EMBEDDED GSM MONITOR AND CONTROL USING ANDROID APPLICATION

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ABSTRACT

Embedded GSM is a microcontroller communicating with an Android Application through a GSM network. A design of ARM processor-based embedded GSM interface is presented. Generally, a device will be widely used with a microcontroller but here the microcontroller monitors the values of the parameters and communicates them to a GSM network. Through GSM, an Android Application receives the information regarding the parameters monitored by the microcontroller. The Android Application, as and when it is required sends a control command to the microcontroller through GSM. The microcontroller executes the control command received from GSM interface on the parameter. Thus the parameters can be remotely monitored and controlled through Embedded GSM and Android Application.

Keywords: Embedded GSM, Android Application, Monitoring of Parameters, Control of Parameters, Microcontroller

I INTRODUCTION

The objective of the paper is to provide a remote user, on-the-go monitoring and controlling of important parameters of a system, using embedded GSM technology and communicating with an Android application running on a mobile device.

Embedded System is generally used for connecting a microcontroller with devices. Though Embedded Systems give an advantage of automated systems with minimal or no human intervention, the microcontroller does a minimum level of communication with the network. Hence there exists a limited availability for the remote user to monitor the current status of the important parameters of the system. As the remote monitoring of the parameters itself is a major drawback, there is a lack of remote user control on the important parameters of the system. The data communicated to the network, by the microcontroller, is conveyed to the remote user either through internet or through a mobile network.

Once monitored, under certain circumstances, there might be a need for the user to remotely control the parameters being monitored. The remote user may lack remote control on the important parameters of the system.

The drawbacks of the previous methods are:

- Microcontroller communicating the data regarding the important parameters of the system with the network
- The availability of the network to the user at the remote location for the monitoring of the parameters of the system

- The availability of the necessary devices to utilize the network and monitor the parameters of the system
- The ease of portability and utilization of the devices that are used for monitoring the parameters of the system
- Lack of remote control of the user on the parameters of the system that are being monitored

Thus due to the minimal communication of the Embedded System with the network, there exists a problem with the constant on-the-go monitoring of the parameters of the system. Though the parameters can be monitored on-the-go remotely, there exists a problem with the on-the-go control of the parameters of the system whenever needed.

II PROPOSED SOLUTION

The paper is meant to propose a simple and on-the-go solution for the parameters that have to be constantly monitored and controlled in a system. People now-a-days are more inclined towards the usage of smart phones and the usage of an Android Application does not need an internet connection. Hence an easy and more portable solution can be provided by installing an Android Application on the smart phones. The following is the block diagram for the Embedded GSM Monitor and Control Using Android Application.

