

IoT Based Security & Controlled Smart Home Automation System Using GSM

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Abstract— Nowadays, technology has overcome the basic daily problems of human beings, which is mainly reduced to an extent by approaching of IOT, further developed the system more upgraded, systematic and effective. The design challenges in home automation are increasingly apparent but, providing the platform for controlling home appliances, their monitoring, programming and simultaneously preventing the entrance of any intruder into the house thereby maintaining security by improvising the system with electronic door lock arrangement. Thus, this system fulfills the essential need of developing a fully independent and extensible home system that can support devices and technologies of differing functionalities and protocols. In this paper, we present a home automation system using Arduino MEGA microcontroller and GSM SIM900 as a connectivity module. It helps the user to manage various appliances such as light, fan, TV and can take decision based on the feedback of sensors remotely. It also helps to provide notification on the Android app by turning its indication from “green” to “red” intimating about the danger is about to happen in the house. Also, automatically switched OFF the appliances or stopping the flow of water from water tap after noticing programmed period of time. Additionally, it allows the person to enter in the house who have authenticated RFID only, thereby if any intruder tries to enter by displacing door, it will provide the notification on the App. We have tested our system through conducted experiment on various environmental conditions.

Keywords: IoT-Internet of Things; GSM-Global System for Mobile Communication; RFID-Radio Frequency Identification; SMS- Short Message Service

I. INTRODUCTION

The Internet of Things (IOT) describes the network of physical objects—“things”—that are embedded with sensors, software, and alternative technologies for the aim of connecting and exchanging data with other devices and systems over the internet. As far as concerned to our house, this concept ensures to make it smarter, safer and automated optionally.

This paper describes how to control, monitor and check the status of home appliances through android application over internet via your cell phone along with maintaining home security by enabling electronic door lock system for unauthorized one. The android mobile is employed to send the commands to the Arduino to manage all the home appliances. This system has designed to feel secure the dear ones even in your absence too. There are unit range of economical home automation systems offered in market. However, these are designed for limited use, but here you can find multiple applications purposed to solve by one designed system only. Therefore, home appliances will one by one controlled each from within the home and

remotely. This is mainly beneficial for the mass who are mostly engaged in jobs which is far away from their house and returns after 12 hours and even in weeks and forgot to turn off the bathroom tap, lights, fans and other electrical appliances. This costly mistake can increase the electricity bill as well as put your and others lives in danger. This system has been designed with a view to handle the great difficulties of the people by creating practically usable Android home automation system.

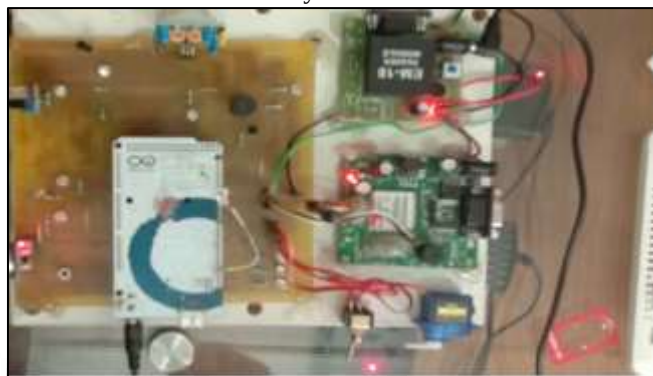


Fig. 1: Final Project Model

II. BLOCK DIAGRAM

This Block Diagram describes about the relationship between various electronic components and modules. Bidirectional arrow represents the data can be transmitted / received. Arduino Mega 2560 acts as MCU, where all the sensors forwarded their signals or piece of information, which further be analyzed by MCU and output provided after processing and controlling of information. Output seems by Glowing of LED connected nearby respective all sensors and Buzzer nearby in case of IR sensor connected on PCB.

