Indian Journal of Science and Technology, *Vol 10(25), DOI: 10.17485/ijst/2017/v10i25/110664, July 2017*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Domestic Equipment Control using Raspberry Pi and GSM Module through Android Application

Shaik Abdul Wajid and T. Anuradha

Department of Electronics and Computer Science Engineering, K L University, Guntur – 522502, Andhra Pradesh, India;
sonuwajid42@gmail.com, anuradha_ecm@kluniversity.in

Abstract

Objective: The main aim of the project is to control the home and the industrial equipment from a distant place by using the raspberry pi through android application and also through a web server. **Methodology:** Controlling of the equipment from a remote place is done through both android application and web server. Based on the type of equipment, different types of sensors are interfaced to raspberry pi. Each sensor senses the surroundings and gives the data to raspberry pi. Then processor displays the sensor data in web server and android application, based on which user will control the equipment. **Findings/Improvements:** In this system, the data is updated for every pulse and if the sensor exceeds the threshold value, automatically user receives the SMS using Global System for Mobile Communication GSM module. Then the user can login to either the application or web server and control the equipment. **Application/Improvements:** The main advantage of this project from the already existing work is that the application is logged out automatically and the user need not logged into the application continuously. Whenever the sensor exceeds the threshold value, user gets the alert message then only he need to login to the android application or web server and control the required equipment.

Keywords: Android Application, GSM Modem, Raspberry Pi 2, Sensors, Wireless Communication

1. Introduction

In earlier days, controlling of equipment is done through wired system and communication is also done by wired technology.[1,2] Now a day, controlling of any equipment is done remotely through wireless technology.[3] Mainly controlling of home and industrial equipment is necessary in these days for different purposes. Home appliances can be controlled remotely by transferring data directly using internet or any wireless modules.[4] Home appliances like light, fan, door, gas detection, fire detection and security can be operated remotely. Similarly, industrial applications like detection of gas leakages, temperature, moisture etc. are controlled remotely using internet data transfer or any wireless data transfer.[5] In the existing system, controlling of equipment is done through the use of android application or through the web server.[6] User gets the message alerts whenever the sensor detects any abnormal condition.

In the present work, different types of sensors are used for different purposes like temperature sensor for detecting fire, moisture sensor for detecting moisture, MQ2 gas sensor for detecting gases like LPG, hydrogen and methane, LDR for detecting Light intensity, and IR sensor for detecting door or shutter status.[7] For each type of application, a sensor is used, which senses the surrounding data and send it to the processor BCM 2836. An Android application is created by Java and web server is designed for showing each sensor output and controlling each load. Android application is developed with user name

**Author for correspondence*

and password for each user. Whenever any user wants to control the load first he need to login to the application by user name and password and then he can control.[8]

For each sensor, a threshold value is arranged, whenever the sensor crosses the threshold value, user gets a message alert by GSM modem interfaced to Raspberry pi 2. GSM modem is interfaced with Attention commands for each action.[9] A sensor node is used for collecting all the sensor data and gives it to the processor. Similarly, output node is used to collect the output data from processor and control the load.

2. System Overview

2.1 Raspberry Pi 2

The Raspberry pi 2 is a small computer of credit-card size that can be plugged into the keyboard, monitor, or touch display. The Raspberry pi 2 model B with six times higher processing speed compared to other previous models is used in this project. It has a processor named Broadcom BCM2836. This processor is a high powered ARM cortex-A7 based 900MHz speed and 1GB memory quad-core processor. It has GPIO Header with 40 pins required for interfacing of different external devices to communicate with the processor.[10] Different communication media like I2C, CAN, SPI can be used. In this project TRX and RXI pins in GPIO are connected directly to the GSM. The Raspberry pi board has Micro SD card slot, quad USB ports, DSI Display connector, 10/100 Base T Ethernet socket, HDMI port, 5V Micro USB, 4-pole 3.5 mm jack and CSI camera connector as shown in Figure 1.

Different varieties of operating systems are used with different models of raspberry pi. In the present model of Raspberry pi 2, Raspbian OS is used. Raspbian is an operating system which works on the basis of Debian optimize compatible to Raspberry Pi hardware and available as open source. This also has an Open image processing library based on Open CV.

