# Design & Development of ARM7TDMI-S based GSM Mobile for Home Automation & Security

**Alka Dubey**
School of Electronics, DAVV, Indore (M.P.), INDIA
E-mail- dr.alkadubey12@gmail.com

**Abstract:** GSM network is widely available network in the form of wireless network which is capable for sending and receiving SMS, MMS, voice call multimedia services, Internet with the help of smart phone. In the present paper a smart phone is developed for security and control purpose for industries as well as home. This system is based on microcontroller, various sensors, GSM modem, GSM SIM. This smart phone is used as normal phone as well as auto security and control device, which is controlled by device holder with the help of mobile phone.

**Keywords:** Microcontroller, GSM Modem, Sensors, AT command

## 1. Introduction

A Smart Security phone is designed to be used as mobile for communication purpose as well as to provide controlling of home equipments remotely and will also enable home security against intrusion in the absence of home owner. This system would be able to alert the device holder in the event of fire, smoke, water tank overflow, LPG leakage, theft detection and many more things. With the help of this smart security mobile one can control the electricity and home appliances of his home from anywhere in the world where GSM network available.[1-4]

## 2. System Design

In this system, various sensors interface with microcontroller unit, which sense and send information to LPC 2148 ARM7TDMI-S microcontroller. Comparator is used with sensor unit to decide the threshold level range for the presence of sensible things like smoke, fire, door vibration, Carbon Mono oxide presence etc. One GSM modem is also attached with microcontroller which would send the SMS to the device holder as well as the emergency services providers like fire brigade, Police etc. In the present system, there is also facility of emergency alarm which could be activated by the device holder or by the microcontroller unit on detection of unusual conditions. Fig. 1 shows the block diagram of present the system.

## 3. Hardware Development

This hardware section has following units:

1. GSM Modem Unit
2. Microcontroller Unit
3. Sensor Unit

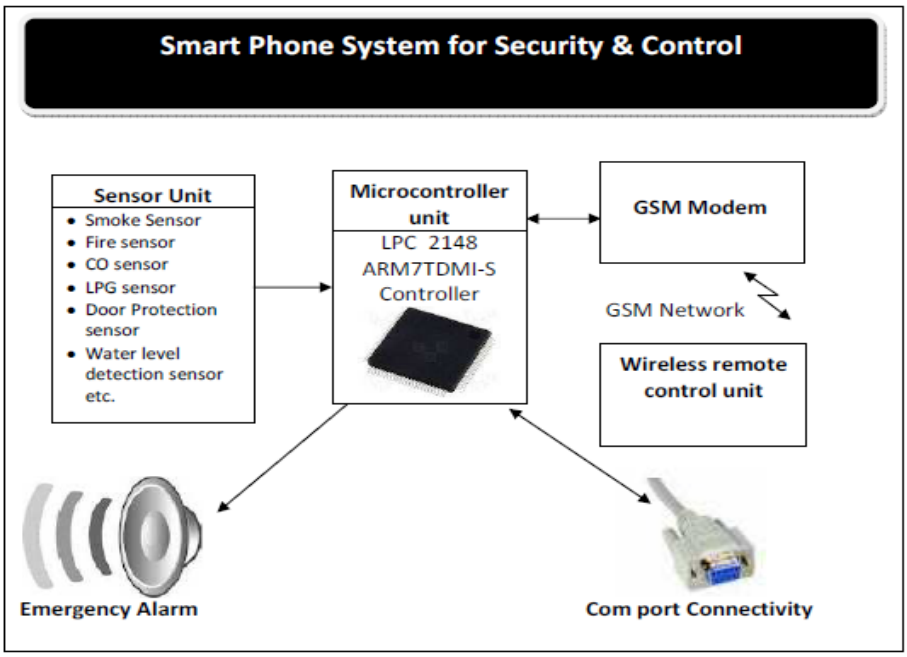


**Fig. 1.** Block Diagram of Present System.

### 3.1 GSM Modem Unit

Simcom 300 modem is used with present system shown in Fig. 2. This modem has GSM as well as GPRS connectivity. Programming for this modem is done by AT commands given in its datasheet.[5] This section is most essential part of the system. Whenever microcontroller receives any signal from the sensor unit, the GSM modem will send the SMS in relation to the event to device holder as well as emergency service agencies.

