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Design and Development of Low Cost Wi-Fi Module Based Home Security system

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Abstract: Now a day we are very much concerned about our home and valuable things. Users require intelligent home with minimum human effort. The invention of digital and wireless technology made the automated security system more intelligent. This paper details the design and development of security system in home and offices using ESP8266 Wi-Fi module used as a Wi-Fi shield to LPC1769. This system consists of sensors which provide users the current status of their home, this system also provide fingerprint based door controlling system in a single android app. PIR sensor, gas sensor, temperature sensor and humidity sensor are the sensors which are used to monitor the status of our home. These sensors gather data of our home and then these data are transmitted to freely available server Thingspeak from where it is read out by the mobile android app. Similarly, mobile android app controls the door based on the fingerprint to open the door. As the system uses wireless fidelity it provides worldwide monitoring and control.

Keywords: - Home security, Wifi, LPC1769, Android smart phone, Web server, HTTP.

I. INTRODUCTION

With the rapid development of Wireless technology and the improvement in people's living standard, smart home services will not be constrained to household space rather the reach of these services will be out of geographical constraints. Smart home security system can be used to realize real-time monitoring of home security status and manage house door using mobile phone. Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real world objects (things) through the Internet [2].

The rapid growth in mobile communications have introduced a technological step forward in home automation. Wireless networks (3G, 4G, Wi-Fi) and smart devices, with wireless communication interfaces (Bluetooth, ZigBee, Wi-Fi), are omnipresent, and allow the user to take home control and building automation to the next level.

The main objective of the project is to build a WSN(wireless sensor node) with the help of Wi-Fi, which monitors the home security with sensors that provide the current status of our home. If there is any gas leakage, Fire or intruder enters into our home these sensors keep eye on these parameters and if something disaster happens user will obtain the notification in their phone. Moreover, we have provided a finger print based security door so that only authorized person can open or close the door from anywhere. So this provide an ease to user to open their door without directly going towards the room by sitting somewhere else user can control the door.

II. METHODOLOGY

The home security system includes mobile phone which act as main monitoring and controlling device, wireless communication system, sensors, thingspeak server.

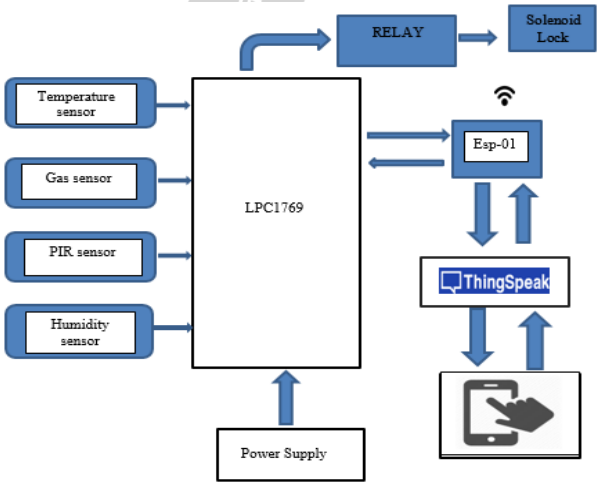

Fig. 1.Block diagram of proposed system

A login ID and password is provided so that only authorized user can use it. The controller gathers the sensors value based on which we are obtaining status of our home. Controller uploads this gathered sensor value and controller also check the updated value of server from the monitoring and control device. The server we have used is a free server which is ThingSpeak server. Based on that

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updated value of server our door lock will be opened and closed.

Server and hardware module is connected as a network infrastructure using Wi-Fi technology. The reason for Wi-Fi selection is it provide improve system security (by using secure Wi-Fi connection), and to increase system mobility and scalability.

III. SOFTWARE

Mainly three software is used to complete the entire project work.

3.1 Android Studio

The Android application is designed using Android studio. Android is an open-source development platform for creating mobile applications. Android applications consist of closely coupled components, bound by an application manifest that describes each component and how they all interact, as well as the application metadata including its hardware and platform requirements. These components are activities, services, content providers, intents, broadcast, widgets and notifications.

The Android application opens to a login screen consisting of fields for username and password and a login button. For secure access a password is used. On pressing the login button the data entered in fields will be matched with the password provided in the database. If the username and password matches with the data in the database, access will be provided and the user will be logged in. Once the user logged in, next is option whether user want to monitor the sensor data or control the door as shown in figure 2. The user can select any one option by clicking on it. Once an option is selected if sensors option is selected user can monitor the sensor value and when an unwanted situation occurs user will get a notification. If the door option is selected by using over fingerprint user can control the door state. This fingerprint can be used to switch open and close the door.

