

A Cost Effective Embedded Design for Security and Automation in Industries

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Abstract

Security in industries and homes is a major confront for the past two decades. Most importantly automation also became a major concern for industries to increase productive and effective use of time. This work concentrates on designing a cost effective embedded design, built for both security and automation. This unique design focused on easy control of different loads in industry or home. This design includes security alerts like fire, gas leak and load failure. Users can easily operate loads through mobile and they receive security alerts when security hazards like fire, gas leak and load failure occur at industry or home. The design is built with an innovative approach to reduce the complexity and cost.

General Terms

Security, Automation, Bluetooth Technology, Global System for Mobile Communication, Sensors.

Keywords

Operation of loads, Wireless Communication, Bluetooth, Security alerts, Fire sensor, Gas sensor, Optocoupler, GSM communication, Message alerts.

1. Introduction

The proposed system is an embedded system which is an industry/home automation system [1] which is operated through an android phone. In this project, automation includes control of lights, fans, and doors. And false detection is also included in this project. The appliances or loads are controlled through an android phone. An application is developed for the android phone which is interface between user and phone through which appliances are controlled – figure 5.

The main 4 parts of the project are:

- Operating lights, fans and doors using Bluetooth technology [3].
- Security alerts like fire alert and gas leak.
- Failure detection.
- Developing an android application through which these appliances are controlled.

The android phone uses Bluetooth technology [2] to control the appliances like lights, fans and doors – figure 1. The microcontroller plays the key role in this project. The Bluetooth modem will be interfaced to the microcontroller

through serial port interface. The Bluetooth in the phone is paired with the Bluetooth in the device. And user sends the user-defined data through your phone Bluetooth to the devices. Then data will be received by the microcontroller and operates the lights/fans/doors according to it. And also project consists of security and fault detection alerts – figure 6. When the home/industry faces hazards like fire accident or gas leak, the device sends alerts to the user's mobile – figure 2. And when fault detected in the household electrical network its sends alert to the user's mobile.

2. Design method

Considering the variety and the complexity of the functions to be performed and the fact that a rather complex controlling structure needs to coordinate the overall activity of the system, a microcontroller-based system is ideally suited for this application. In addition to coordinating the functions of the system, the controller itself may be used to simplify the implementation of some of the desired functions or tasks (like counting, comparison of data, interrupts handling etc.). The use of a microcontroller has the advantage that it has a CPU (a microprocessor) in addition to a fixed amount of RAM,ROM,I/O ports & timer are all embedded together on one chip, thus decreasing the size and cost of the system. Future design changes are quickly and easily implemented, primarily by changing the program. Thus reducing the material costs. Also, software is more flexible than hardware. The Top-Down policy approach has been followed in the design of this system. This approach is basically a step-wise refinement. First, the general structure is created. The problem is broken into smaller segments and each one is dealt with individually. This process is repeated until the problem segment in hand is manageable.

