

Design of IoT based Smart Home Security System using Arduino

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Abstract—The project presents a versatile security and alarm system which can be used by individuals, corporations and establishments which require a cheap but reliable security system. The idea behind this project is to provide its users with a simple, fast and reliable way to get help during emergency situations. The device can be placed at any remote location which can be easily accessed by the user. It uses a microcontroller for system control, GSM technology for communication and sends SMS containing the emergency message and Wi-Fi module for sending the data to webpage. The project consist of an Arduino, GSM module, Wi-Fi module to send the data to webpage.

Key words: Arduino, GSM, Wi-Fi

I. INTRODUCTION

Smart home security system is a project that deals with automatic threat detection in home. When the temperature, humidity and soil moisture value reach the particular threshold a security message will be sent to the registered mobile number. Same will happen if any physical threat occurs like as break the door. Temperature, humidity, soil moisture and interruption values continuously uploaded on the web page in every 90 seconds.

II. RELATED WORK

This section gives the work done earlier in this field. A GSM based home automation system has a very low cost of installation and maintenance [1]. It is also very flexible and durable. An advantage of such a system is that there is no risk of it being hacked since it involves only a mobile network [1]. However, these systems involve daily operation costs as the user has to pay for each SMS [1]. So, researchers are trying to simplify the systems and minimize costs of installation and maintenance. Several SMS based home security systems were developed in [1], [2], [3], [4]. In [1], microcontroller AT89C55 has been interfaced with GSM module through RS-232 communication protocol for interaction between the user's mobile phone and the security system. Rozita, Walah, Chan and Mok in [2], developed a full control home based automation system using PIC16F887 microcontroller which was integrated with GSM module communicating at a baud rate of 9600 bps. Another such system was developed in [3], where a GSM module was interfaced with a desktop computer. Here, clients were connected to the computer through Wi-Fi access points and the home appliances have wired connection to the computer. Md. Shafiul Islam in [4] used PIC18F452 microcontroller to monitor doors and windows of a home which could be accessed only by entering the proper ID.

III. COMPONENTS

The overall system contains a lot of different functional units which combine together and interact with each other to provide the total functionality of a security system.

These different components are combined as follows to provide the total functionality.

- Arduino and GSM Module are put in the same box along with Wi-Fi module called as device along with a push-button. They are wired together to be installed at the users preferred location and define the hardware of the system.
- Open IoT platform “thingspeak”.

A. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

B. GSM SIM800A

This is an ultra-compact and reliable wireless module. The SIM800A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications Featuring an industry-standard interface, the SIM800A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mmx24mmx3mm, SIM800A can fit in almost all the space requirements in user applications, especially for slim and compact demand of design.

C. WI-FI Module

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

D. Open IOT Platform

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data

posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.

IV. SYSTEM DESCRIPTION

As mentioned earlier, our project is the sum total of the components: Arduino, GSM Module, Wi-Fi module and an open IOT platform. The individual working of each components and their integration can be technically broken down into the following subtasks:

- The Arduino and GSM module communicate with each other through USART communication
- The Arduino sends an SMS using the GSM module on occurrence of any threat condition.
- Every sensor output data continuously uploaded in every 90 seconds on the web page server (Thingspeak) using Wi-Fi module.

V. DESIGN PROCEDURE

A. Microcontroller and GSM Module Interfacing

Arduino consist microcontroller Atmega 328/128P. The microcontroller Atmega328P and the GSM Module SIM800A are connected to intercommunicate via the USART device present in the Atmega16 chip. The Rx (PDO) and Tx (PD1) pins of Atmega16 are connected to the Tx and Rx of the GSM Module respectively.

B. Interfacing of WI-FI module with arduino

The ESP8266 is a low-cost Serial-to-Wi-Fi module that interfaces nicely to any microcontroller. However, a word of caution -- it is highly undocumented (primary reason for writing this document), and more importantly, it is frequently updated and not backward compatible.

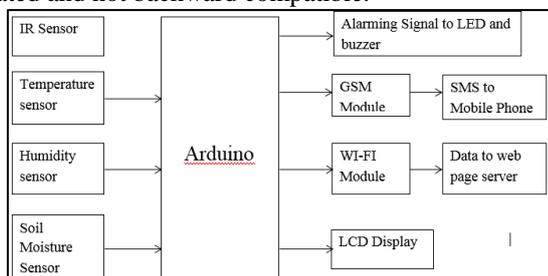


Fig. 1: Block diagram of proposed model

The ESP8266 has a full TCP/UDP stack support. It can also be easily configured as a web server. The module accepts commands via a simple serial interface. It then responds back with the operation's outcome (assuming everything is running correctly). Also, once the device is connected and is set to accept connections, it will send unsolicited messages whenever a new connection or a new request is issued.