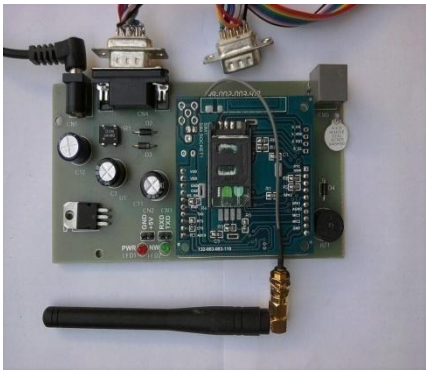

**Fig. 2.** Simcom 300 modem

### 3.2 Microcontroller Unit

In the present system LPC 2148 microcontroller is used as a controller unit. The LPC2148 microcontroller is based on 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded 8 trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. 128-bit

wide memory interface and a unique accelerator architecture which enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. A blend of serial communication interfaces ranging from a USB 2.0 Full Speed device, multiple UARTS, SPI, SSP to I2Cs and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for our application.[6] Fig. 3 shows the LPG 2148 Microcontroller.

**Fig. 3.** LPC 2148 Microcontroller

### 3.3 Sensor unit

Sensor unit involve various sensors like AS-MLC, MQ 6, MQ2, LM 35, IR sensor, door vibration sensor etc.

#### a. CO detection sensor

In the form of carbon mono oxide sensor AS-MLC is used. It's a reliable sensor component for detection of carbon monoxide presence. Applied Sensor's high-performance ML sensor components offer reduced power consumption and increased packaging flexibility. The sensors are produced by combining the benefits of thick film, thin film and patents pending technologies on silicon substrate. Heater and inter digital electrode structures are positioned on a 1 μm-thin membrane on top of which is deposited a tin dioxide sensitive layer that creates gas concentration-dependent conductivity. The sensor component has high sensitivity and selectivity to carbon monoxide and is packaged in a standard TO-39 (solid TO-5), 4-pin header. Fig. 4 shows the carbon monoxide detector. [7]

**Fig. 4.** AS-MLC Carbon Mono oxide Detector

## b. Fire Detection Sensor

The LM35 is used as temperature sensor for detection of fire, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. Fig.5 shows the fire detector LM35. [8]

**Fig. 5.** LM 35 temperature sensor

## c. Smoke Detection sensor

Gas Sensor (MQ2) module is useful for gas leakage detecting in home as well as industry. It can detect LPG, i-butane, methane, alcohol, Hydrogen, somke and so on. Based on its fast response time. measurements can be taken as soon as possible. Also the sensitivity can be adjusted by the potentiometer. Fig. 6 show the smoke detector MQ2. [9]

**Fig. 6.** MQ2 smoke sensor

### d. LPG Detection Sensor

In the form of LPG Gas Sensor MQ-6 is used, This is a simple-to-use liquefied petroleum gas (LPG) sensor, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The drive circuit is very simple; all you need to do is power the heater coil with 5V, add a load resistance, and connect the output to an ADC. Fig. 7 shows the LPG detector MQ6. [10]

**Fig. 7.** MQ6 LPG detector

### e. Door/Window Protection sensor

In the present system variable capacitance type vibration sensor is used for measurement of vibration of door/window during theft try to open/ break the door/window. This vibration sensor is customized in the laboratory for using it as variable capacitor. This sensor is attached with astable multivibrator, which generate square wave according to frequency of the vibration. The frequency is applied on microcontroller's timer pin having a certain range which activate the emergency buzzer as well as send SMS to the prescribed number that anybody trying to break/open the Door/window. Fig. 8 shows the photograph of door/widow protector sensor.[11]

**Fig. 8.** Door/Window Protector Sensor

**f. Motion Control Sensor**

Motion control sensor is the couple of strain gauge deployed inside the door mat and the IR transmitter receiver pair for getting the information on entrance of anybody inside the home while no one at home.

The complete system is a hub of sensors, GSM Modem and Microcontroller which controllers the overall mechanism of the present system. Fig. 9 shows the complete circuitry of the present system

**Fig. 9.** Circuit diagram of ARM7TDMI-S based Smart Phone

## 4. Software Consideration

C- Language program is developed with the help of Keil compiler. This program is transferred to microcontroller using Flash Magic software. The program works in following steps:

a) System initialization: GSM initialization.
b) The default value display.
c) The controller goes to interrupt mode whenever a sensor signal is detected.
d) Software implementation for modem interface using AT commands.

