

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/301675752>

# Smart Home Security System Based on Microcontroller Using Internet and Android Smartphone

Conference Paper · June 2015

CITATIONS

3

READS

14,944

2 authors:



**Md. Hanif Ali Sohag**

University of Saskatchewan

18 PUBLICATIONS 91 CITATIONS

[SEE PROFILE](#)



**Md Asif Ahamed**

Bangladesh Telecommunications Company Limited

12 PUBLICATIONS 89 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



An accurate and efficient solar tracking system using image processing and LDR sensor [View project](#)



Embedded System [View project](#)

# Smart Home Security System Based on Microcontroller Using Internet and Android Smartphone

Md. Hanif Ali Sohag

Department of Electrical and Electronic Engineering  
Khulna University of Engineering & Technology  
Khulna-9203, Bangladesh  
hanifalisohag@gmail.com

Md. Asif Ahamed

Department of Electrical and Electronic Engineering  
Khulna University of Engineering & Technology  
Khulna-9203, Bangladesh  
asif.fx@live.com

**Abstract**— Home security has become a prime concern in recent years. As the technology is emerging every second, abundant home based security systems have been developing and implementing with many modern features to keep the home safe. This paper presents design and prototype implementation of a home security system that makes home security more convenient, flexible, and less expensive. The system is based on microcontroller, which assists in ensuring residential security. This system includes a PIR sensor, an android application, a microcontroller (ATmega8), a Bluetooth module (HC-05) and a cloud-based application which readily endow the users the ability to monitor their home in real-time from anywhere via the Internet. This system also provides an alarm facility. We developed an android application, which is able to connect to the cloud server and send or receive data by checking the door status and occurrence of motion. User can easily be connected to the system and will be notified through the android application running on the user's phone and via SMS. The application also includes a logging facility, which ensures only authorized users to check the home status. We tested the application on android version 4.2.

**Keywords**— *Android; PIR Sensor; Microcontroller; Server; Bluetooth*

## I. INTRODUCTION

Smartphones are becoming more and more popular around the world because it combines the features of a mobile phone with other features, such as GPS navigation unit, web browsing, Wi-Fi, and 3rd-party apps. Among smartphones, Android smartphones are becoming so popular nowadays. Currently, Android operating system dominates about 81% of world smartphone market. Prevention of crime by using android smartphone is one of the goals of this research.

Crime is increasing day by day and people have less time to spend at their houses. Now it has become a matter of great concern. While remaining in outside, people become tensed about their house safety. For this nowadays, security guard has become a common figure for home maintenance. This paper presents a smart home security system, which can prevent crime like robbery, kidnapping, murder etc. Nowadays many people have more than one android mobile because of various

facilities and low cost of android devices. By this system, they can utilize their old unused android phone for home security. In this system, user will get real-time status of his house weathers it is secured or not and any unwanted motion occurred in the house can be detected by the PIR sensor [1]. This system also includes a facility of anti-theft door security system [2]. If anyone enters in the house, an alarm will be on and both a message and a notification will be send to the user's phone [8]. For being notified, user needs to install an application in his android smartphone, which communicates with a cloud server. By using this smart home security system, user can be alerted any time weather staying anywhere in the world [7].

## II. SYSTEM OVERVIEW

The system has the following features:

1. **Internet Based:** By this system, user can get notification by using the android application. The system is independent of fixed IP address. So that, the user can easily be connected to the system.
2. **SMS Based:** In case of internet connection failure, user will be notified through SMS.
3. **Low Cost:** The price of the components of this system is low. It can be constructed with 1361 BDT.
4. **Very short response time:** The system takes less than a second to give notification or SMS.
5. **Wide area coverage:** As the system is based on internet, it can be accessed from anywhere.
6. **User-friendly interface:** This system offers user-friendly interface. Anyone having little knowledge on android can use this system.

## III. WORKING PRINCIPLE

This system includes two Android smart phone, a Microcontroller (ATmega8), a Bluetooth module (HC-05), a PIR sensor (HC-SR501), a Security Alarm, a Cloud-based application and an android application. The Android has two sides and they are Device side and user side.