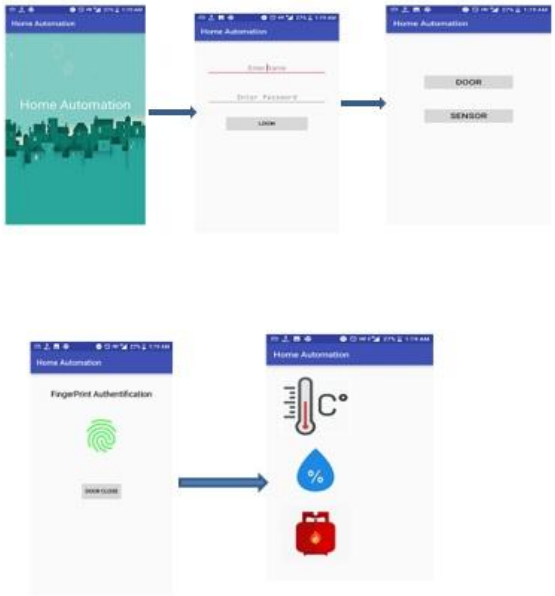

Fig.2.Android Application

3.2 LPCXpresso 7.3.0

LPCXpresso gives developers a low-cost, feature-rich development toolchain. LPCXpresso IDE gives developers a way to create high uality applications for LPC Microcontroller. LPCXpresso development tool platform is available from NXP. This is a complete embedded C/C++ integrated development platform.

These boards mainly used for point for LPC Cortex-M MCU based projects, provide easy-to-use and practical development hardware. A Workspace is created which is simply a directory that is used to store the project. Multiple projects can save in a single workspace, and can have multiple workspaces on a computer. Only single workspace can access at a time through the LPCXpresso IDE, although it is possible to run multiple instances in parallel with each instance accessing a different workspace.

LPCXpresso tool is used for building c code. Then the generated hex file is burned into LPC1769 using Flash magic tool through a USB COM port.

3.3 ThingSpeak

ThingSpeak is an open source "Internet of Things" platform to store and retrieve data using HTTP over internet. Sensor data can be sent to ThingSpeak from microcontroller. With the help of thing speak data analysis is made easier. Data from microcontroller to android app and vicevesra is obtained through this ThingSpeak platform. Data are retrieved and transmitted by making a TCP connection. API keys enable to write data to a channel or read data from a private channel. API keys are auto-generated when you create a new channel.

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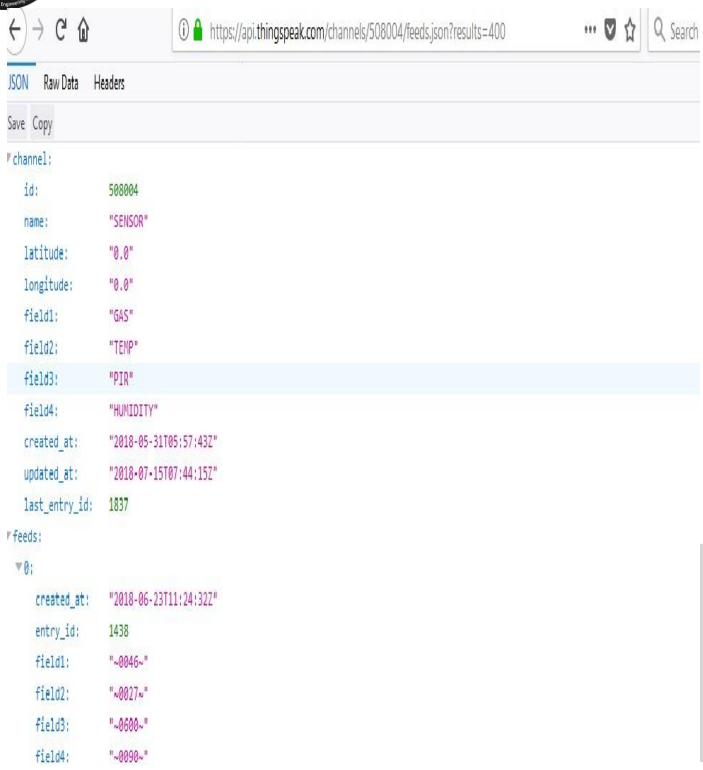

Fig.3.ThingSpeak channel data in Json format

IV. ALGORITHM

Fig 4 shows the flowchart for the embedded system. The Lpc1769 initializes the required UARTs. Then the LPC and Wi-Fi module are set to the same baud rate. We are configuring Wi-Fi module by sending AT commands. We try to establish connection between Wi-Fi module and internet by TCP protocol using HTTP request by sending a command with a link containing URL of server. The code will jump into continuous loop when the server is linked.

