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A Novel Design and Implementation of Smart Home Security System: Future Perspective

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Abstract

Development in technology from last few decades open doors to various threats to human and his surroundings. Individuals with the advancement in security had taken several measures to control the threats for safeguarding their belongings. From time to time various intrusion detection systems established for earmark intruders from home environment and provide tangible benefits to users, but can also expose users to significant security risk. Smart home security system is gaining popularity for industry, government, and academia as well as for individual that has the potential to bring significant personal, professional and economic benefits. This paper presents design and implementation of smart home security system based on GSM/GPRS (Global System for Mobile Communication /General Packet Radio Service) and response rapidly to alarm incidents and has a friendly user interface including a LCD (Liquid Crystal Display) and keypad. Special emphasis is placed on the empirical security analysis of such emerging smart home platform by dividing into two case scenarios. The paper will conclude by discussing future perspective and challenges associated with the development of security system for home.

Keywords: Security, Sensor, GSM (Global System for Mobile Communication) Internet of Things (IOT), Smart Home

I. INTRODUCTION

As technology is still evolving, there is not a specific appropriate standard to define a 'smart home' nor a distinctive features to classifying 'smart home' in relation to various related terms used and from similar other systems. We can say home system as 'smarter' due to collective intelligence of individual home appliances, all electronics and non electronic items in collaboration with other devices in surroundings. The term 'smart home' is used for all residence those are equipped with something that makes inhabitants to monitoring all things automatically and facilitates home environment so as optimize and automate all facilities designed for basic day today need of an individual. The basic principles on which a smart home stands fruitful mentioned in Fig. 1.

With the advent of Internet of Things (IOT) it hopes to connect all things those have their certain unique identities with self configuring capabilities to communicate data associated with users and their environment and to take actions based on their operating conditions. It is not just connecting things, devices, appliances & machines to internet but to allow these things to execute while achieving common user and machine goal for communicating and exchanging data with surroundings and from machine to corresponding environment, machine to machine, machine to human & human to machine.

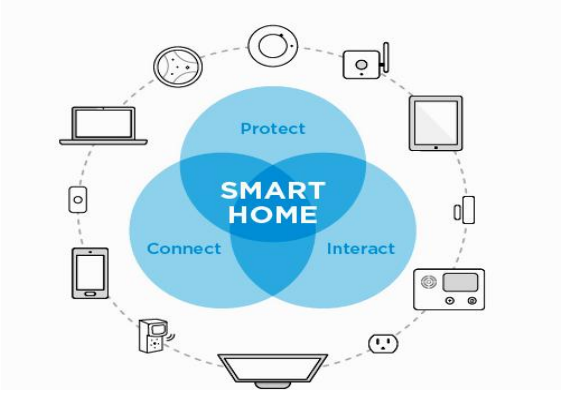

Fig. 1. Goals of smart home system.

In recent years, the home environment has seen majority of digital technologies with rapid introduction of need of safety and preventive measures for guarding the critical situations which may otherwise leads to destruction of property, human lives, assets etc.

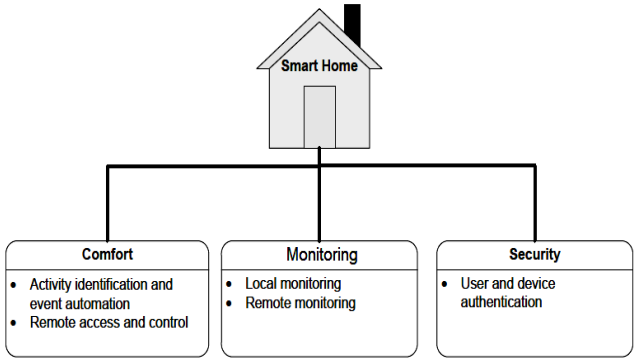

Fig. 2. Categorization of smart home fields according to the intended services.

In the era of technology, where smart homes are pacing steps with other dedicated technology, categorizing smart home fields according to intended services provided for comfort, monitoring & security. Fig. 1 classifying the comforting zone

as activity identification and event automation so as to provide the satisfaction relax environment. Secondly to monitoring local and remote environment when events may become obscure remotely. Thirdly, the factor which is more concerning towards keeping secure authentication according to proper access control by providing appropriate user identification.