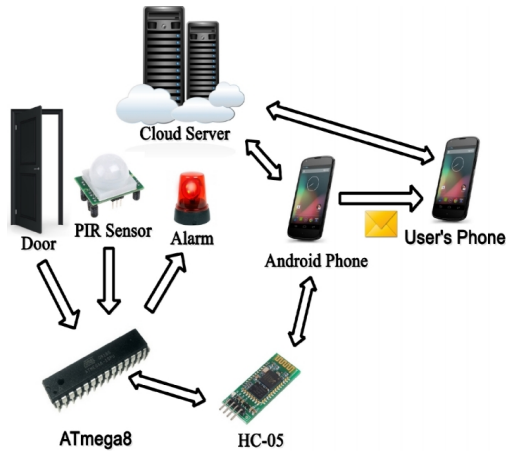


Fig. 1. Operational diagram of the system.

The working steps are given bellow.

1. The process starts in two situation, one when any one enters in the house by the front door and another when any unwanted movement is detected in the house by PIR sensor. This sends a signal to microcontroller [1].
  2. Then microcontroller turns on the alarm through the relay [4] and sends a signal to the Bluetooth module.
  3. Bluetooth module receives the signal from the microcontroller. Through Bluetooth module [5], the signal goes to the android device.
  4. There is an application in android device, which sends a data to a particular cloud server. At the same time, it sends a message to the user's phone [3].
  5. In the server, there is a website and a cloud based application. Server sends a data to the user's android phone.
  6. In user's phone, there will be an application that receives the data from the server. Then the application gives a notification to user.
- User can check the status of his house through the application at any time. For this privilege, an active data connection is required in user's phone. By this user can also get the time of occurrence of the incident.

#### IV. FUNCTIONAL BLOCK DIAGRAM

Based on the working principle described in section II, Fig.2 shows the functional block diagram of the entire system.

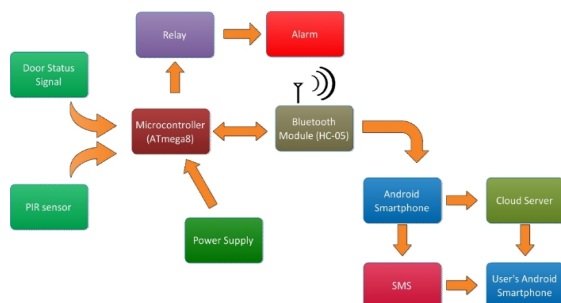


Fig. 2. Functional block diagram of the system.

#### V. HARDWARE DESIGN AND IMPLEMENTATION

The key hardware components that make up the smart home security system are android Smartphone and the Microcontroller Board. Other components are Bluetooth module, PIR sensor, Relay, Alarm and Door state detection output. These components are connected to the Microcontroller board. We have implemented the code in C programming language by using WinAVR.

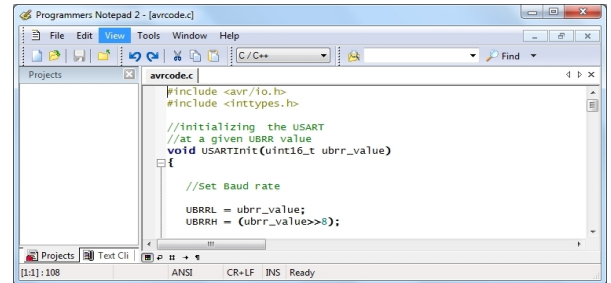


Fig. 3. Code of microcontroller program using WinAVR.