The application is developed with Qt creator which uses C++, JavaScript and a QML IDE which is a part of SDK for designing Qt graphical applications. It has the facility of visual debugging and forms designing. For different OS, it has different compilers.

2.2 GSM

For transmitting the mobile voice and data services, a digital cellular technology Global System for Mobile communications abbreviated as GSM is used. GSM works at 900 MHz or 1,800 MHz frequency band and uses TDMA digital wireless telephone technology.

The data is transmitted with a speed up to 9.6 Kbit/s using GSM. GSM contains two links for transmission of data like uplink and downlink. The uplink (sending data from the mobile station to the base station) frequency of GSM-900 is 890–915 MHz and downlink (sending data in the other direction) frequency is 935–960 MHz. It contains 124 RF channels with a spacing of 200 kHz and a Duplex spacing of 45 MHz.

GSM modem is directly connected with transmission and receiving pins of raspberry pi 2 (TXI, RXI), GSM TXI pin connected to raspberry pi 2 RXI pin and vice versa with common ground. The GSM modem interfacing with Raspberry pi 2 is shown in Figure 2.

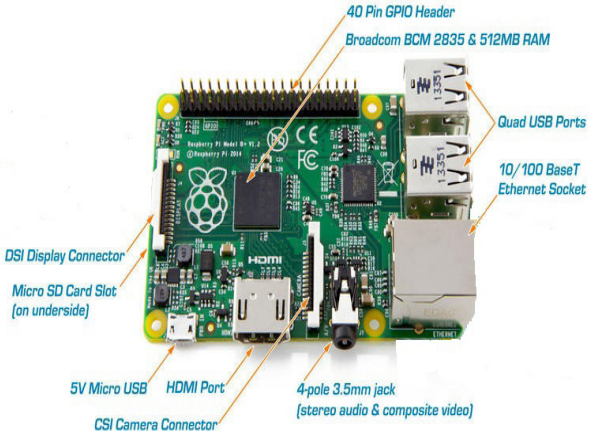

Figure 1. Raspberry Pi board.

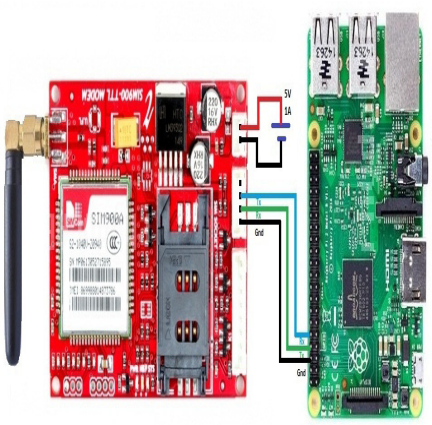

Figure 2. GSM modem.

2.3 Temperature Sensor

A sensor converts one kind of energy into electrical energy and here the temperature of surrounding area need to be sensed. For this purpose, LM35 is used as temperature sensor.[11] LM35 is an integrated temperature sensor, its output voltage varies linearly with temperature.[11] An Analog to Digital converter is used to convert the output of the LM35 which is in analog form into digital form. LM35 has a very low self-heating of less than 0.1°C in still air and it draws only 60 µA from its power supply. It is operated over a temperature range of −55° to +150°C. Figure 3 shows the connection of temperature sensor to raspberry pi 2.

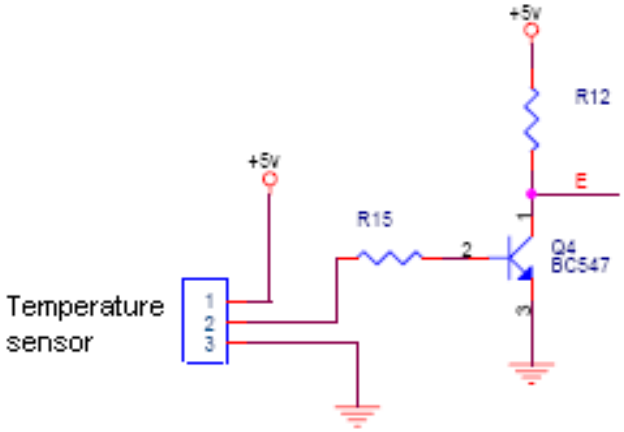

Figure 3. Temperature Sensor.