Fig. 10 shows the basic flow chart for the present system.

## 1. Testing & Debugging

The present system software is primarily tested and debugged inside the laboratory using Proteus and Keil simulator and after that it is burnt on microcontroller using flash magic software and then the physical acceptance test for the PCB functional testing is also carried for various subunits. The test carried out has shown correct result as observed by the required waveform on the storage CRO.

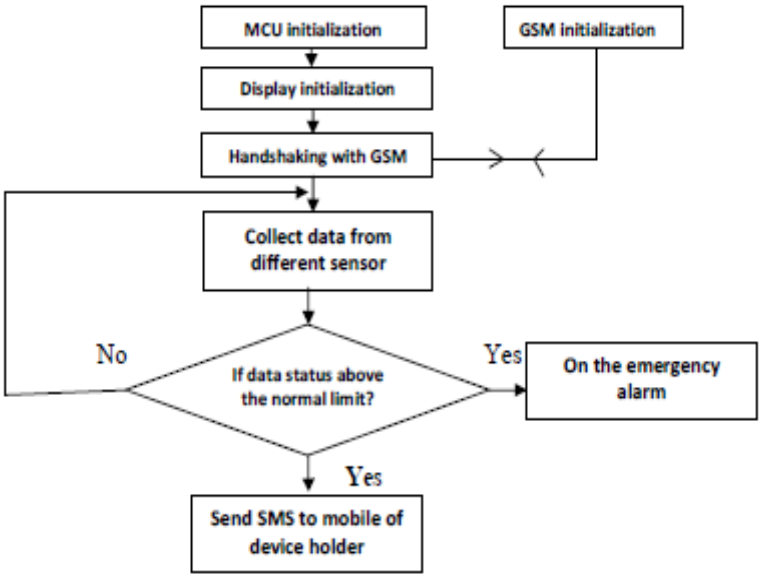


**Fig. 10.** Flowchart of present system

## 1. Conclusion

The sensor unit and GSM Modem with NXP LPC 2148 ARM7TDMI-S microcontroller interface has been designed, developed and tested for reliability of electronics. The information of sensors is transferred to prescribed mobile number as well as emergency service providers via GSM network in the form of Short Message Service through this device. This system is more feasible for the people having lonely home for a long time. With the help of this system one can successfully monitor the abnormal conditions inside the home, while nobody at home and also prevent the major causality which may be arise due to any unwanted event.

This system may further be modified as per user requirement. It has so many pins left unused inside the port of microcontroller which may be used different sensor interfacing.

## References

[1]. Alkar, A. Z., & Buhur, U. (2005). An Internet Based Wireless Home Automation System for Multifunctional Devices. IEEE Consumer Electronics, 51(4), 1169-1174.

[2]. Ciubotaru-Petrescu, B., Chiciudean, D., Cioarga, R., & Stanescu, D. (2006). Wireless Solutions for Telemetry in Civil Equipment and Infrastructure Monitoring. 3rd Romanian-Hungarian Joint Symposium Applied Computational Intelligence (SACI) May 25-26, 2006.

[3]. Conte, G., & Scaradozzi, D. (2003). Viewing home automation systems as multiple age RoboCUP2003, Padova, Italy

[4]. Jawarkar, N. P., Ahmed, V., Ladhake, S. A. & Thakare, R. D. (2008). Micro-controller based Remote Monitoring using Mobile through Spoken Commands. Journal Of Networks, 3(2), 58-63.
[5]. Simcom 300 GSM modem datasheet, probots.co.in/Manuals/SIM300.pdf
[6]. NXP LPC 2148 microcontroller datasheet, www.nxp.com/documents/user_manual/UM10139.pdf
[7]. www.appliedsensor.com/pdfs/AS-MLC_CO_0809.pdf
[8]. Lm-35datasheet, https://www.national.com/ds/LM/LM35.pdf
[9]. MQ 2 datasheet, http://www.cooking-hacks.com/index.php/smoke-sensor-mq2.html
[10]. MQ 6 datasheet, http://www.probots.co.in/Datasheets/MQ6.pdf
[11]. Alka Dubey et al. Smart Sensor For Analyzing Train Vibration In WCR Zone, Journal Of Sensors And Transducers, Vol.108, Issue 9, 2009, PP. 1-7.