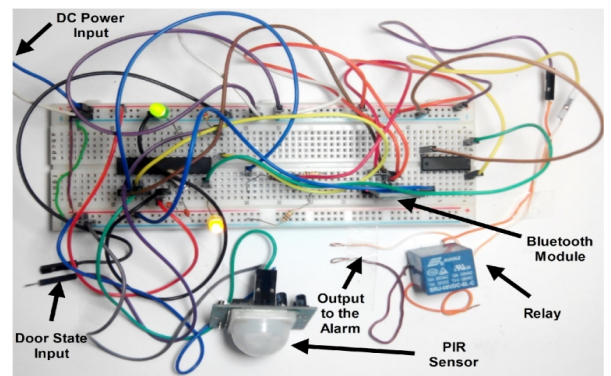


Fig. 4. Experimental setup of the microcontroller board.

##### A. Microcontroller Board

An ATmega8 microcontroller does the total operation. A Bluetooth module (HC-05) is connected to the microcontroller, which communicates with the android device. Microcontroller gets data form the door state detection output pin, and the PIR sensor (HC-SR501) output pin. PIR sensor gives a signal to the microcontroller when any motion is detected [1]. The relay triggers the alarm by taking the output from the microcontroller.

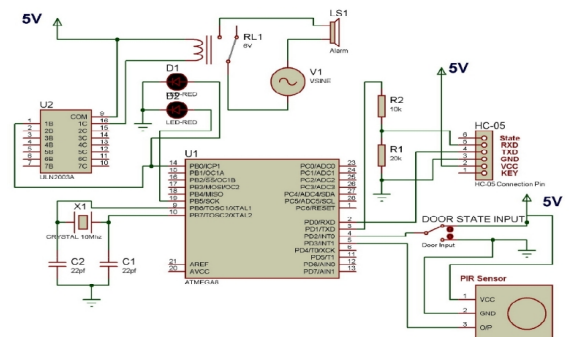


Fig. 5. Circuit diagram of the microcontroller board.

## B. Power Supply

A 5V regulated power supply gives power to the microcontroller board.

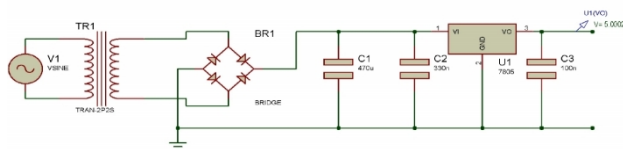


Fig. 6. Regulated power supply.

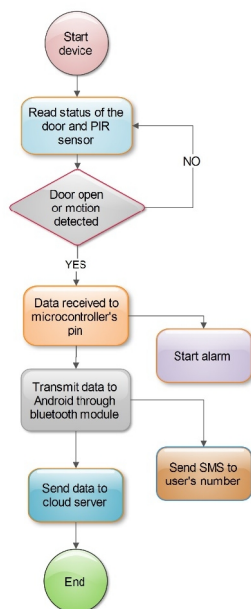
## VI. SOFTWARE DESIGN AND IMPLEMENTATION

There are several platforms for developing smartphone applications such as Windows Mobile, Symbian, iOS and Android. Android platform being truly open and users can easily customized the tools of it and develop the applications according to their needs, we developed the application in Android platform. The Android SDK provides a wide range of useful libraries, tools, and APIs necessary to develop applications on the Android platform using the Java programming language. We use Android Software Development Kit (SDK) for developing the application of smart home security system.

Working procedures of the two sides of the android application is illustrated in figure 7. When the application executes the monitoring system, a homepage will be presented to the user with the following options,

- Device side
- User's side

Device Side Flowchart



User Side Flowchart

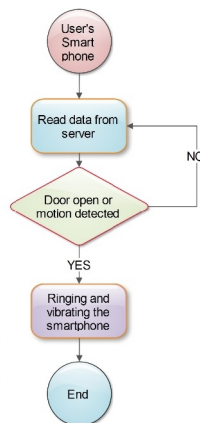
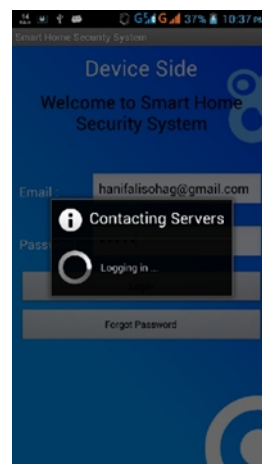


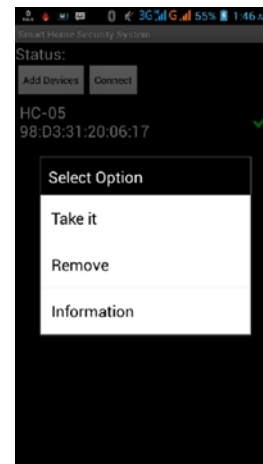
Fig. 7. Flowchart of the user and device side.