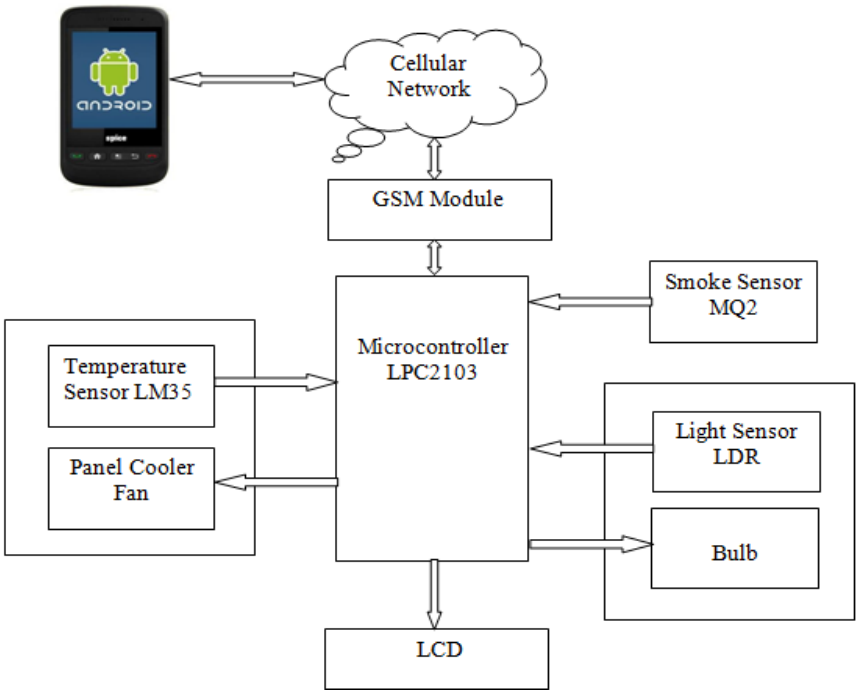

Fig. 1: Block Diagram of Embedded GSM Monitor and Control

The constant monitoring and controlling of the parameters can be achieved by using sensors, to detect the state of parameters. The sensors communicate the state of the parameters to the microcontroller which in-turn communicates the status to the Android application user through GSM module. If the Android application senses that the parameter status has to be controlled, it will communicate the necessary control action through GSM module to the microcontroller.

As a mobile device is portable and is easy to carry, a simple, remote on-the-go solution is provided to monitor and control the important parameters of a system. The remote monitoring is made possible as the data regarding

the important parameters of the system is communicated by the microcontroller, to a remote user through Android application. And the remote controlling can be achieved as the application is able to communicate the necessary control commands to the microcontroller.

The communication between the microcontroller and the remote user takes place as follows:

- The microcontroller is *embedded* with a *GSM* module.
- An ARM processor based Embedded GSM interface will be developed for the communication between the system and the remote user for *monitoring and controlling* the parameters using an *Android application.*
- The important parameters to be monitored and controlled are sensed by the respective sensors.
- The data regarding the parameters is then shared with the microcontroller.
- The microcontroller, using the GSM module, communicates the data regarding the status of the parameters with mobile device of the remote user.
- The remote user would have installed an Android application on his mobile device through which he can monitor the status of the parameters shared by the microcontroller.
- Whenever the Android application senses that, the parameters that are being monitored need to be controlled, the application sends a message to the microcontroller through GSM module.
- Whenever the microcontroller receives the message from the Android application, it understands as to which parameter needs to be controlled.
- The microcontroller then sends the received message as a control instruction to control the respective parameter in the application.

Thus using an ARM processor, an embedded GSM interface is achieved, through which the parameters in the system can be remotely monitored and controlled on-the-go by using an Android application.

2.1 Advantages of the Solution

- Microcontroller communicating the data regarding the important parameters of the system with the network using a GSM interface
- The availability of the network to the user at the remote location for the monitoring of the parameters of the system
- The device required to monitor and control the parameters of the system is only a mobile handset, hence reducing the extra effort needed to set-up a new system at the remote location
- As the mobile device will be readily available with the user, the device will be always available on-the-go with the user
- The use of the mobile devices for monitoring and controlling the parameters of the system make the solution more portable
- The use of the mobile devices for monitoring and controlling the parameters of the system make the solution easy to use, as the user will be acquainted with the mobile device
- The installation of solution or any changes in the Android application is a simple process
- The Android application can control the parameters being monitored in the system, hence there is an on-the-go remote control by the user on the system

2.2 Scope of the Solution

The following gives the scope regarding the proposed solution:

- User can access the information regarding the parameters from any remote location and at anytime using the Android application.
- User can even control few parameters from any remote location as and when it is required.
- The limitation on the remote monitoring and controlling of the parameters will be the availability of the mobile phone network that the user is connected to.

The major drawback for the solution is when there is no availability of mobile network. Then the user will neither be able to receive any monitoring data regarding the parameters of the system nor will be able to send any control information to the system.