Security has become an important part of life everywhere. It is necessary to secure home as the possibilities of intruders are increasing intentionally or unintentionally to gain access inside premises for harming and to become potentially threat to life, property which may cost to loss of unauthorized materials and information. Whatever may be the technology, it is always with humans as being an assistant and somewhere but under the domain of IOT we configure and control those things which are traditionally not associated with internet.

Intrusion detection and surveillance system purpose is to detect intrusion using sensors (such as PIR sensor) and raise alert. Smart home security system can potentially become a device where they can interact more seamlessly with the immediate environment. There is potential in smart home security system to make the home a service rich safe and secure environment. But instead still we face many challenges and hurdles while advancement and acceptance of these services. However, the smart home security system based on GSM (Global system for mobile communication) provide enhanced security by signalling whenever disturbances in sensor occurs and in response beside raising alarm, a text message is also sent to a desired number to take necessary actions. The proposed approach has been implemented under two case scenarios.

The first system implemented when in case all members are present inside home premises and simply accessing main door for in-out using 4x4 matrix keypad and authorising themselves by giving unique password for system to provide access. The second system implemented only in case this system is activated by the residence and when all members away from home. After activation of second system it works in parallel to first system by giving enhanced security with PIR motion detector, buzzer for raising alarm, GSM module for sending alert message, camera for capturing image, so as to warn members of home regarding any intrusion trying to intrude.

II. SYSTEM ANALYSIS

Smart Home Security System is design and developed keeping in mind to monitor our home security from intrusion.

A. Problem Definition

In most of previous systems those are developed earlier are affected by breach of security and power failure as earlier traditional locks were used to guard the home. Somewhere there are chances for key loss. Due to this short come full system break down. The main objective of this system is to make our home security more efficient and more reliable. It is low cost, low power consumption, with battery backup. This system works in those conditions also when in case security breached, so in response alert notification send and alarm raised.

B. Proposed System Features

This Smart Home Security System developed with advanced feature to overcome shortcomings of previous security system. It is more than normal home security using phone application to monitor door lock and intrusion detection.

- Controlling system up to 100 meter
- Monitoring with mobile app
- Alarming in case intrusion detect
- Capturing image from camera
- Alert notification through GSM
- Password protect through keypad
- Friendly user interface with LCD display
- Power backup in case power failure
- Automatic door lock after unlocking
- Low cost system with affordable price

III. SYSTEM DESIGN AND IMPLEMENTATION

Smart Home Security System for facilitating authorised access and monitoring intrusion detection divided according to need and on time basis for saving energy into two sub-system. The first system (module1) implemented when in case all members are present inside home premises and second system (Module2) implemented only in case it is activated by the residence and when all members away from home.

Components used in first security system (Module1):

- 4x4 matrix keypad,
- Arduino Uno microcontroller
- 16x2 LCD (Liquid Crystal Display)
- Potentiometer
- Sonoff SV
- Electromagnetic Lock
- Power Bank (12 Volt)

