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Design and Implementation of GSM based Environment Monitoring System

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ABSTRACT

Environment monitoring system is developed to ensure the safety and convenience of an environment which needs high security. It makes use of a temperature sensor, door sensor, hall effect sensor, RFID and accelerometer. This paper aims to develop such an embedded system that monitors parameters like temperature and door status through an android app along with providing security and high temperature alerts. Over current sensing is also employed to protect the circuit by relay switching. The real time values from the sensors are monitored by LPC1754 and SMS is sent to required mobile numbers having the EMS app with the help of a GSM module. The system uses a compact circuitry built around ARM Cortex M3 LPC1754 microcontroller Programs are developed in Embedded C using the IDE Keiluvision4. JTAG is used for loading programs into Microcontroller.

I. Introduction

Security systems are gaining more relevance in this modern World, whether it be in home, bank lockers, ATMs or in industrial areas. So it is highly necessary to develop an Environment Monitoring System (EMS) that can be implemented anywhere of these places. This paper is intended to monitor certain parameters inside a premise such as temperature, door open or close status, over current, authentic card entry and any motion caused to our device. There are many home security systems developed solely for monitoring and controlling the electrical devices and domestic activities in home. But due to the elevated costs, incompatible standards and complexity resulted in a small market share, limiting these systems to the hobbyists or the wealthy[1]. This paper discusses an approach where an authorized remote mobile user receives an SMS when temperature exceeds the set threshold limit or the device in the protected location detects a vibration in the absence of an authorized person. The minimum requirement at the user end is that the mobile device should have an ANDROID OS. ANDROID is a java based operating system which runs on the Linux 2.6 kernel. It's lightweight and full featured. [2] Any warning condition triggers the GSM module to transmit a warning SMS into already registered numbers. The SMS on the users' end is interpreted by the ANDROID Application and if it finds that the SMS is of the designated format, the application immediately informs the person with a frequent pop-up menu along with voice alert. The user must acknowledge the message by clicking OK, else the alert will continue playing.

II. Existing Methodologies

A variety of security systems are available in the market. Different approach has been proposed at different times. However, a system using ANDROID is still ongoing research project field. Google is trying to join home control arena with ANDROID application. Two of the approaches relevant to the topic are listed below.

A. Android interface based GSM home security system

This paper looks into the development of an ANDROID application which interprets the message a mobile device receives on possible intrusion and subsequently a reply (Short Message Service) SMS which triggers an alarm/buzzer in the remote house making others aware of the possible intrusion.

B. Android based home security and device control using GSM

A home automation technique based on ARM controller. This technique uses an IR sensor to detect the person. If the IR sensor detects a person then the keypad will be activated to enter the pass code. A SMS will be sent to the owner for authentication. Depending on the owner's replay the door will open. If the person enters a wrong password, an intimation message will be sent to the owner and at the mean time buzzer will be activated. Android application is used to control the electrical appliances. The firmware for this paper is written in embedded 'C' language and the machine codes for the program are stored in the non-volatile flash memory of the embedded controller.

C. Design and Implementation of a GSM Based remote home security and appliance control system

The aim of this research is to design and implement a cost effective and yet flexible and powerful home security system using the GSM technology. A mobile based home security system is needed for the occupant's convenience and safety. The system is designed to detect burglary, leaking of harmful gas; smoke caused due to fire and after detecting suspicious activity it sends a alarm message to the owner number. The whole process in controlled by a android cell phone application. The user can activate all the alarm system while going outside thorough the apps.

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The app. has the feasibility of activating and deactivating the alarm system with the additional control for some home appliance switching. With this system installed a person can travel anywhere in this world within the GSM covered region with the assurance of complete safety of his/her house.

III. Proposed Methodology

The Block diagram of the proposed methodology is shown in figure. We are using two ARM LPC1754 devices- one to ensure safety and the other to monitor required parameters. Both uses GSM functionality for warning conditions. Door status, over current protection and temperature sensing is done in device1 whereas RFID and accelerometer functions are done in device2. Both together implements the proposed Environment Monitoring System. Part from home automation systems seen so far, EMS can be implemented anywhere which requires adequate security.