The solution "Embedded GSM Monitor and Control Using Android Application" is used to monitor and control the vital parameters anytime, anywhere. That is, it is used to have on-the-go monitoring and controlling of the parameters of the system. The following gives the schematic diagram of the LPC2103. The schematic explains how the microprocessor is connected to the 16x4 LCD, GSM Module through DB9 socket, sensors and relays which operate the panel cooler fan and bulb.

In this system we are using ARM7 TDMI-S based NXP's (national semiconductors and Philips) LPC 2103 microcontroller in LQFP (Liquid Quad Flat package) with 48 pins. The following gives the schematic diagram of LPC2103 microcontroller board.

One of the important feature is Power requirement of LPC2103 Microcontroller is 3.3 VDC. The power supply (3.3V) for the LPC2103 is produced by using the power supply circuit which consists of mainly four components: 1.Transformer 2.Rectifier 3.Filter and 4.Voltage Regulator. An AC to DC socket adapter is used for the conversion of AC power to 12V DC. The conversion of 12V DC supply which includes four most basic steps: (1) voltage is step downed by using transformer, (2) rectifier for converting alternating power to DC (here we are not obtaining pure dc voltage), (3) Hence in the filter circuit, capacitor bypasses the AC to ground and it blocks DC voltage. (4) The obtained pure DC voltage is supplied to regulator for getting the required voltage which we need to give for the processor LPC2103. An LM7805 voltage regulator is used for a constant DC voltage supply of 5V to all the IR transmitters connected in the circuit. The 5V supply is regulated to 3.3V as needed by the microcontroller and also from 3.3V to 1.8V with the help of the regulator LM1117. There is a reset pin, which will reset the processing of the microcontroller and it restarts the processing of the microcontroller. The 5V DC power is given to the VDD pin of the LCD. The P0.16- P0.23 pins of the microprocessor are connected to the data lines DB0 – DB7 of the LCD display. The RS pin and Enable 'E' pin of the LCD are connected to the P0.12 and P0.13 pins of the microcontroller. The communication between the Android Application and the microcontroller is done with the help of a GSM module. A SIM card is inserted to the GSM module. After checking whether the network is ready using the AT commands, RS232 cable is directly connected between DB9 of the module and the DB9 on the controller port. This establishes the serial communication between them. The GSM commands embedded in the controller takes care to communicate with the GSM Module via RS232 cable-MAX232-Serial I/O pins of the Controller.

The MAX232 is given a 5V power supply. The TXD and the RXD mentioned in the figure with the microprocessor MAX232 indicate the transmission and reception of messages to and from the mobile network that the SIM card uses.

The temperature sensor LM35 is connected to the port P0.10 of the microprocessor on the LPC2103 board. A 5V DC supply is given to the sensor. A 12V power supply is given to the relay and the fan is connected to the P0.04 of the processor through the relay. The relay circuit controls the operation of the fan by switching it on only when the microcontroller instructs it to turn-on the fan. The relay also switches the fan off when the microcontroller instructs it to turn-off the fan.

A smoke sensor which is used in the system to detect smoke is connected to the port P0.02 of the microprocessor. A 5V voltage is supplied to the sensor. The pin 8 of the LM358 processor in the smoke sensor is connected to the P0.02 of the microprocessor in LM2103 controller board. The LM358 is connected to an LED which will be turned-on whenever the smoke is detected by the sensor. The CO sensor is connected to pin 3 of the LM358 processor.

The LDR Sensor is used with the LM358 processor to get connected to the LPC2103 microcontroller board. The LDR sensor is given a 5V voltage. LDR is connected to the pin2 and pin3 of LM358. LM358 is given 5V of voltage. The pin1 output IR-Obstacle of LM358 is connected as input to the port P0.11 of the LPC2103 processor as IR Sensor. An LED is connected to the LM358 to indicate the absence and detection of light. The LED turns-on whenever the LDR senses no light. It turns-off at the presence of light. A 12V power supply is given to the relay and a bulb is connected to the P0.05 of the processor through the relay. The relay circuit controls the operation of the bulb by switching it on only when the microcontroller instructs it to turn-on the bulb. The relay also switches the bulb off when the microcontroller instructs it to turn-off the bulb.