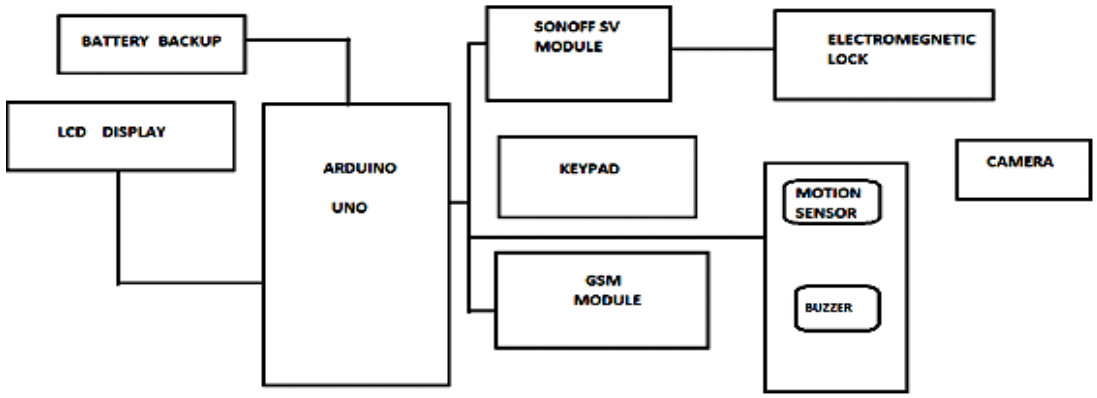

Fig. 4. Block diagram of main security system (System 1 with System 2)

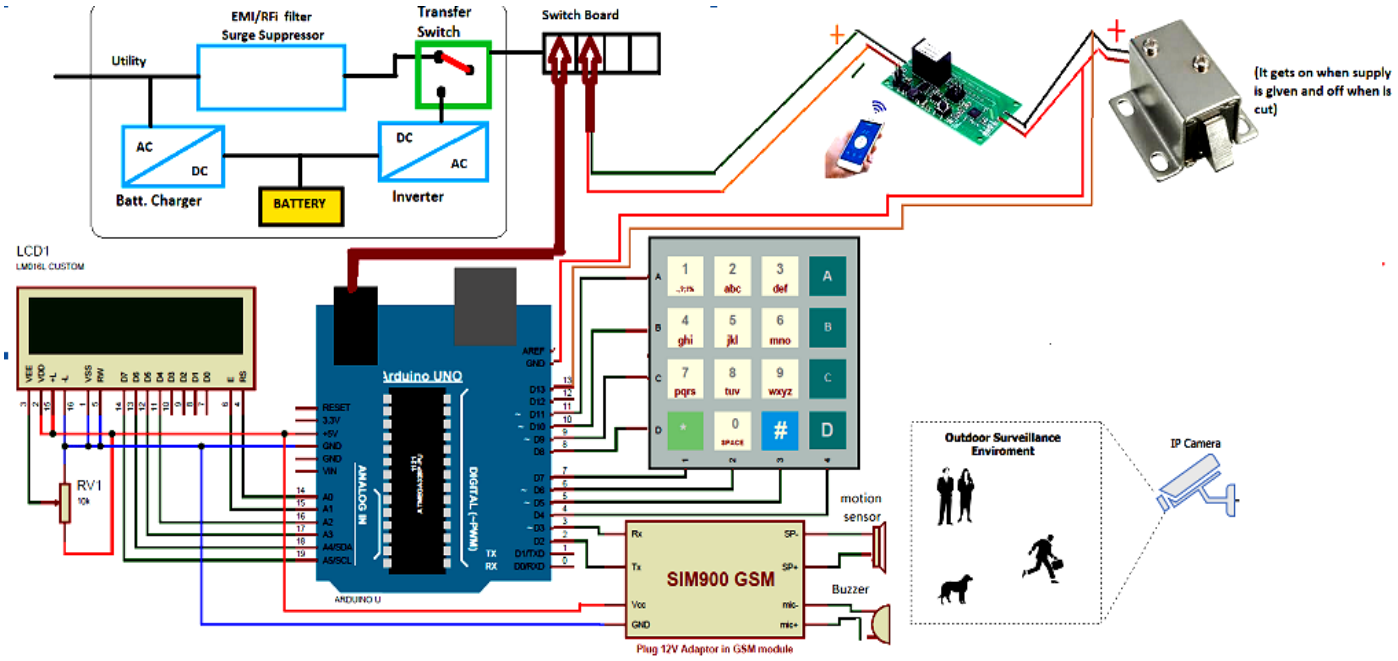

Fig. 5. Circuit diagram of main security system (System 1 with System 2)

Components used in second security system (Module2):
Arduino Uno microcontroller

- GSM (Global system for mobile) module
- Infrared Camera
- PIR motion sensor
- Buzzer
- Battery Backup

Smart home main security system (Module1 with module2) consisting of both security system connected to common Arduino Uno microcontroller as shown in Fig. 4. Complete circuit diagram illustrated in Fig.5 with battery backup and infrared camera.