VI. WORKING OF PROPOSED MODEL

In below figure 2 the data flow of working model is shown. In LCD display all 4 sensors output. The first horizontal line shown on the display is indicating the output of humidity and temperature sensor. The second horizontal line shown on display indicating the soil moisture and infrared sensor output and the last slot of LCD indicate the time scale of running clock.

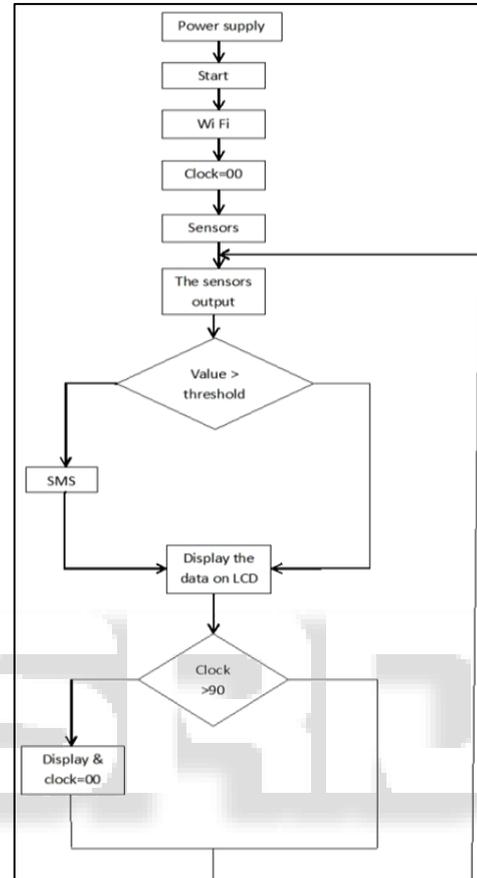


Fig. 2: Data Flow Diagram



Fig. 3: LCD Display

A. Thingspeak Results

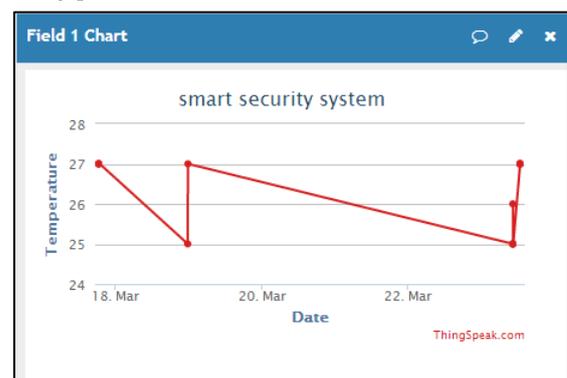


Fig. 4: Temperature sensor result

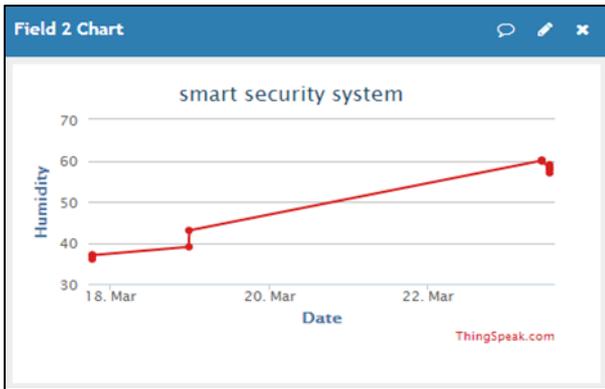


Fig. 5: Humidity sensor result

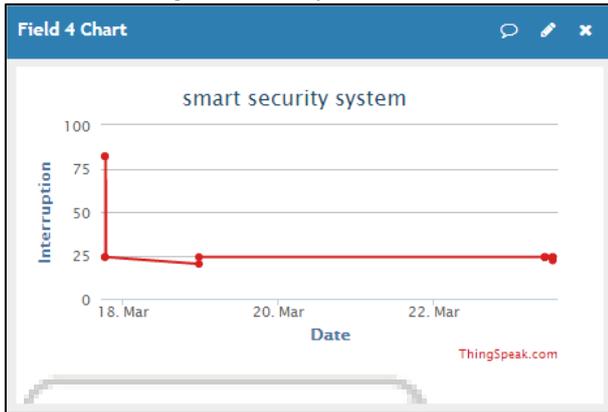


Fig. 6: Interruption result

B. Comparison between proposed and existed model

Parameter	Existing Model	Proposed Model
Technology used	8051 Microcontroller and GSM SIM300 Module	ATMEGA328 Microcontroller and GSM SIM900 Module
Clock Speed	12MHz	20 MHz
Interrupt handling capability	Less flexible	More flexible
Accuracy	Less accurate	More accurate
Program memory(ROM)	4Kb	32Kb
Data memory(RAM)	128B	2KB
Range	Limited	Globally can be accessed
Data Transfer	Circuit switching	Packet switching