## A. Android Application's Device Side

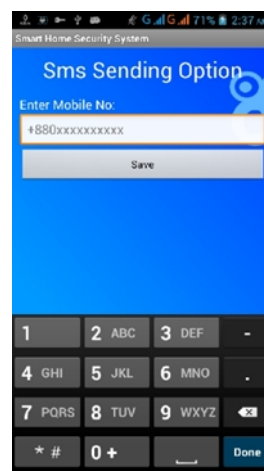
In the device side part of the android application, logging facility is included for the authentication of user. The user has to start the system by entering the correct email address and password in the starting activity of the device side. If both the fields are correct then the user will be displayed the Bluetooth connectivity activity and has to choose the proper Bluetooth module (such as HC-05) and connect the android phone with the Bluetooth module. The user also has to enter his mobile number where the SMS will be sent [6]. Now the system is ready for reading data from the microcontroller through the Bluetooth module [5]. When the application reads door status "Door Close" and PIR sensor status "Motion not detected" it will not send data to the cloud server.



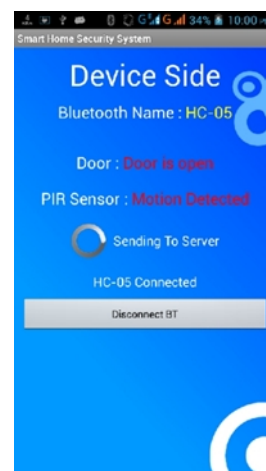
(a)



(b)



(c)



(d)

Fig. 8. Screen shots of some processes, (a) Logging to server (b) Connecting to Bluetooth Module (HC-05) (c) Adding users mobile number for sending sms (d) Sending data to the server.

But when it will read "Door Open" or "Motion Detected" it instantly send the data to the cloud server. The screenshots of the device side part of the Smart Home Security System application is shown in Figure 8.

### B. Android Application's User's Side

In the user's side part of the android application, logging and registration facility is provided for the user. The user must have to register for the first time to start the system. After successful registration, the user has to enter the correct email id and password to log in the cloud server through the Android application. If everything goes well a screen with the status of the door and PIR sensor reading will be displayed. Then to check the safety status of the home the user has to click the button "Start Checking." Then the application will continuously retrieve data from the cloud server with a definite interval and show the current status of the home to the user. If the home status is secure, the background of the Android application will be green.