A. Module1 Security System

Module1 security system design to simply facilitate door lock-unlock using electromagnetic lock with 4x4 matrix keypad password matching and with android application showing status of door through LCD (Liquid Crystal Display). Fig. 6 showing the block diagram of Module1 security system. In case users are inside home premises, it can work on keypad lock system. In which a user enters the password by pressing the keys on the keypad. If password matches then it generates the signal which passes from the Arduino microcontroller to Sonoff SV module to the electromagnetic lock which results in unlocking door and the status of door shown on LCD screen.

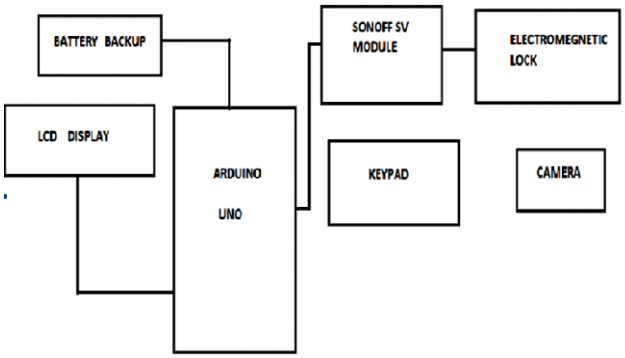

Fig. 6. Block diagram of Module1 security system

If system faces problem of a power cut, it has a back up for it. It gets switched from the main supply to the power backup devices which further provide the power to the security system.