The basic communications that take place in the system is the microcontroller gathers the sensors value and interacts with the web server repeatedly over a fixed interval of time and upload these sensor value, it also checks for any updates from our android app to lock or unlock door. If a user logs in to the android application, he can monitor the home status under his ownership and change its status.

Once the timer interrupt is updated by the microcontroller, a flag will be set by the controller. The microcontroller will be continuously checking this flag. When it reads the flag status as set, the microcontroller will upload the sensor value to the server. Also it will be checking for any update from android app This update will be received in JSON format. The embedded software will decode the JSON encoded data. Then it will send control signals to the output ports to make the corresponding changes to the door lock.

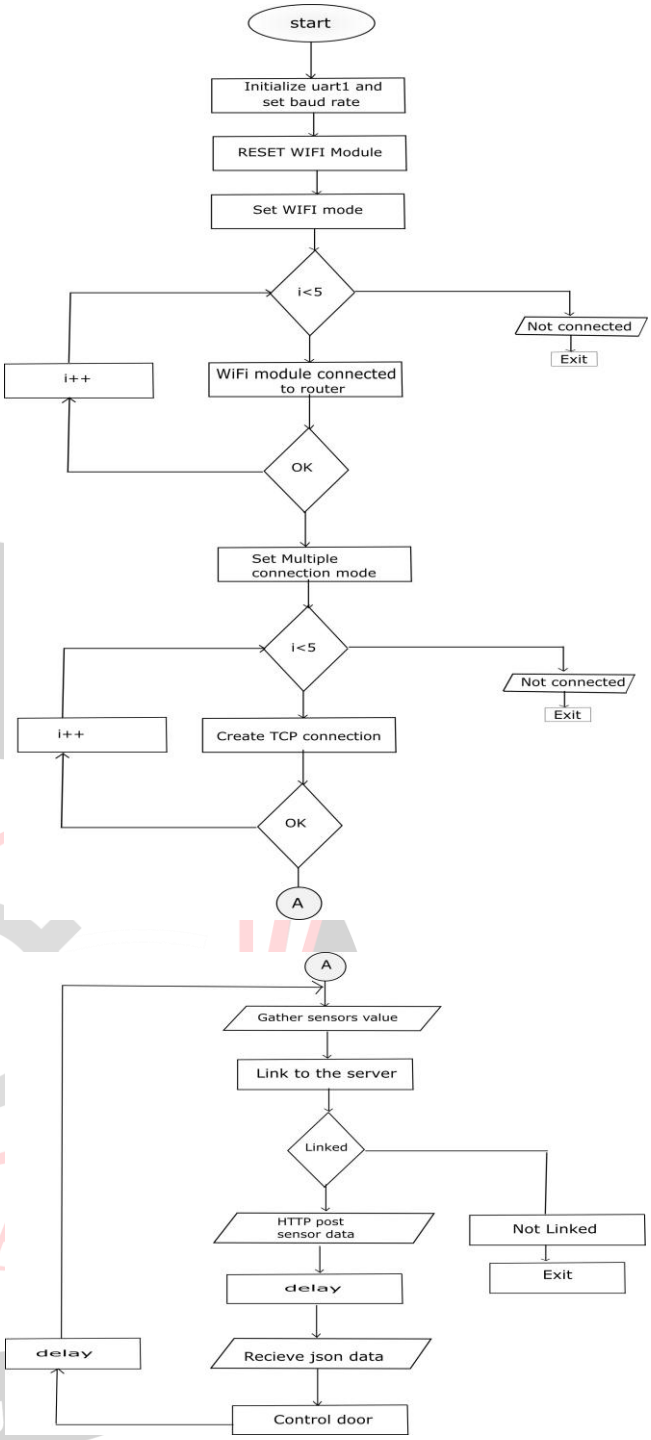

Fig.4. Flow chart of embedded system

V. HARDWARE IMPLEMENTATION

ARM Cortex-M3 processor based LPC1769 microcontroller is used in this project. LPC1769 microcontroller functions at a frequency of 120MHz. The sensor and door status are transmitted from/to microcontroller to/from ESP-01 module using UART(universal asynchronous receiver / transmitter) communication protocol.