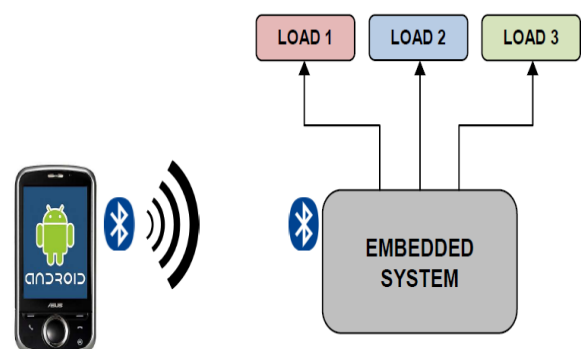


Figure 1. Switching the loads

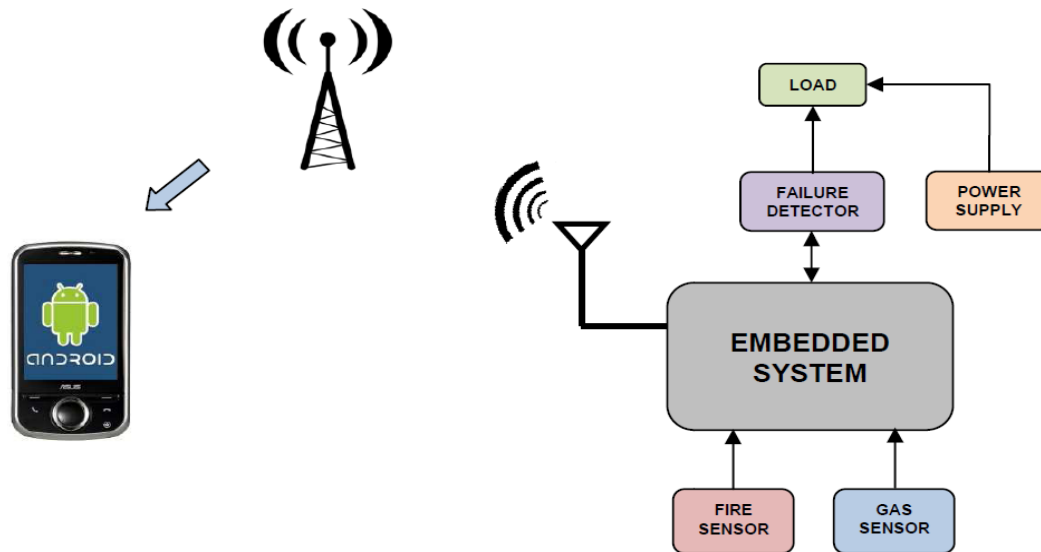


Figure 2. Receiving security alerts from the system

The basic functions to be performed by this system could be distinctively divided in the following manner:

- reading the SMS
- Verify number
- connecting bluetooth
- operate load through bluetooth
- sending alerts if there are any security issues
- Send Feedback

The controller is continuously looking for inputs from the Bluetooth modem. If the input is a legal command, the routine that performs that desired function is called and the function is performed.

2.1 Design Functioning

The whole project comprises of eleven basic units. These units were built and tested separately, and then combined to get the fully functional device [9]. The eleven basic units are:

1. The GSM (Global System for Mobile Communication) Modem.
2. The Bluetooth module
3. The Max 232 Serial Interface
4. The 8051 BASED AT 89S52 Microcontroller
5. The L239D motor driver
6. buffer 74LS244
7. LCD
8. Optocouplers MCT2E
9. Triac MOC3021
10. gas sensor
11. fire sensor

In this project we are using AT89s52 Microcontroller [6] which belongs to the 8051 family (MCS51 Popular INTEL Architecture). In this controller the pins 18 and 19 are XTAL1 and XTAL2 respectively and they are connected to 11.0592 MHz crystal, to generate clock pulses to the internal oscillator circuit. If the Power is "ON" the 10micro farad capacitor is connected across the 9th pin (i.e. reset pin) of micro controller discharges and produces a pulse on the reset pin due to that the reset interrupt occurs which serve reset ISR i.e. from 0th location of the program memory. From that the 10 micro farad

capacitor blocked DC voltage (5v) goes to 40th (VCC) and 30th pins and 20th pin is grounded. In this project we are

disabling the external access pin due to the use of internal program memory (8Konly). in our project the main interfacing are LCD, serial communication, relay interfacing. First initially insert sim into gsm module, then power on the device and the gsm module. open the Bluetooth spp application in your android phone and connect it to the Bluetooth in the device. Then send message to the inserted sim so that it store the senders phone number. open the Bluetooth spp application and set values(L,F,D) to the buttons. after setting the values click on the buttons to operate the loads.

And when security hazards occur like fire, gas sensor the device sends message to the user's phone through GSM modem. When there is fault in load it sends message to the user's phone.

3. Performance & Effectiveness

The main 4 parts of the project are:

- Operating lights, fans and doors using Bluetooth technology.
- Security alerts like fire alert and gas leak.
- Failure detection.
- Developing an android application through which these appliances are controlled [7].

The android phone uses Bluetooth technology to control the appliances [4]. The microcontroller plays the key role in this project – figure 3. The GSM modem will be interfaced to the microcontroller which continuously receives the messages from the user cell phone and passes the same to the microcontroller. The Bluetooth modem will be interfaced to the microcontroller section through serial port interface. If the user wants to operate the door, lights and fan, he can just send a user-defined signal to the Bluetooth modem that is interfaced to the controller section. The controller section will have the switch control of the door. The loads which are to be controlled will be connected to the controlling device i.e., to the microcontroller section. The status of the loads will be displayed in the LCD. It also contains security alerts like fire and gas sensor. When any fire and gas hazards occur at home immediately we get message from the gsm modem to our mobile. It also contains fault detection, when there is fault in the load we will get message from the gsm modem.