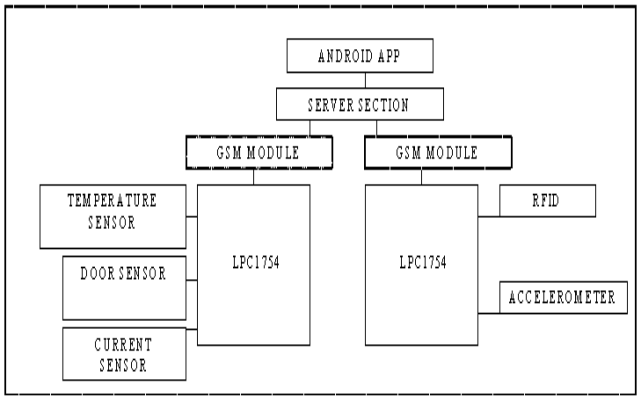


Fig 1. Block Diagram.

A. Temperature Sensor

The temperature sensor used is an industrial standard DS18B20 which gives a one wire communication. The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. Information is sent to/from the DS18B20 over a 1-Wire interface, so that only one wire (and ground)needs to be connected from a central microprocessor to a DS18B20. Power for reading, writing, and performing temperature conversions can be derived from the data line itself with no need for an external power source. Measures temperatures from -55°C to +125°C. Converts 12-bit temperature to digital word in 750 ms (max.) Applications include thermostatic controls, industrial systems, consumer products, thermometers, or any thermally sensitive.system. The core functionality of the DS18B20 is its direct-to-digital temperature sensor. The resolution of the DS18B20 is configurable (9, 10, 11, or 12 bits), with 12-bit readings the factory default state. This equates to a temperature resolution of 0.5°C, 0.25°C, 0.125°C, or 0.0625°C. Following the issuance of the Convert T [44h] command, a temperature conversion is performed and the thermal data is stored in the scratchpad memory. The temperature information can be retrieved over the 1-Wire interface by issuing a Read Scratchpad [BEh] command once the conversion has been performed.

The temperature read will be stored in the scratchpad register which is read to the microcontroller. But to communicate with LPC1754, a DS2480B converter needs to be interfaced. The DS2480B is a serial port to 1-Wire interface chip that supports standard and overdrive speeds. It con-nects directly to UARTs and 5V RS232 systems. The DS2480B directly interfaces a 5V serial communication port with its lines TXD (transmit) and RXD (receive) to a 1-Wire bus.

In addition the device performs a speed conversion allowing the data rate at the communication port to be different from the 1-Wire data rate.

Fig 2. Ds18b20 Temperature Sensor.

B.Door Sensor

The door sensor employed is basically a magnetic reed switch. The door when open, the circuit remains open and outputs a low signal. And when the door closes an output of high signal is provided to the microcontroller. The respective status is monitored by the server and updated in the EMS android application

C.Current Sensor

ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. Sensor in fig.3 The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switch mode power supplies, and over current fault protection. The device is not intended for automotive applications. The device consists of a precise, low-offset, linear Hall circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which the Hall IC converts into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer.

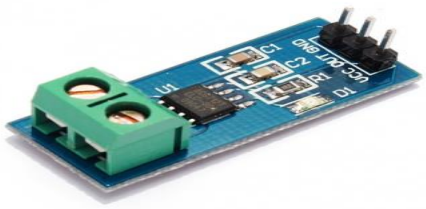


Fig 3. Hall Effect Sensor

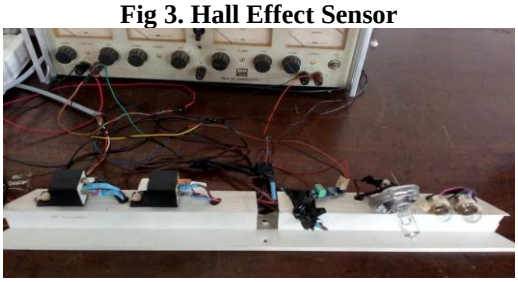


Fig 4. Hardware Set Up

The hardware set up in fig.4 implements hall effect sensor to sense the current flowing through the circuit. The two small bulbs draw a current of 0.7 Amperes each. Both in parallel constitutes 1.4 Amperes. The sensor outputs a voltage of 2.3V without any overload. When the overload (The larger bulb with 35Watts) is turned on, there occurs a sudden voltage dip with increased current reading of about 4.5Amperes. The voltage dip is detected by the microcontroller and the overload is turned off via relay switching. Thus current in the circuit is maintained the same.

D.RFID

Radio Frequency Identification here is employed so that only the authenticated person can have access to our systems. Here we use 2 cards- 1 for unlocking and the other for locking purpose.