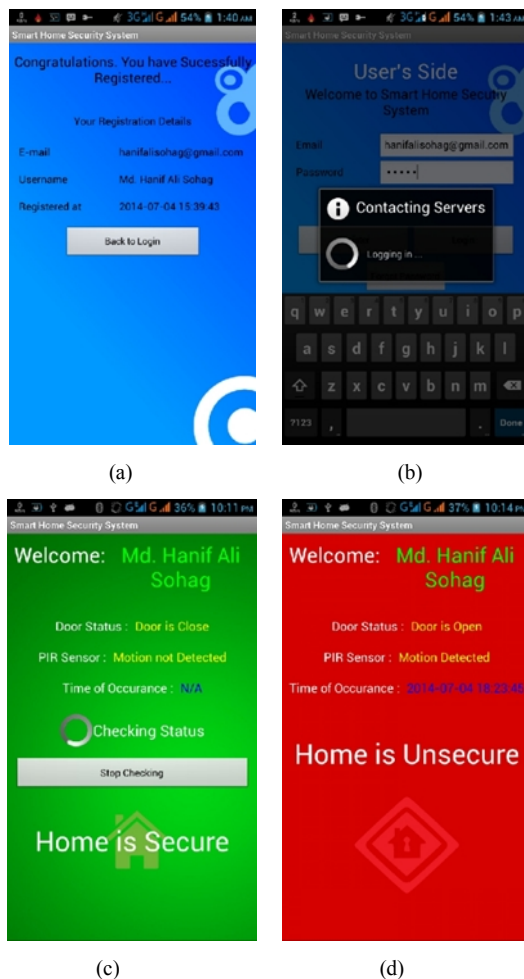


Fig. 9. Screen shots of some processes, (a) Registration to the server (b) Logging to the server (c) Home is secure (d) Home is unsecure.

But if the home status becomes unsecure, the android application background will be red and the smartphone begins to vibrate and ringing. By this way, the user will be informed of the home status and can take proper steps to ensure the safety of the home.

### C. Web Development

The web development is the main part of the system. It maintains all the communication to the user and the server. The web development consists of three parts.

1) *Connection to the MySQL server:-* MySQL is done by using PHP script. The first thing is to connect to the MySQL server. The connection to MySQL server is done using the function `mysql_connect()`. This function returns a resource which is a pointer to the database connection. The `mysql_connect()` function takes three arguments, Server, username, and password. Passing the correct arguments to the function, there will be a successful connection to the MySQL server. After establishing the connection to the server, the required database is selected using the function `mysql_select_db()`. The connection opened in a script will be closed as soon as the execution of the script ends. The connection can also be closed by calling `mysql_close()` function.

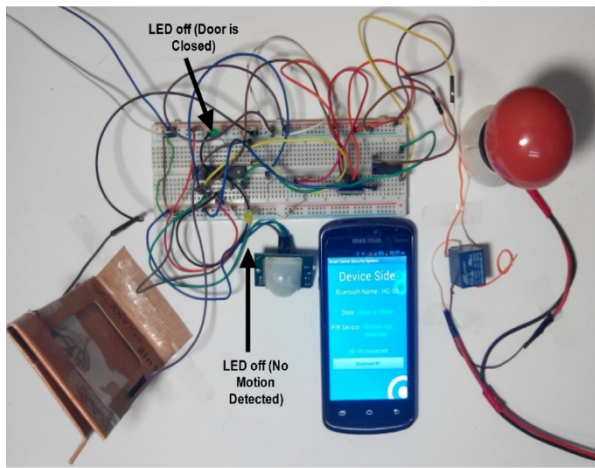
2) *Inserting and updating data to the MySQL database:* A MySQL query with the "INSERT INTO" syntax is used for inserting data to the database. The android application send the data to the PHP script using the POST method and then the data is inserted into the database. Data is updated into MySQL tables by executing SQL "UPDATE" statement through the PHP function `mysql_query()`.

3) *Retrieving data from the MySQL database:* The function used to perform queries is named `mysql_query()`. This function returns a resource that contains the results of the query, called the result set. To examine the result we're going to use the `mysql_fetch_array()` function, which returns the results row by row. In the case of a query that doesn't return results, the resource that the function returns is simply a value true or false. The android app can't read the data from the PHP script like this way. So we need to use JSON format so that the android application can retrieve the data easily and it is done using the function `json_encode($result_array)`. follows.