III WORKING PRINCIPLE

The solution mainly focuses on the monitoring and controlling of three parameters using the Embedded Microcontroller LPC2103. The microprocessor reads the temperature value, monitors the light and detects smoke in the system using temperature sensor – LM35, light detector – LDR and detects the presence of smoke using smoke detector – LM358 respectively. The processor sends the data from these detectors to the Android Application using GSM commands. The Android Application in-turn sends the necessary commands as and when required. The Android Application also receives the regular updates regarding the system temperature, thus monitoring the temperature of the system.

The monitoring and controlling is done as follows:

- The microcontroller sends the “SYSTEM STARTS” message to the Android application mobile through GSM commands. Regular updates of the current temperature detected by the microcontroller through the temperature sensor will be sent to the Android application. Whenever the system’s temperature crosses 50^{o}C, the microcontroller sends a “TEMP HIGH” message to the Android application through GSM commands.
- As the Android application receives the “TEMP HIGH” message, it retrieves the sender information and sends back a message “RFO@” to the microprocessor through GSM. This message is actually a command to the microprocessor to turn-on the fan. Thus the processor turns-on a panel cooler fan through the relay

circuit. Once the panel gets cooled by the fan and the temperature sensor senses temperature less than 50^{o}C, a "TEMP NORMAL" message is sent to the Android application by the microcontroller through GSM.

- As the Android application receives the "TEMP NORMAL" message, it retrieves the sender information and sends back a message "RFF@" to the microprocessor through GSM. This message is actually a command to the microprocessor to turn-off the fan. Thus the processor turns-off the panel cooler fan through the relay circuit. Whenever there is no light around the system, the microcontroller sends a "NO LIGHT" message to the Android application through GSM commands.
- As the Android application receives the "NO LIGHT" message, it retrieves the sender information and sends back a message "RBO@" to the microprocessor through GSM. This message is actually a command to the microprocessor to turn-on the bulb. Thus the processor turns-on a bulb through the relay circuit. As and when the bulb is turned-on and light is detected around the system, the microcontroller sends a "LIGHT DETECTED" message to the Android application through GSM commands. As the Android application receives the "LIGHT DETECTED" message, it retrieves the sender information and sends back a message "RBF@" to the microprocessor through GSM. This message is actually a command to the microprocessor to turn-off the bulb. Thus the processor turns-off the bulb through the relay circuit. Whenever any smoke is detected around the system, the microcontroller sends a "CO DETECTED" message to the Android application through GSM commands. The parameter status is displayed at the Android application, as and when a message is received by the application or a command is sent by the application through GSM.

Thus through the system, the parameters temperature, light and smoke are monitored remotely through the Android application with the help of Embedded GSM.

IV RESULTS

The following are the outputs displayed at the Android application.

1. When a "TEMP HIGH" is received as shown in Fig.2
2. As and when the temperature becomes normal and the fan is off as shown in Fig.3

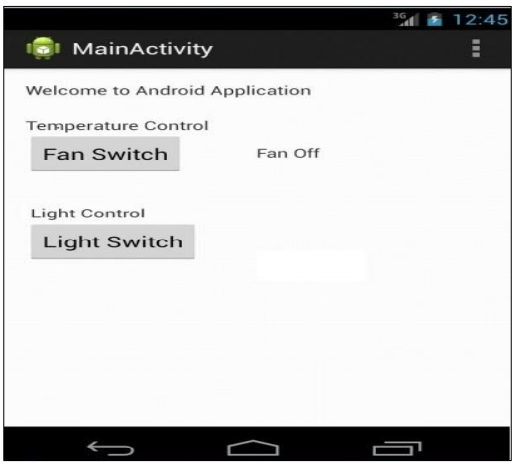

Fig. 2: Output when "Temperature is High" **Fig. 3: Output when "Fan is Off"**

3. The application showing the current temperature value as shown in Fig.4
4. When a "NO LIGHT" message is received as shown in Fig.5