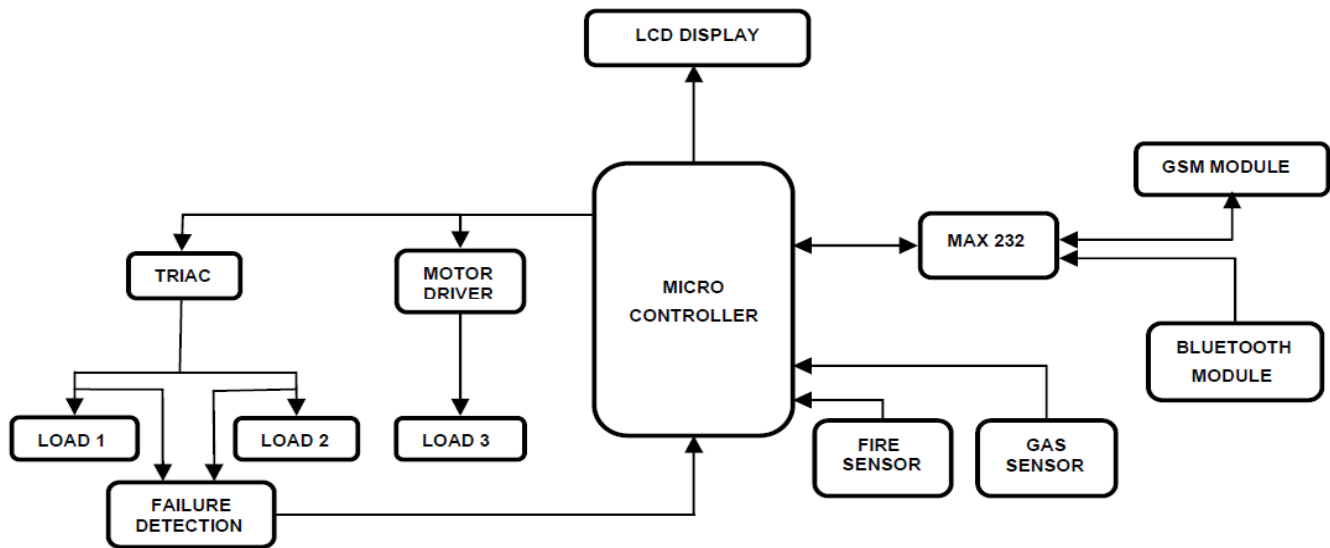


Figure 3. Block diagram of the design

3.1 Individual performance

ATMEL 89S52 Microcontroller

The AT89S52 [8] is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

Optoisolators triac driver moc3021

From ages electro-magnetic relays are being used as switches to control high voltage devices. But because of their bulky size and noise (both electrical and mechanical) people started using TRIAC with opto-coupler as better alternative [5].

Benefits of this circuit

1. Very low voltage 3V to 5V can be used to control load device.
2. Opto-Coupler maintains separation between high voltage and low voltage circuitry and never allows high voltage to flow back to micro-controller making it safe.
3. No mechanical noise.
4. Compact, occupies less volume on PCB.
5. Can be used for fast switching, electromagnetic relays cannot due to mechanical make/break.

Gas Sensor

A gas detector is a device which detects the presence of various gases within an area, usually as part of a safety system [10]. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can also sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave the area. This type of device is important because there are many gases that can be

harmful to organic life, such as humans or animals. Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in a variety of locations such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may also be used in firefighting. They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, methane, alcohol, hydrogen, smoke. Typical sensitivity characteristics of the MQ-135 for several gases is shown in figure 4, sensor composed by micro AL₂O₃ ceramic tube, tin dioxide (SnO₂) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net, the heater provides necessary work conditions for work of sensitive components.

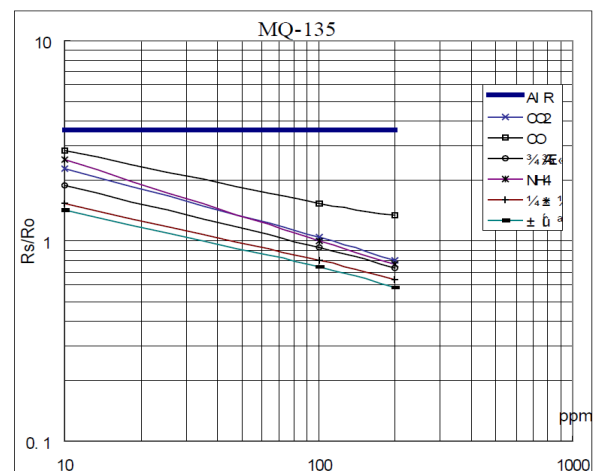


Figure 4. Typical sensitivity characteristics of the MQ-135 for several gases.