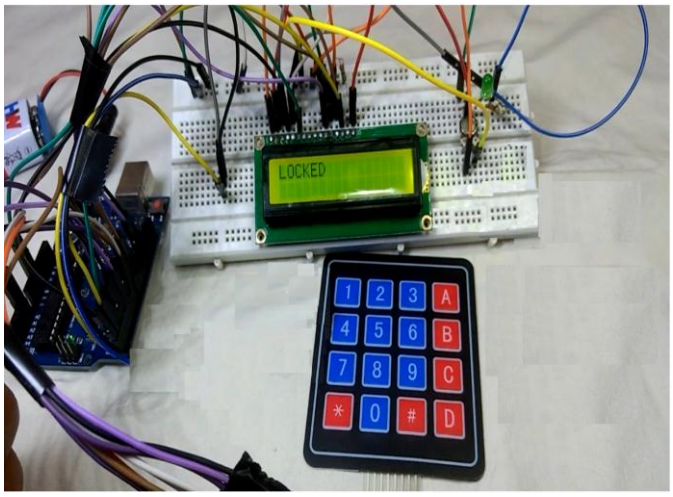

Fig. 7. Implementation of Module1 Security System

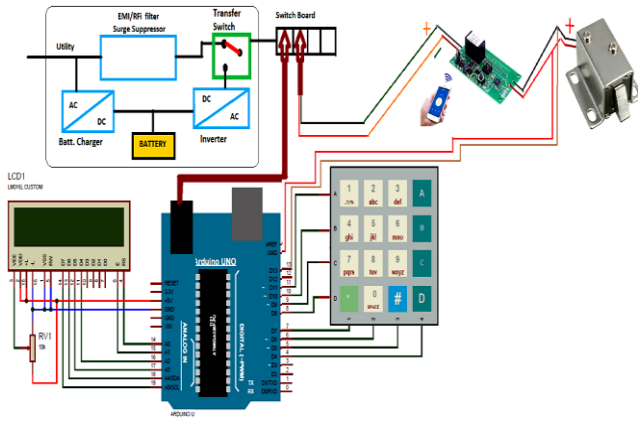

Fig. 8. Circuit diagram of Module1 Security System

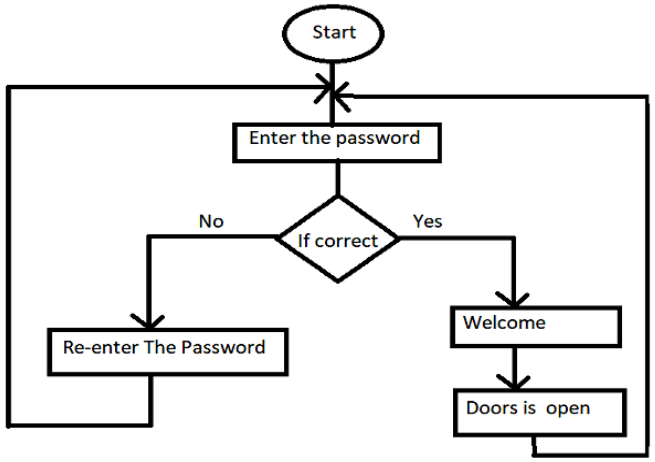

Fig. 9. Working flow diagram of Module1 Security System

B. Module2 Security System

The second module is implemented only in case this system is activated by the residence and when all members away from home. Block diagram of module2 security system shown in Fig. 10. After activation of second module it works in parallel to first module by giving enhanced security with PIR motion detector, buzzer for raising alarm, GSM module for sending alert message, camera for capturing image, so as to warn members of home regarding any intrusion trying to intrude.

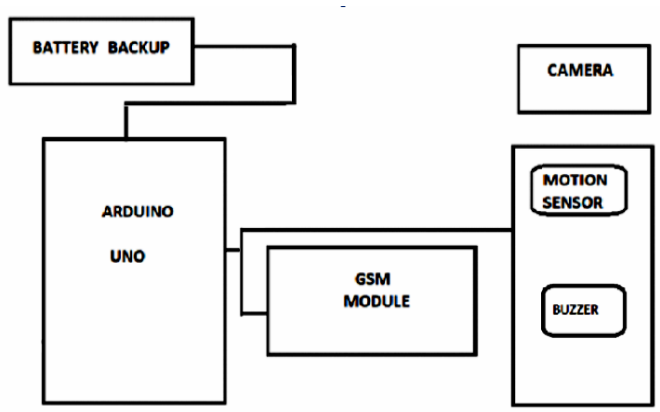

Fig. 10. Block diagram of Module2 Security System

A PIR motion sensor generate signal when an interrupt (warm-blooded animal) hurdle in front of it. After detecting interrupt it raises alarm and passes a signal to the GSM module. GSM module sends the signal to the phone application by using the network. Then the user receives the alert notification and checks the interrupt by a camera.