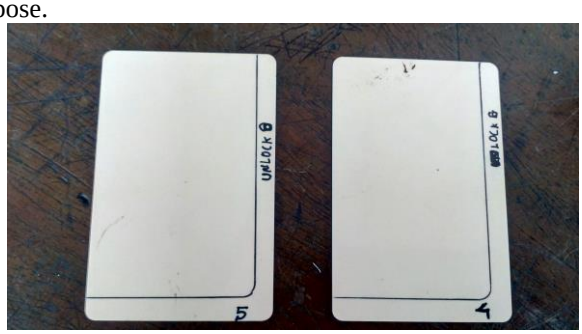


Fig 5. Unlock and Lock Cards

Passive tags are used here which get energized by the interaction with Mifare RF reader. The frequency range employed is high frequency 13.56MHz. Reader and tag interacts by inductive coupling.

Inductive coupling is the transfer of energy from one circuit to another via the mutual inductance between the two circuits. For RFID inductive coupling to be used, both the tag and the reader will have induction or "antenna" coils. When the tag is placed close enough to the reader the field from the reader coil will couple to the coil from the tag. A voltage will be induced in the tag that will be rectified and used to power the tag circuitry.

To enable data to be passed from the tag to the reader, the tag circuitry changes the load on its coil and this can be detected by the reader as a result of the mutual coupling.

RFID inductive coupling is a near field effect.

E. Accelerometer

The MMA8452Q is a smart, low-power, three-axis, capacitive, micro machined accelerometer with 12 bits of resolution. This accelerometer is packed with embedded functions with flexible user programmable options, configurable to two interrupt pins. Embedded interrupt functions allow for overall power savings relieving the host processor from continuously polling data. Motion is often used to simply alert the main processor that the device is currently in use. When the acceleration exceeds a set threshold the motion interrupt is asserted. A motion can be a fast moving shake or a slow moving tilt.

F. LPC1754

The LPC1754 is an ARM Cortex-M3 based microcontroller for embedded applications requiring a high level of integration and low power dissipation. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals.

The peripheral complement of the LPC176x/5x includes up to 512 kB of flash memory, up to 64 kB of data memory, Ethernet MAC, a USB interface that can be configured as either Host, Device, or OTG, 8 channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C interfaces, 2-input plus 2-output I2S interface, 8 channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, 4 general purpose timers, 6-output general purpose PWM, ultra-low power RTC with separate battery supply, and up to 70 general purpose I/O pins.

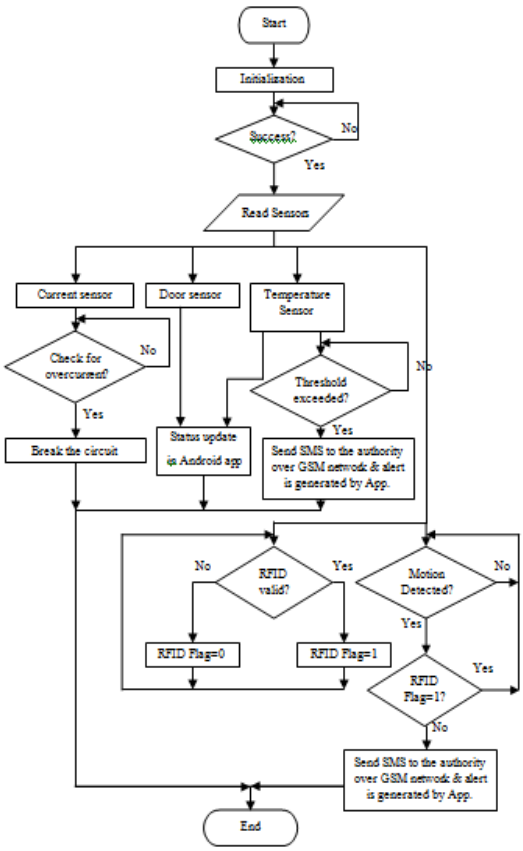
IV. Flowchart

DS18B20 uses one wire interface to send/receive information. But to communicate with the microcontroller through UART serial data is required. For this the 1-wire output is converted using DS2480B 1-wire to serial converter. Both the sensor and converter are initialized to establish communication. Afterwards, the real time temperature is monitored and updated. The temperature value measured is continuously compared to a pre-set threshold, and if it exceeds the threshold a SMS in the format "*1_TEMP"is sent to the configured mobile numbers having the app through GSM. The app on receiving the message of designated format, generates voice alert.