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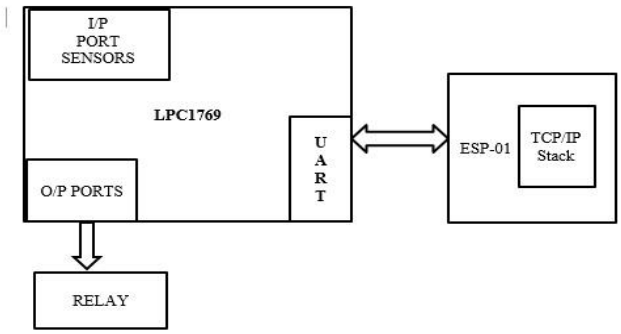

Fig. 5. Hardware block diagram

By using UART communication with ESP-01 and microcontroller, microcontroller obtain a Wi-Fi access. For communication to work properly both device has to manage same baud rate. Transmission speed in asynchronous communication is measured by baud rate. We are transmitting AT commands to make a TCP connection between the ThingSpeak and Wi-Fi module. First we checked the AT commands transmission and reception in PC using a terminal program docklight by connecting UART port of LPC1769. There is in built UART on LPC1769 trainer kit and we used an FT232 USB to serial UART interface for monitoring correct transmission.

VI. Experiment Results

Wi-Fi based wireless sensor node is implemented using LPC1769 and ESP8266-01 Wi-Fi module used as Wi-Fi shield. HOME security system provide status of Fire, any gas leakage status, intruder motion detection and these data are transferred to a free web server thingspeak. When something unusual happens a notification will be obtained and we can monitor these values in a mobile app created by android studio. in android app. By using this android app it is possible to control the door using our fingerprint based on the data send from our mobile to server corresponding to which relay switches.

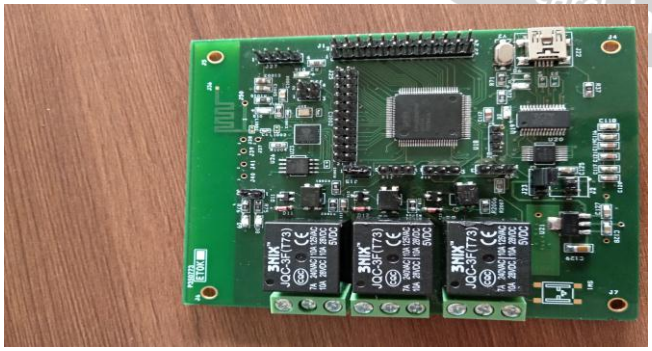

Fig.6. LPC1769 with relay interfaced on single board.

Fig 8 shows sensors connected with a LPC board. Temperature, gas, humidity and PIR sensor values are measured and communicated to LPC1769.These data are send to server through Wi-Fi module. LPC1769 communicate with Wi-Fi module using AT commands. The AT commands send to LPC1769 is shown in figure 7

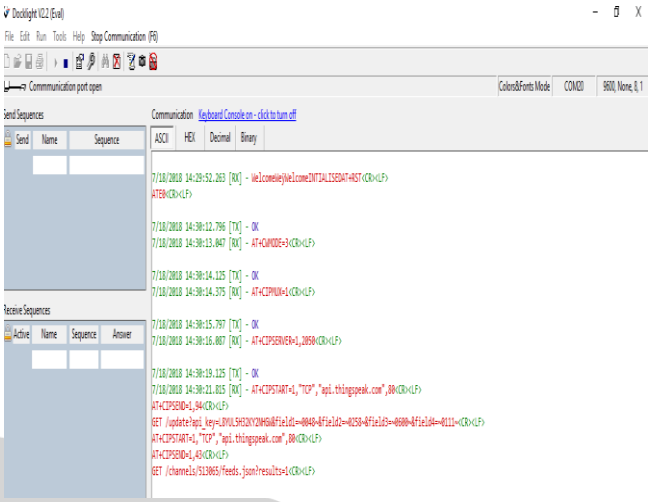

Fig.7. AT commands

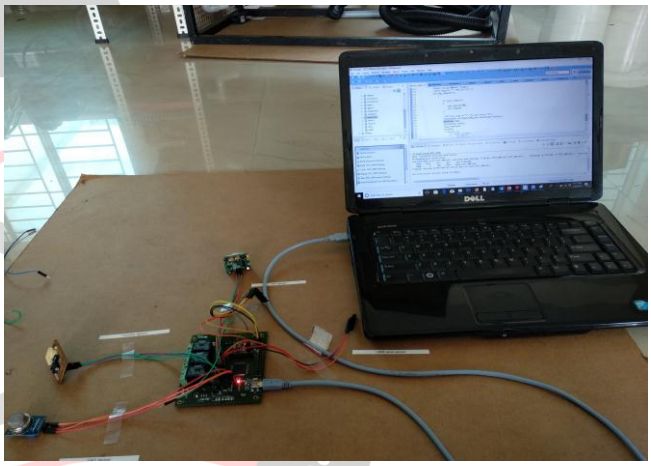

Fig. 8. Home security system with sensors.