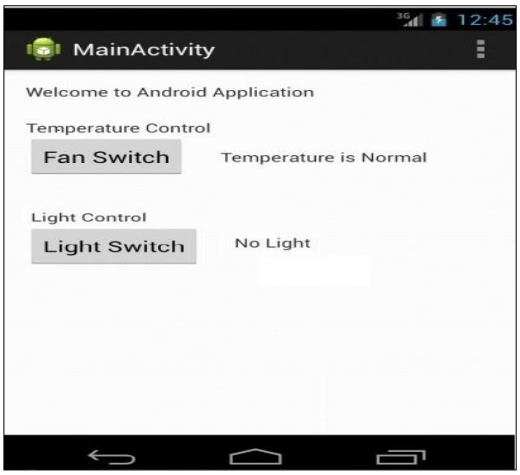

Fig. 4: Output displaying "Current Temperature" **Fig. 5: Output when "No LIGHT" is detected**

4. As and when the bulb is on and light is detected as shown in Fig 6
5. When smoke is detected as shown in Fig.7

Fig. 6: Output when Light is detected **Fig. 7: Output when smoke is detected**

V CONCLUSION AND FUTURE SCOPE

The solution "Embedded GSM Monitor and Control Using Android Application" has been successfully designed, developed and tested. This system is designed and implemented with ARM7 TDMI controller in embedded system domain. The system has been implemented using advanced ICs and fast growing technology like Android Applications. The on-the-go monitoring and controlling of the parameters is successfully achieved using Android application.

Experimental work has been carried out carefully. The results show that the requirements are efficiently fulfilled using the embedded system and Android Application. Presence of every module has been reasoned out and placed carefully, contributing to the best working of the unit.

The future work can include the following enhancements:

- Inclusion of remote, on-the-go smoke control. This requires the enhancement of the android application to take necessary actions like dialing to 101 whenever smoke is detected with a pre-recorded voice.
- Smoke control may also include sending an SMS to the related staff / calling them with pre-recorded voice.
- For improving the security, whenever an un-authorized person enters the building which has the system, the doors to it and other important systems must be locked for the person.

The break-in entry of any person must be responded with an immediate call to police, security and other important members of the staff with a pre-recorded voice along with a lock of the main door.

REFERENCES

[1] V.L. Varaprasad Nagula, M.Venkateswara Rao, T.Raghavendra Vishnu, *"Embedded Ethernet Monitor and Controlling Using Web Browser"*. IJESAT - Jan-Feb 2012.

[2] Vini Madan, S.R.N. Reddy "*GSM - Bluetooth based Remote Monitoring and Control*" IJCA Volume 46– No.1, May 2012.

[3] B. Purna V. Subbarao , L. Chandarashekar , V. Santhisri "*Wireless Patient Monitoring System Using GSM*" IJECCE - Volume 3, Issue 3.

[4] Hua Fu, Tao Wang, Cui Yang. "*Gas monitoring system based on ARM and information fusion*." Application of electronic technique. 2009(11) 39-42.

[5] YU Cheng-bo, LIU Jie, and TAO Hong-yan, "*Research on remote monitor technology of equipment*," Information and Control, Magn. China, vol.31 (3), pp.236-240, June 2002.

[6] Maglaveras, N., Home care delivery through the mobile telecommunications platform.

[7] http://developer.android.com/guide/components/index.html.

[8] Microcontroller designing by Mazidi and Mazidi.

[9] w.ww.keil.com/dd/docs/datashts/philips/ LPC2101/02/03 product data sheet.

[10] Global System for Mobile communication – http://www.iec.org