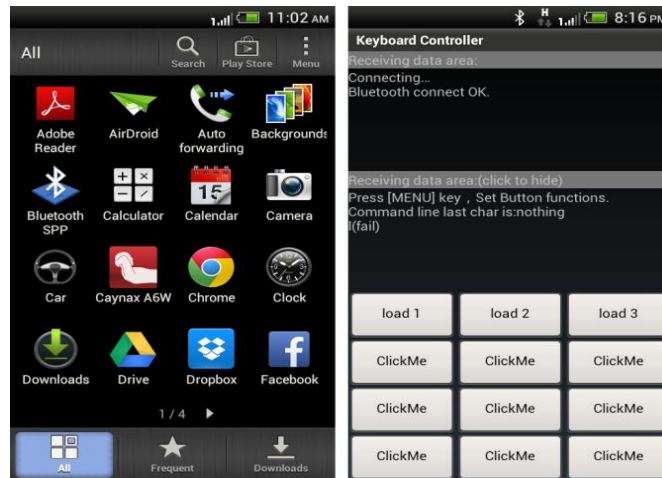


Figure 5. Operation of loads through android application

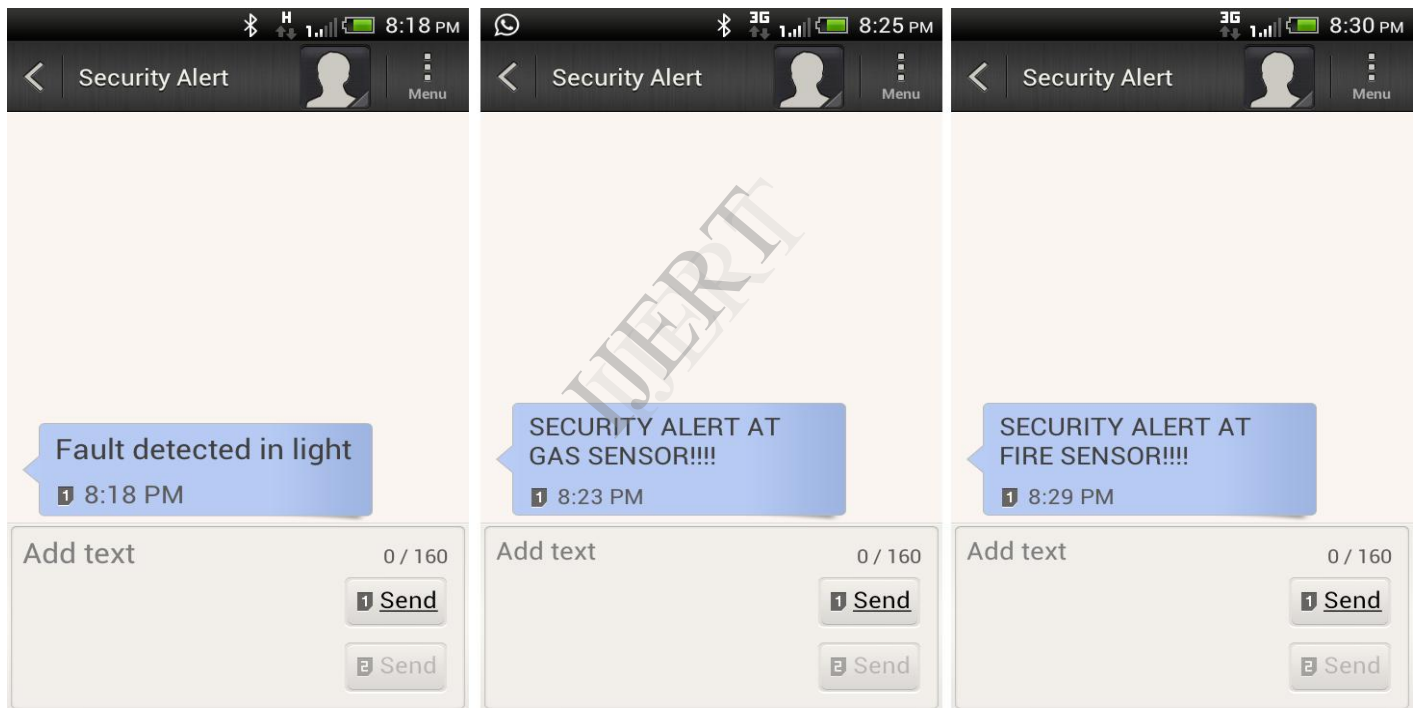


Figure 6. Security alerts sent to user's mobile

4. CONCLUSION

We operate loads through Bluetooth which makes life more comfortable. And also security alerts like fire, gas and fault detection is provided for a secured life. The design can further developed by using advanced components. The security can be increased by using different high functioning sensors. The loads can also be operated through sms from the user's mobile. Some of the advantages by using this design are

- GSM providers are available almost in many countries
- using Bluetooth to control appliances as Bluetooth is available in most of the mobiles.

- It is cheaper when compared to the other type of automation system.
- It is more effective when compared to the other type of automation system.
- It is easy to change the system's action according to change in situation.

FUTURE ASPECTS

- Some of the pins of the microcontroller are left unused & hence can be used in the future by defining the functions.
- We can control many devices by increasing the ULN2003 IC's (which are connected to the microcontroller).
- We may implement this project for the large scale industries.

5. REFERENCES

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