Also, the data received by GSM module for transfer of information at the internet server which will be further indicated at mobile App simultaneously. Hence, MCU get connected through all the 6 sensors, RFID module, GSM module, servomotor, Power Supply of 5 V which is easily represented by Block Diagram

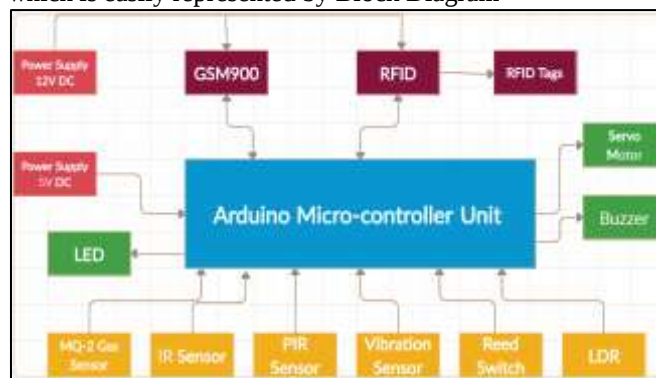


Fig. 2: Block diagram of Prototype

III. HARDWARE REQUIREMENT

Arduino MEGA 2560, GSM Module, RFID Module, Servomotor, Different types of sensors like-MQ-2 (gas sensor), IR sensor, PIR sensor, Vibration Sensor, LDR, Reed switch, Buzzer, Adapters 5V and 12 V

IV. MODAL DESCRIPTION & ANALYSIS

Collect all physical data from different types of sensors available in the circuit board. As per the sensor status, controller activate the corresponding output signals (LED's). At the same time, controller continuously communicates with GSM module which consequently changes the status on Mobile App. When user access with authorized RFID card, the controller gives command to open the gate via Servomotor. When someone switch ON the system and forgot to switch OFF, controller automatically switch OFF the system after delay time.

A. Arduino Mega:

It is a Microcontroller board based on Atmega2560. There are 54 digital I/O pins and 16 analog pins incorporated on the board that build this device unique. Out of 54 digital I/O, 15 I/O are used for PWM (pulse width modulation). A quartz oscillator of 16MHz frequency is added on the board. This board comes with USB cable port that is used to connect and transfer code from laptop to the board. DC power jack is coupled with the board. ICSP header is an exceptional addition to Arduino Mega that is employed for programming the Arduino and uploading the code from the computer. There is a reset button and 4 hardware serial port interface called USART which produces a maximum speed for setting up communication.



Fig 3: Arduino Mega 2560

B. GSM Module:

The SIM900 is a complete Quad-band GSM/GPRS answer during solution in a SMT module which might be embedded with the client applications. That includes an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 millimeter, SIM900 will match the majority the area necessity in your M2M application, particularly for slim and compact demand of design.



Fig. 4: Physical Representation of GSM SIM900

C. RFID Module

RFID stands for Radio Frequency for Identification. Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to spot the presence of RFID tags. A bit like Bar code reader, RFID technology is used for identification of individuals, object etc. presence. In RFID technology we have to tendency to simply bring RFID tags in range of readers. RFID is employed in several applications like attendance system in which everybody can have their separate RFID tag which will help identify person and their attendance. RFID is used in several companies to provide access to their authorized employees. It is additionally helpful to keep track of goods and in automated toll collection system on highway by embedding Tag (having unique ID) on them.

RFID based system has two basic elements:

1) RFID Tag:

Inside RFID tag there is microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number.



Fig. 5: RFID tag

2) RFID Reader:

The reader is used to read unique ID from RFID tags. When the RFID tags comes in range of reader, RFID reader reads its unique ID number and transmits it serially to the microcontroller or PC. RFID reader has transceiver with an antenna mounted on it. It is mostly fixed in stationary position.



Fig. 6: RFID Reader

RFID Reader has transceiver which generates a radio wave signal and transmits it through antenna. This signal itself is within the kind of energy which is used to activate and power the tag. Once RFID tag comes in range of signal

transmitted by the reader, electronic transponder in the tag is hit by this signal. A tag attracts power from the electromagnetic field created by reader. Then, the transponder converts that radio signal into the usable power. After getting power, transponder sends all the data as information it has stored in it, such as unique ID to the RFID reader in the form of RF signal. Then, RFID reader puts this unique ID data information in the form of byte on serial Tx (transmit) pin. This data information can be used or accessed by PC or microcontroller serially using UART communication.

D. Servo Motor:

An electric device, Servo motor can be used to rotate objects (like robotic arm) precisely. Servo motor consists of DC motor with ability of error sensing negative feedback mechanism. This allows dual axis precise control over angular velocity and position of motor.