These sensors value are send to ThingSpeak server using HTTP protocol by keeping ESP-01 module as Wi-Fi shield. Mobile phone android app build in android studio reads this sensor value and display it for monitoring and gives a notification if sensor value increases above a threshold which is shown in Fig.9

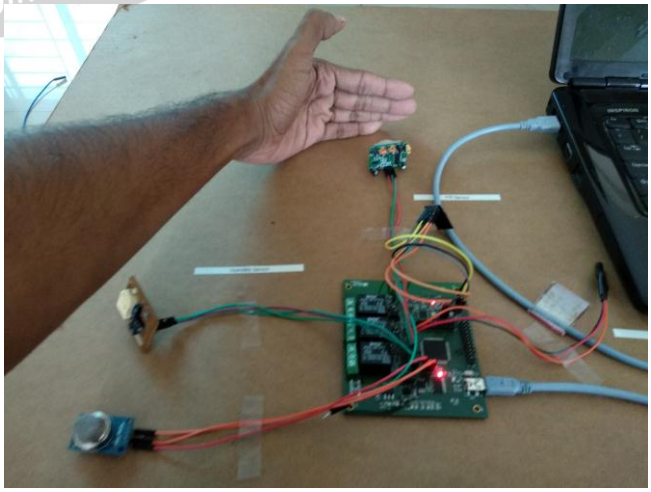

Fig.9. When motion detected

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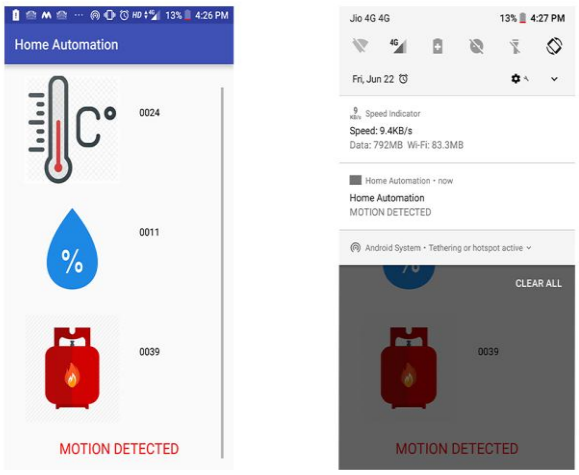

Fig. 10. The sensors value and notification when motion detected.

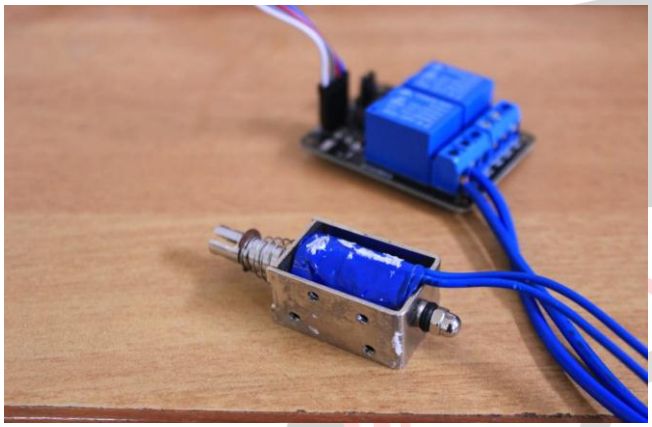

Fig.11.Solenoid tested as solenoid door

VII. CONCLUSION

While the initial objective of the home security was to monitor the current status of our home and keep it save from any unwanted disasters. This paper proposes a system with low cost, more security, remotely monitoring and controlled solution. The method discussed in the paper has achieved the target to monitor our home status remotely in a mobile app and provide a fingerprint based door lock using the Wi-Fi technology to connects system parts, satisfying user needs and requirements. The mobile android app is user friendly which can be used by any one. Home security system with Wi-Fi technology has proved to be controlled and monitored remotely and is cost-effective as compared to the previously existing systems.

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