2.4 Moisture Sensor

Measuring the moisture of the soil is required in agriculture to help the farmers for managing their water supply to the field's efficiently.[12] Soil moisture sensors are used for this purpose. A probe is designed with multiple soil moisture sensors. To grow the crop with high quality, generally the farmers use less water in the critical stage of the plant growth by better management of soil moisture.

The soil moisture sensor can be used in all types of soils and they give reliable readings. They can be placed either on the surface or at any depth in the soil. This sensor gives the readings with a ±3% precision. Connection of moisture sensor to the controller is shown in Figure 4.

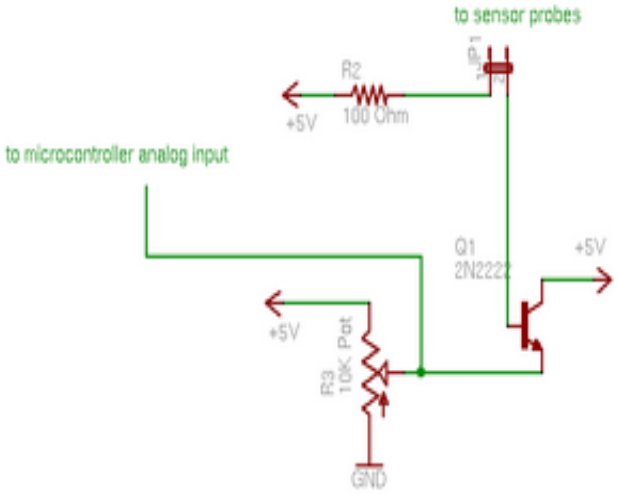

Figure 4. Moisture sensor.

2.5 IR Sensor

An IR (Infrared) sensor detects surrounding objects by sensing object radiation as well as its motion. In the infrared spectrum range, all objects emit some amount of thermal radiations. These are not visible to the naked eye but an infrared sensor can detect them.[13] The emitter and detector act like IR LED and IR photodiode respectively. This IR sensor consists of LM 35 IC for IR transmitter and receiver, resistor of kilo ohms range, variable resistor for sensitivity adjustment and LED.

2.6 Gas Sensor

Gas sensor will detect the leaked gases like LPG, propane and hydrogen, methane and smoke etc. In our study MQ2 gas sensor is used for detection of leakage gases. MQ2 is high sensitive to the LPG, propane and hydrogen gases. It contains 4 pins for supply, ground, output pins as analog output and digital output. This MQ2 sensor is connected to GPIO pins of raspberry pi 2.

2.7 LDR

Light Dependent Resistor (LDR) is used for home applications like automatic light control. It changes its resistance based on the light falling on it.

3. Operation

The block diagram of the entire system is shown in Figure 5.

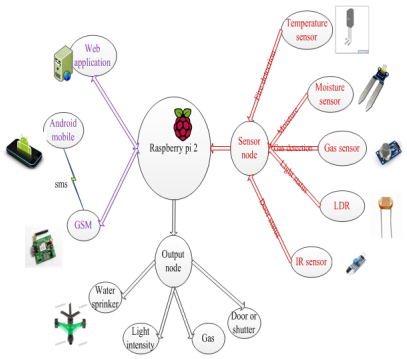

Figure 5. System block diagram.

The system consists of Raspberry pi 2 with BCM 2836 as a processor. All the sensors are connected with raspberry pi 2 as inputs and all the types of loads connected with the processor as an output. For controlling purpose we use android application and web server. A threshold value is set for each sensor. Whenever a sensor crosses that value, an alert message will be sent to user mobile using GSM modem. The processor consists of 1GB for storing sensor data, applications and other data. Initially all the sensors read the surroundings and send that read data to the processor. The processor accepts all the sent data from sensors and check if any sensor data crossed its threshold value. If any sensor value exceeds its cutoff value, an alert message will be sent to user and particular output load will be controlled either automatically or manually. To control manually, user has to login to the web server or android application. The entire operation of the system is shown as a flow chart in Figure 6.