Fig. 7: Servo Motor

E. MQ-2 (Gas Sensor):

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material, when it comes in contact with the gas sensing material resistance changes. This change in the value of resistance is used for the detection of gas. The Grove - Gas Sensor(MQ2) module is useful for detection of gas leakage detection (home and industry). It MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.



Fig. 8: MQ-2 Gas Sensor

F. IR Sensor:

An infrared sensor is an electronic device. An IR sensor can measure the heat of an object as well as detects the motion of object. Infrared sensors measures only infrared radiation. Usually in the infrared spectrum, all the objects are radiate some form of thermal radiations. These types of radiations are invisible to human eyes that can be detected by an infrared sensor. The emitter is just an IR LED (Light Emitting Diode) and the detector is just an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. Once IR light falls on the photodiode, the resistances and these output voltages,

change in proportion to the magnitude of the IR light received.



Fig. 9: IR Sensor

G. PIR Sensor:

A Passive Infrared Sensor known as PIR Sensor is an electronic device that measures the infrared (IR) light emitted by the objects in its observable area. The term 'Passive' in the PIR Sensor indicates that the sensor actually doesn't emit any infrared light but rather passively detects it that is emitted by its surrounding objects. PIR sensor detects a human being moving around within the range approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m. PIR are fundamentally made of a pyroelectric sensor, which can detect levels of infrared radiation. Every physical object, with its surface temperature greater than absolute zero i.e. -2730 C emits heat in the form of infrared radiation. Humans cannot see this radiation as the radiations are in infrared wavelength. The radiation detected by PIR Sensors detect these radiations and change them into appropriate electrical signals.



Fig. 10: PIR Sensor

H. Vibration Sensor:

Vibration sensor can be used in variety of vibration detection projects. In ideal condition two contacts of sensor are not connected in idle condition. When someone applies vibratory force on the switch, spring inside the switch vibrates and makes a momentary short circuit between the two terminals, the sensor's two contact pin are closed and contact is made between the two pins. When the force is removed the sensor terminals return back to normally open contacts.

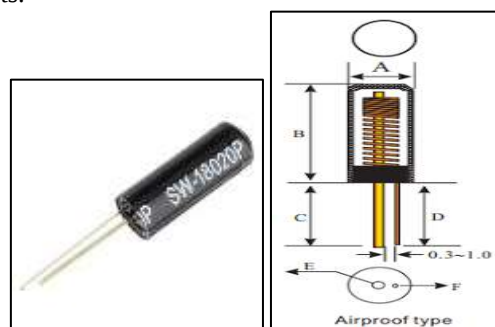


Fig. 11: Vibration Sensor

I. LDR (Light Dependent Resistor):

It is also called a photo resistor. It is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also known as photo conductors, photo conductive cells or simply photocells. They are created of semiconductor materials having high resistance. A light dependent electronic resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light photons are absorbed by the material.

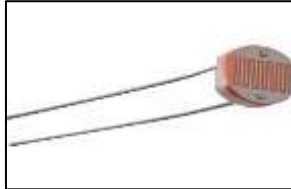


Fig. 12: LDR

J. Reed Switch:

The reed switch is an electrical switch which is operated by an applied magnetic field. It consists of a pair of ferromagnetic flexible metal reeds contacts in a hermetically sealed glass envelope, where there are two ferrous flexible reeds and is loaded with inert gas called rhodium. The contacts are normally open and when a magnetic field is present contact will close, or it may be normally closed and open when a magnetic field is applied. The reed switch sensing element is the metal part inside the reed switch envelope that is relatively thin and wide to make it flexible. At the point when an attractive substance ways to deal with the glass envelope, the reeds contact terminal will meet up because of the attractive field subsequently finishing an electric circuit. At the point when the outer attractive field vanishes, two reeds contact will be isolated in view of their versatility, the circuit is likewise disconnected. It has been connected in printers, clothes washers, fridges, cameras, door magnets, window magnets, electromagnetic transfers, electronic measuring gadgets, level meters, gas meters, water meters, and so forth.



Fig. 13: REED Switch

K. Buzzer:

An electrical device i.e. used for signaling and makes buzzing noise.