A magnetic reed switch is employed to sense door status. The output is fed to the microcontroller through a port pin. This value is updated in the server.According to the output of door sensor, door closed or open icons are shown in the app for high and low outputs respectively.

ACS712 is used to detect over current conditions. It provides an output voltage proportional to the load connected. A threshold is set considering normal and over current working conditions. The microcontroller detects the voltage drop below threshold caused due to over current and breaks the circuit.

RFID reader reads the ID when the card is flashed and compares it with saved IDs . If the ID belongs to unlock card, a RFID flag is set else if it belongs to lock card the flag is reset.



The MMA8452Q accelerometer continuously checks for motion in any direction. When any motion is detected, the ARM checks the status of RFID flag. If the flag is set, the motion is authorized and need not be warned. Otherwise, it indicates motion under locked condition and provides an SMS in the format "*2_TEMP" to the configured mobile numbers. The app on receiving the message of designated format, generates voice alert.

Fig 5. Hardware Screen Shot

The whole system must be initialized to start functioning. The device is powered from a 12V dc power supply. The supply voltage required for proper functioning of various modules are derived by voltage division. After initialization of necessary sensor modules, GSM network is registered. Then ARM keeps on monitoring the output of various sensors.

V. Android App

Android applications are always created for better user interface.In this project we have developed a EMS android application to monitor required status.Android devices become increasingly more common, demand for new apps will only increase. Android Studio is an easy to use (and free) development environment to learn on. Java is the language used by Android.

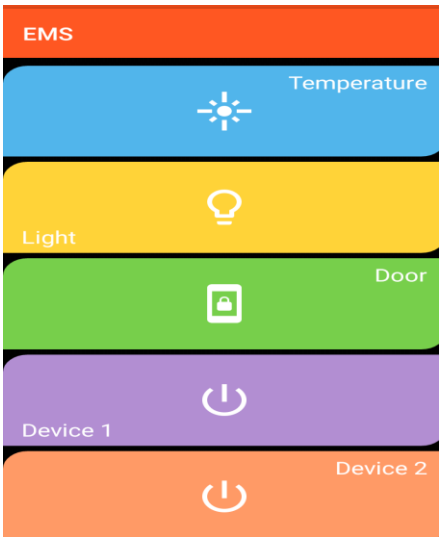


Fig 6. Android App Screenshot

VI. Applications

Environment Monitoring System finds variety of applications in:

- Industries
- Banks, ATMs
- Hospitals
- Homes

VII. Conclusion

This paper demonstrates Design and Implementation of an Environment Monitoring System used for monitoring the required parameters. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing real time data to the server over the GSM network. The sensors have been integrated with the system to monitor status of door, temperature, current, authentic card entry and accelerometer through EMS app. SMS are generated when the threshold limits are exceeded. Smart phone with EMS Android app, on detecting the message in the predefined format generates corresponding voice alerts.

VIII. Future Scope

Adding more sensors for measuring humidity, PIR for motion detection imparts more advantages for the project. Cameras can also be used to capture pictures when a motion is detected.

The EMS Android application can be utilized to implement controlling various devices as per the requirement.

IX. References

[1]Home Automation System using LPC1769G. UNIVERSITY OF BUENOS AIRES FACULTY OF ENGINEERING EMBEDDED SYSTEMS LABORATORY Daniel Schermuk Ezequiel Esp´osito Federico Roasio

[2] Android Interface based GSM Home Security System Rupam Kumar Sharma Ayub Mohammad Himanka Kalita sun l_rupaml@yahoo.com ayub.mohammadl028@gmail.com himanka.kalita.official@gmail.com Dhiraj Kalita dhiraj.sanju@gmail.com J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon,

[3]Design and Implementation of Weather Monitoring and Controlling System P.Susmitha
Dept. of ECM K L UNIVERSITY Guntur (Dt), India
G.Sowmyabala Assistant Professor Dept. of ECM K L University, India

[4] Design and Implementation of a GSM Based remote home security and appliance control system G.M. Sultan Mahmud Rana1, Abdullah Al Mamun Khan2, Mohammad Nazmul Hoque3, Abu Farzan Mitul4 1Department of Mechanical Engineering, Khulna University of Engineering & Technology (KUET)

[5] Implementation of Home Security System using GSM module and Microcontroller Abhishek S. Parab *M.Sc Computer Science student Mithibai College Mumbai, Maharashtra, India.* Amol Joglekar *Professor, Computer Science. Mithibai College, Mumbai, Maharashtra, India.*