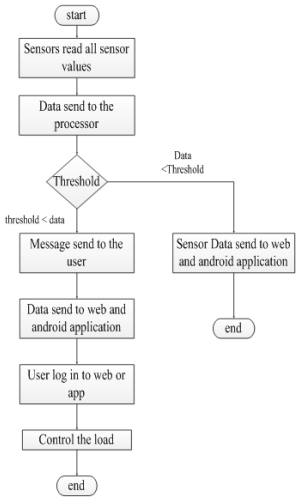

Figure 6. System flow chart.

4. Implementation of the System

The hardware kit of the entire system is shown in Figure 7.

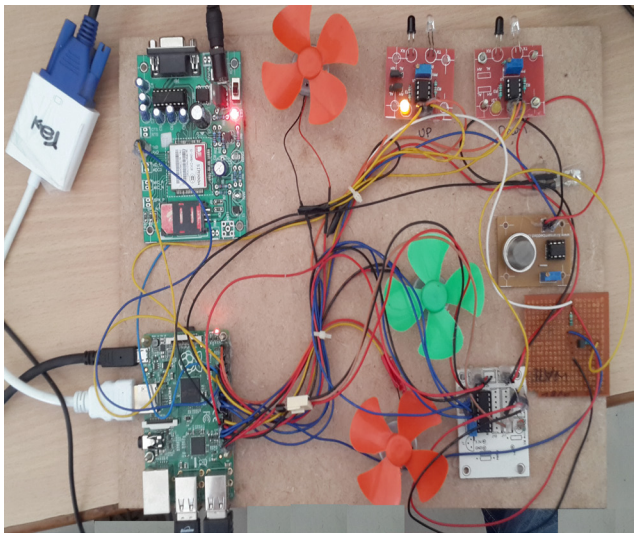

Figure 7. Hardware kit.

In this system to check the output, dc motors are used. Whenever output gets signal, particular motor will be switched on. The application is developed for controlling the home and industrial equipment. For each type of application, an on or off button is placed for controlling manually. Whenever user wants to control from a distant place, he needs to login to the android application and control at any time. The application is shown in Figure 8.

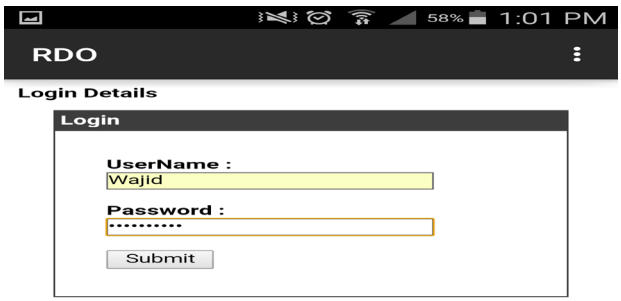

Figure 8. Android application login display.

This system requires a Wi-Fi module for internet usage. The commands used for running the application are Linux based as the OS used in Raspberry pi is Raspbian OS. When the application is run using sudo, a terminal will be developed as shown in Figure 9. From that terminal, user knows all sensor values.

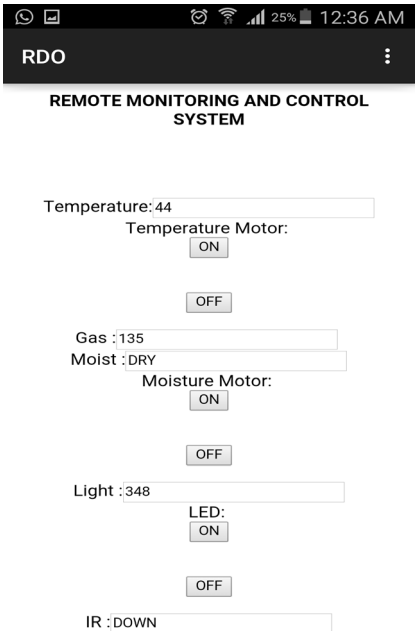

Figure 9. Sensor data.