Fig. 14: BUZZER

V. SOFTWARE REQUIREMENT

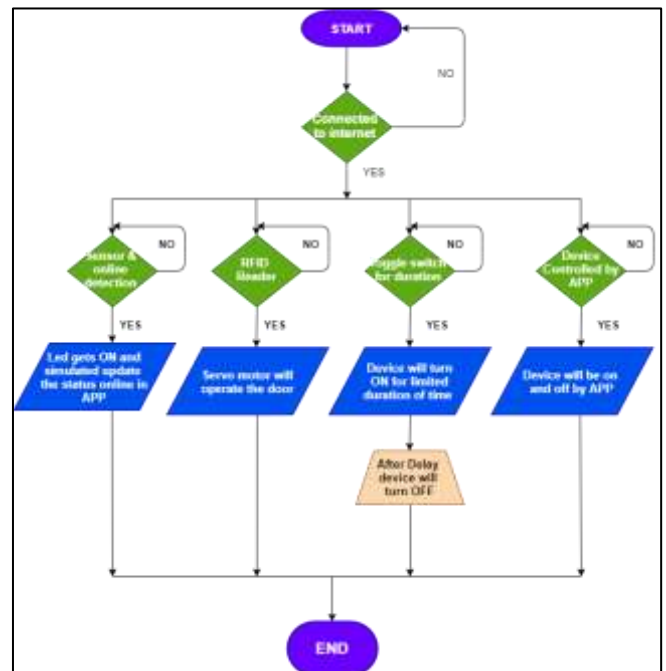
Arduino Mega 2560 can be programmed using Arduino Software called IDE (Integrated Development Environment). It is an Open Source Software which supports C Programming. It is easy to write code and upload it on Microcontroller board.

VI. WORKING METHODOLOGY

In this system all the six sensors like IR, PIR, Vibration, MQ-2 gas sensor and Reed Switch are used for sensing and then microcontroller used for controlling and then a GSM module which is used for calling purpose. When anybody comes in range of anyone of the sensor, then sensor sends a logic signal to microcontroller, then it will necessary action to take control and perform a given task. Here a calling and SMS task is given to microcontroller using GSM. Security Alarm Systems are very important in present day society, since crimes are increasing. With the technological advancements we have achieved in the recent years, a homeowner doesn't have to worry about home security while getting off his/her home. Modern home security systems are capable to provide enough security from burglars; fire, smoke, and etc. They also provide immediate notification to the homeowner to the Android App or via SMS directly, which further controls and enable the owner to take necessary action through his mobile. Also, the authorized person can enter into the house having individual RFID card.

The aim of this project is to implement a simple, reasonable and affordable, but efficient home security alarm system. The project is designed for detecting intruders and informing the owner.

VII. FLOW CHART OF WORKING:



VIII. FUTURE SCOPE

The developed automation security system can also be used to in industrial and commercial applications such as offices, warehouses and other domestic and industrial areas where some specific areas are reserved for authorized person only or other places where human safety and precautions are the main primary concerns such as internet server room of a big MNC from where corporate data can be stolen. The system can also be easily upgraded to add extra safety features such as figure print reader, optical sensor, cameras, motion detection sensors, etc. for increased safety. For future use, the researchers would recommend as:

- 1) Reducing the time delay to turn ON and OFF of an appliance.
- 2) Adding speech recognition to the system.
- 3) Encouragement of intimation system through SMS & call to the mobile phone.
- 4) Can be expanded to 4G & 5G system supportable.
- 5) Cameras can be adjusted to the system for monitoring and further forwarding the details to the Mobile app.
- 6) RFID can be upgraded to finger print scanner or password number.

IX. CONCLUSION

In this paper, a novel architecture for easy and flexible home security and monitoring system using Arduino microcontroller unit is proposed and implemented. The important of home automation security measures are elaborated using easily available electronic programmable sensors like the PIR sensor, LM35 (Temperature sensor), by implementing this type of advance system we can secure access point of our home as well as for more security feature we can use various sensors. This advance security home feature become draw much attention in the future. People getting more concerned to protect their family and house from unauthorized people. This system can monitor a house by use of different type of sensors that integrated with a microcontroller and a GSM unit. SMS use to alert users via mobile phone when system detects a possible intrusion occur. Today almost everyone using smart mobile phone so by use this system user will not have to carry additional device to monitor their house.

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