Table 1: Comparison between proposed and existed model

VII. CONCLUSION

This project presents analysis and monitoring of an IOT and GSM based design of smart home controlling system. Prototype operates for data gathering and transmission using GSM-SMS and preliminary test prove that the developed prototype is capable to monitor devices in the deployed environment and has several advantages in term of fast delivery, zero data lose, low cost, flexibility, user friendliness and energy efficiency. The established GSM network is a highly efficient and the average SMS deliver time is 3.5 sec. It is important to note the following attributes of the application: the user interfaces are simple and intuitive.

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REFERENCES

- [1] H. Elkamchouchi and A. EISHafee, "Design and prototype implementation of sms based home automation system," in Electronics Design, Systems and Applications (ICEDSA), 2012 IEEE International Conference on, Nov 2012, pp. 162-167.
- [2] R. Teymourzadeh, S. Ahmed, K. W. Chan, and M. V. Hoong " Smart gsmbased home automation system," in Systems, Process Control (ICSPC), 2013 IEEE Conference on, Dec 2013,pp. 306-309.
- [3] M. Khandare and A. Mahajan, "Mobile monitoring system for smart home," in Emerging Trends in Engineering and Technology (ICETET), 2010 3rd International Conference on, Nov 2010, pp. 848-852.
- [4] M. Islam, "Home security system based on pic18f452microcontroller," in Electro/Information Technology (EiT),2014 IEEE International Conference on, June 2014, pp. 202-205.
- [5] Golzar, M.G. and Tajozakerin, H.R. (2010) A New Intelligent Remote Control System for Home Automation and Reduce Energy Consumption. 4th Asia International Conference on Mathematical/Analytical Modelling and Computer Simulation, Kota Kinabalu, 26-28 May 2010, 174-180.
- [6] Van Der Werff, M., Gui, X. and Xu, W.L. (2005) A Mobile-Based Home Automation System. Proceedings of the 2ndInternational Conference on Mobile Technology, Applications and Systems, Guangzhou, 15-17 November 2005, 1-5.
- [7] Hwang, I.-K., Lee, D.-S. and Baek, J.-W. (2009) Home Network Configuring Scheme for All Electric Appliances using ZigBee-Based Integrated Remote Controller. IEEE Transactions on Consumer Electronics, 55, 1300-1307.
- [8] Lee, H.-B., Park, J.-L., Park, S.-W., Chung, T.-Y. and Moon, J.-H. (2010) Interactive Remote Control of Legacy Home Appliances through a Virtually Wired Sensor Network. IEEE Transactions on Consumer Electronics, 56, 2241-2248.
- [9] Islam, M.S. (2014) Home Security System Based on PIC18F452 Microcontroller. Proceedings of 2014 IEEE International Conference on Electro/Information Technology, Milwaukee, 5-7 June 2014, 202-205.
- [10] H. Elkamchouchi and A. EISHafee, "Design and prototype implementation of sms based home automation system," in Electronics Design, Systems and Applications (ICEDSA), 2012IEEE International Conference on, Nov 2012, pp. 162-167.
- [11] R. Teymourzadeh, S. Ahmed, K. W. Chan, and M. V. Hoong, "Smart gsmbased home automation system," in Systems, Process Control (ICSPC), 2013 IEEE Conference on, Dec 2013,pp. 306-309.
- [12] M. Khandare and A. Mahajan, "Mobile monitoring system for smart home," in Emerging Trends in Engineering and Technology (ICETET), 2010 3rd International Conference on Nov 2010, pp. 848-852.

- [13] M. Islam, "Home security system based on pic18f452 microcontroller," in *Electro/Information Technology (EiT), 2014 IEEE International Conference on*, June 2014, pp. 202-205.
- [14] Z. Xia, L. Xiaoyan, I. Boxue, S. Jin, and W. Yajing, "Design of intelligent security system based on arm microcontroller," in *EProduct E-Service and E-Entertainment (ICEEE), 201 International Conference on*, Nov 2010, pp. 1-4.