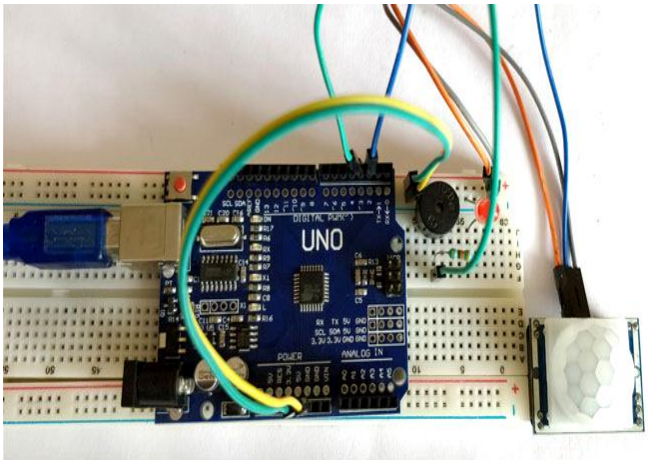

Fig. 11. Implementation of Module2 Security System

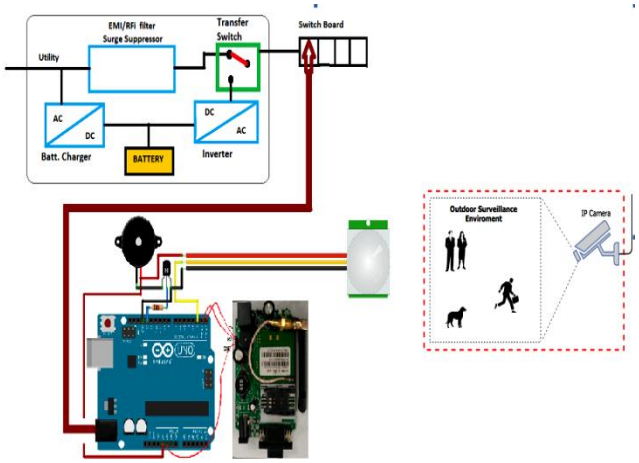

Fig. 12. Circuit diagram of Module2 Security System

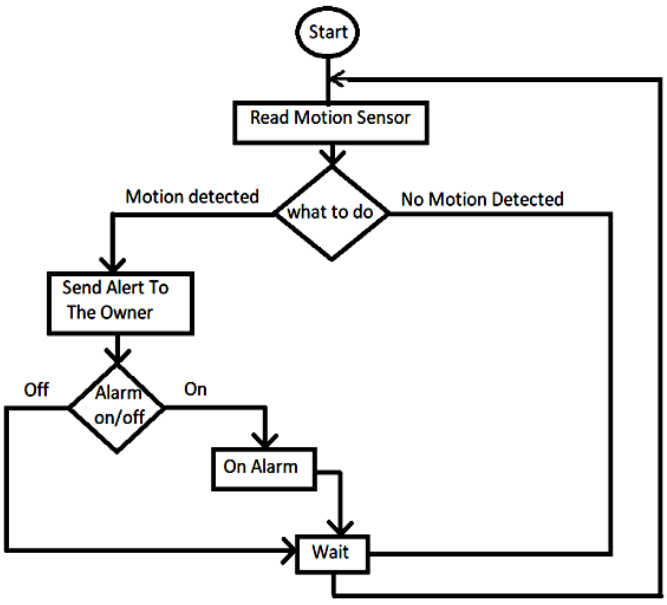

Fig. 13. Working flow diagram of Module2 Security System

C. Software Design

The phone Application helps to control the home security lock according to the user requirement. It is a smart security that manages all door lock through the application. It lets app to flip the switches for locking-unlocking electromagnetic lock.

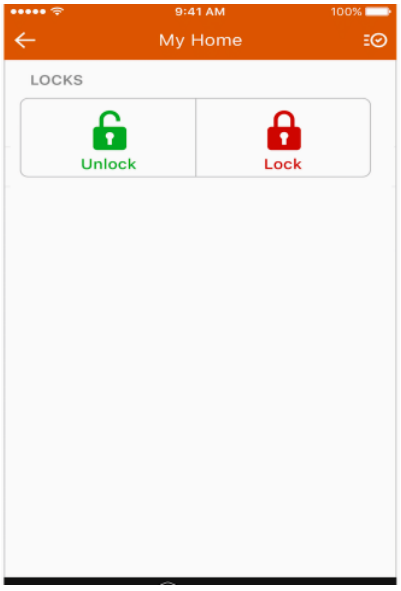

Fig. 14. Mobile user interface for Smart Home Security System

IV. ADVANTAGES

Protect Valuable is the most important benefits of the security system. In many case we lost our many valuable things due to home invasion. A home security has an alarm that scares off many unwanted things and can notify on phone application if someone tries to break-in. Remote surveillance allows you to remotely access to home security system at any hour of the day, from any location. Individual can monitors what happens via cameras through phone as well as lock door and other devices also. With a home surveillance, don't need to worry about home safety.

In case of a power failure if problem arise the security system has a backup plan for it and which provide the backup power after the power failure.

V. FUTURE PROSPECT

Smart home security system is more efficient than the traditional method of the door locking system which helps to regulate your security according to user convenience to monitor and controlling authorized entry inside home. If above security system integrated with internet connectivity through ZigBee module it will help to monitor intrusion remotely from anywhere. Somewhere we can implement this system to work on real time processing for providing the live recording with camera. System is easy to extend further with different modules and various sensors as per requirement of home.

VI. CONCLUSION

This security system has generic concept and implementation with effective GSM to notify users with message with raising alarm. It meets the secure technological security advancement. Used in anywhere or any place like organization, banks, home or many place. This approach improves the working of the security system in many worst cases like power failure and likely to enhanced security levels for securing and monitoring.

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