Figure 10 represents the output terminal in a PC.

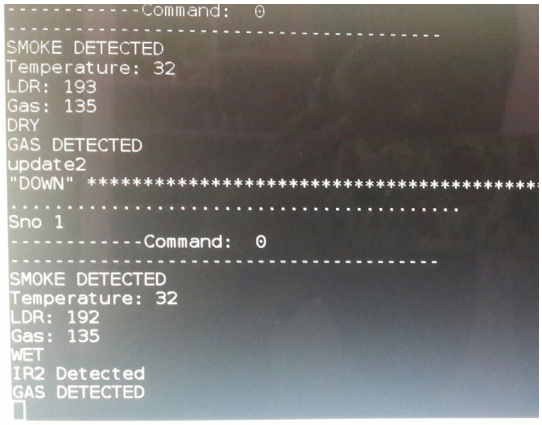

Figure 10. Output terminal in PC.

5. Conclusion

This system deals with controlling of all the domestic and industrial equipment by using different sensors. It is designed based on real time requirements for home and industrial applications. It provides high security standards created by giving separate user name and password for different users. It needs Wi-Fi continuously when the user is operating the system. This system is very efficient, user friendly and works with high speed.

6. References

1. Yunze Z. Intelligent control system for domestic appliances. Wireless Communications Networking and Mobile Computing (WiCOM). 2010 International Conference; 2010 Sep 6. Crossref
2. Lee HB, Park LJ, Park SW, Chung TY, Moon JH. Interactive Remote Control of Legacy Home Appliances through a Virtually Wired Sensor Network. IEEE Transactions on Consumer Electronics. 2010; 56(4). Crossref
3. Bian J, Fan D, Zhang J. The new intelligent home control System based on the dynamic and intelligent gateway. Broadband Network and Multimedia Technology (IC-BNMT). Proceedings of 2011 4th IEEE International Conference on BNMT; 2011. Crossref
4. Ng WL, Ng CK, Noordin NK, Rokhani FZ, Ali BM. Home Appliances Controller using Wireless Controller Area Network (WCAN) System. International Conference on Computer and Communication Engineering (ICCCE); 2010; Kuala Lumpur, Malaysia. IEEE; 2010. Crossref
5. Chen JY, Kuan JT, Wen FL, Lin SJ. A Remote Control System for Home Appliances using the Internet and Radio Connection. IEEE International Symposium on Computer Aided Control Systems Design; 2014 Sep; Taipi, Taiwan. IEEE; 2014 Sep.
6. La HJ, Kim SD. A Service-based Approach to Developing Android Mobile Internet Device (MID) Applications. Service Oriented Computing and Applications (SOCA). IEEE International Conference; 2009. p. 1–7
7. Baghyasree T, Janakiraman K, Parkavi D. Efficient Remote Video Monitoring for Industrial Environment Based on LPC2148 and GSM. Indian Journal of Science and Technology. 2014; 7(9):1333–4.
8. Morris ME, Adair B, Miller K, Ozanne E, Hansen R, Pearce AJ, Santamaria N, Viegas L, Long M, Said CM. Smart Home Technologies to Assist Older People to Live Well at Home. Journal of Aging Science. 2013; 1(1):1–9.
9. Chen CY, Tsoul YP, Liao SC, Lin CT. Implementing the design of smart home and achieving energy conservation. 7th IEEE International Conference on Industrial Informatics (INDIN); 2009 Jun. p. 273–6. Crossref
10. Download the Required Operating System [Internet]. Available from: Crossref
11. Precision Centigrade Temperature Sensors [Internet]. [updated 2000 Nov]. Available from: Crossref
12. Nhivekar GS, Mudholkar RR. Microcontroller Based IR Remote Control Signal Decoder for Home. Advances in Applied Sciences Research. 2011; 2(4):410–6.
13. Nallani S, Hency VB. Low Power Cost Effective Automatic Irrigation System. Indian Journal of Science and Technology. 2015 Sep; 8(23):1–6. Crossref