detector detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The MQ2 can measure concentrations of flammable gases of 300 to 10,000 ppm. The operating temperature of the sensor is from -20 to 50°C and consumes less than 150 mA at 5 V.

Fig 5: MQ2 Flamable Gas sensor

G.   TTP223B Digital capacitive Touch Sensor

A touch sensor detects touch or near proximity without relying on physical contact. Touch sensors are making their way into many applications like mobile phones, remote controls, control panels etc. Present day touch sensors can replace mechanical buttons and switches. The TTP223 is a touch pad detector IC which offers one touch key. The touch detection IC is designed for replacing traditional direct button key with diverse touch pad size. The key features are Low power consumption and wide operating voltage for DC or AC application.
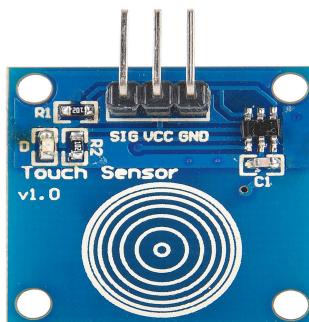

Fig 6: TTP223B Digital capacitive Touch Sensor

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II.   DESIGN ASPECTS AND BASIC DEVELOPMENT

Once the system is turned on, it continuously scans the environment to detect signs of intrusion. The user has the option of either positioning the Ultrasound sensors, the PIR sensors and the Audio Sensors in such a way that they cover the same space or in a way that they cover multiple points of entry. In the first arrangement, the system covers one area but covers a very large portion of that area and in the second, the system covers multiple entry points but small portions of those areas. Once the system detects an intrusion, an SMS message is generated and sent to the user's phone number. Also the MQ2 Gas sensor is placed over an area that has a possible chance of gas leakage. If there is any leakage of combustible gas or smoke, the system will send an alert to the user. As such the system is also capable of notifying the user of electrical fires or gas leaks. Also the user can deactivate the system by sending an SMS in the pre-set format to the system.

Moreover if the user wants, he/she can remotely ON/OFF any gadget connected to the system in the house via a pre-set format of SMS. And when the user walks into the house, he/she can OFF the system by his swiping his unique RFID card near the reader mounted externally. Another added feature of this system is the two-pronged switch OFF mechanism, where if the user has to first swipe his RFID card near the reader (hidden in an external concealed location) and then touch the digital capacitive Touch sensor which is again hidden in another concealed location.

Due to this two-pronged deactivation mechanism, there is no way to switch OFF the system even if the user's RFID key card falls in the hands of intruders. And also the array of 4 ultrasound sensors, 4 PIR sensors, 4 Audio sensors and one Gas sensor makes it a fool-proof system which has very minimal chance of failure due to redundant deployment of sensor arrays.

A.   Flowchart of the System's Complete Decision Analysis Tree
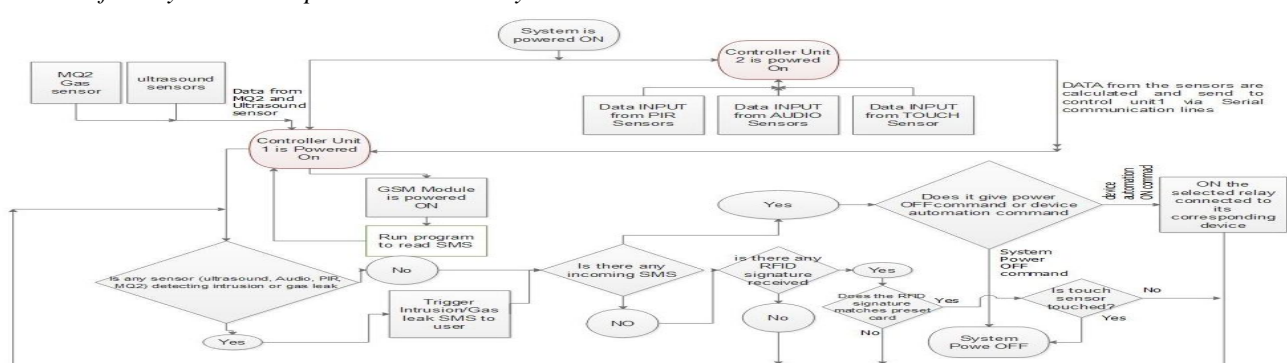
III.   RESULTS AND CONCLUSION

Hence we can conclude that this Security and Automation system is a smart step in the domain of Home Security Systems. Its fool-proof measures ensure that the system will perform up to specification and expectation even in the event of malfunction of one or more sensors. And the deployment of arrays of redundant numerous number of sensors make this system immune to sensor malfunction.

IV.   ACKNOWLEDGEMENT

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