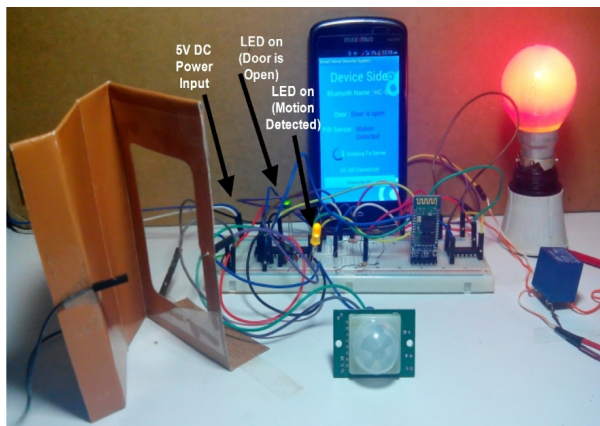
## VII. DEVELOPED PROTOTYPE

Fig. 10 shows the developed prototype of the smart home security system. In microcontroller board there are two LED green and yellow which indicates the status of the door and motion detected by the PIR sensor. Green LED remains off if door is closed and Yellow LED remains of when no motion is detected by the PIR sensor. When any of the LED is on application on android phone will send data to the server and a SMS to the user's phone. A Red bulb is used as alarm indicator, which is connected to the ac supply and it will become on the home is unsecured.





(a)



(b)

Fig. 10. Developed prototype of the smart home security system, (a) Door is closed and no motion is detected, (b) Door is open and motion is detected by the PIR sensor.

### VIII. COST ANALYSIS

The cost of the components of this system is given below,

TABLE I. COST OF THE COMPONENTS

Name	Quantity	Price (BDT)
ATmega8A	1	106
PIR Sensor Module (HC-SR501)	1	185
Bluetooth Module(HC-05)	1	620
Alarm	1	200
IC(ULN2003a)	1	20
Relay	1	30
Other Components	1	200

Now, various home security systems are available but they are costly. The price of the security systems available in the market similar to this system is about 15000 BDT. The cost of this system is only 1361 BDT. Now the lowest price of an android phone is about 4000 BDT. User can also utilize their old android phone by using this system.

### IX. CONCLUSION

In this paper, we present the design and implementation of a smart home security system based on microcontroller using internet and Android smartphone. The system is capable of monitoring the home from any part of the world via internet. The system has a friendly user interface and all the required expectations and objectives have been achieved. The system requires an Android phone having a minimum API level 10. As android phone is now available to almost all the users, the system can easily be implemented within a very low cost. Users can also utilize their old android phone by this system. The system is tested on Android operating system 4.2 and desired result has been achieved. In comparison with the current existing devices in home security application, this design features high-speed response in real-time mode, remote monitoring support, cost effective and compactness.

### REFERENCES

- [1] Z. I. Chowdhury, M. H. Imtiaz, M. M. Azam, M. R. A. Sumi and N. S. Nur "Design and Implementation of Pyroelectric Infrared Sensor Based Security System Using Microcontroller," in Students' Technology Symposium (TechSym), IIT Kharagpur, pp- 1-5, January-2011.
- [2] V. M. Ibrahim and A. A. Victor "Microcontroller Based Anti-theft Security System Using GSM Networks with Text Message as Feedback," International Journal of Engineering Research and Development, vol-2, no-10, pp 18-22, August 2012.
- [3] S. Panth and M. Jivani "Home Automation System (HAS) using Android for Mobile Phone," International Journal of Electronics and Computer Science Engineering, ISSN 2277-1956, vol-3, No-1, 2014.
- [4] R.K. Rajput, "Power System Engineering" in Firewall Media, pp 271-350, 2006.
- [5] F. R. M. Rashidi, M. H. Ariff and M. Z. Ibrahim, "Car Monitoring using Bluetooth Security System," in International Conference on Electrical, Control and Computer Engineering, Pahang, Malaysia, pp 424-428, June 2011.
- [6] H. ElKamchouchi and A. ElShafee, "Design and Prototype Implementation of SMS Based Home Automation System," in IEEE International Conference on Electronics Design, Systems and Applications (ICEDSA), Control and Computer Engineering, Kuala Lumpur, pp 162-167, November 2012.
- [7] Y. Zhang, G. Zhao and Y. Zhang, "A Smart Home Security System Based on 3G," in international Forum on Computer Science-Technology and Applications (IFCSTA), Chongqing, pp 291-294, December 2009.
- [8] Y. Zhao and Z. Ye, "A Low Cost GSM/GPRS Based Wireless Home Security System," IEEE Transactions on Consumer Electronics, vol-54, no-2, pp 567-572, May 2008.