

A Mobile Based Embedded Solution for Automatic Field Irrigation using Zigbee and GSM Modem

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Abstract — This paper aims to present the design and implementation of automatic field irrigation system. The researchers aim to utilize the presented technology for use in the agricultural activities. Indian villages are facing the problem of abrupt electric power supply and at the same time irrigation of fields depends on availability of electric power. If the power is available at midnight, farmers have to run to the farm immediately and this affects their day-to-day life. The present work provides a novel approach to solve these types of problems of the farmers. It is a microcontroller (P89v51rd2) based system which works as a brain and controls all activity it also includes GSM modem used for call/message sending and receiving. Farmer can check the status (humidity, moisture, water level) of the field at any time by using his mobile phone. Sensors are used to collect data from the field and Zigbee module is used for wireless communication. Farmer can control the motor and irrigation status from home by using mobile phone.

Keywords— GSM MODEM, P89v51rd2, ZIGBEE

I. INTRODUCTION

The primary purpose of the system explained in this research paper is to solve the problems encountered by the farmers due to unavailability of power and because of the fact that the field is usually at quiet a distance from the residence of the farmer. Moreover in the current scenario, human intervention is continuously required to monitor the water fed to the field. Thus the system explained below will provide the farmer the facility to turn ON/OFF the motor by just a phone call. The system will automatically detect the water level in the farm and thereafter will stop the motor automatically reducing the need for human intervention.

II. DESIGN METHODOLOGY

A complete hardware is developed for the system mentioned. DIPTRACE software has been used for PCB designing, Keil micro vision 4 has been used for 'C' code compilation and Flash Magic has been used for loading the hex file in EPROM of microcontroller.

The hardware details are as follows:-

- 1) Phillips 8051 microcontroller (p89v51rd2) – It is an 80C51 microcontroller unit(MCU) with 64 kB Flash and 1024 bytes of data RAM with ISP (In-System Programming) and IAP (In-Application Programming).
- 2) GSM modem –GSM/GPRS TTL UART Modem is built with Dual Band GSM/GPRS engine- SIM900, works on frequencies 900/ 1800 MHz. The level The baud rate is configurable from 9600-115200 through AT command. The GSM Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface.

GSM Modem Features

- High Quality Product
 - Dual-Band GSM/GPRS 900/ 1800 MHz
 - Configurable baud rate
 - SIM Card holder.
 - Built in Network Status LED
 - Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
 - Audio interface Connector
 - Normal operation temperature: -20 °C to +55 °C
 - Input Voltage: 3.6- 4.5 VDC
- 3) Real Time Clock – RTC-DS 1307 is used to send the date and time information to MCU.

Zigbee TX and RX module –The XBee/XBee-PRO ZNet 2.5 OEM (formerly known as Series 2 and Series 2 PRO) RF Modules are engineered to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices.

- 4) Liquid Crystal Display (LCD).
- 5) Relay—To switch ON/OFF the motor.
- 6) Relay Driver—ULN 2803 is used, to energize the relay, it gives 15-20mA current for relay to energize.
- 7) Sensors—Transistors BC-547 are used to sense the water at appropriate places, used in simple CE mode as a switch.HSM 20G is used as a humidity sensor and Soil moisture sensors measure the water content in soil. A soil

moisture probe is made up of multiple soil moisture sensors.

8) DIP Switch – Used for mode selection.

III MODES OF OPERATION

The system operates in three modes-

1. Mobile mode
2. Auto mode

For mode selection 3 DIP switches are interfaced to the 8051.

1. Mobile mode -In this mode, user can switch ON/OFF the motor and valve using his mobile phone by sending message .This message is encrypted and only the receiver can decrypt it .To receive the message a GSM modem is used, which can receive call, send call ,receive message and send message. A message will be initiated by user which will be received by GSM modem at the farm. This message will consist of specific words which indicates turning ON/OFF motor or valve. Only GSM modem will be able to understand this message and the microcontroller is programmed in such a way. Next, the microcontroller will receive serial data from modem and if it is correct it will energize the relay to turn ON/OFF the motor and valve. As the motor turns ON water starts spreading in the field. There are various sensors mounted over the entire field. These sensors are connected to the Zigbee transmitter, which will communicate to the Zigbee receiver. As the water reaches every corner, sensors will sense and indicate to the Zigbee TX. TX will send this to RX and finally to the microcontroller. As a result Controller will switch off the motor through relay and at the same time inform to GSM modem, which will immediately send the message to the user. In this mode user can check the status of the field (water level, humidity, moisture, etc.) simply by sending a message to the modem.

2. Auto mode– In this mode motor/valve will start automatically if power is available. This system is more secure, as the farmers send the message, this message consists of special symbols only the person who knows the symbol can operate the system.For Example if the message is “turn on” in our system we have added this message like this:”#\$%#turnon\$\$*\$\$” Unauthentic person must also know the mobile number of GSM modem SIM. We are using Zigbee because it is better as compares to RF and other wireless technology as far as the range, interference and cost is concerned.

IV FLOW CHART

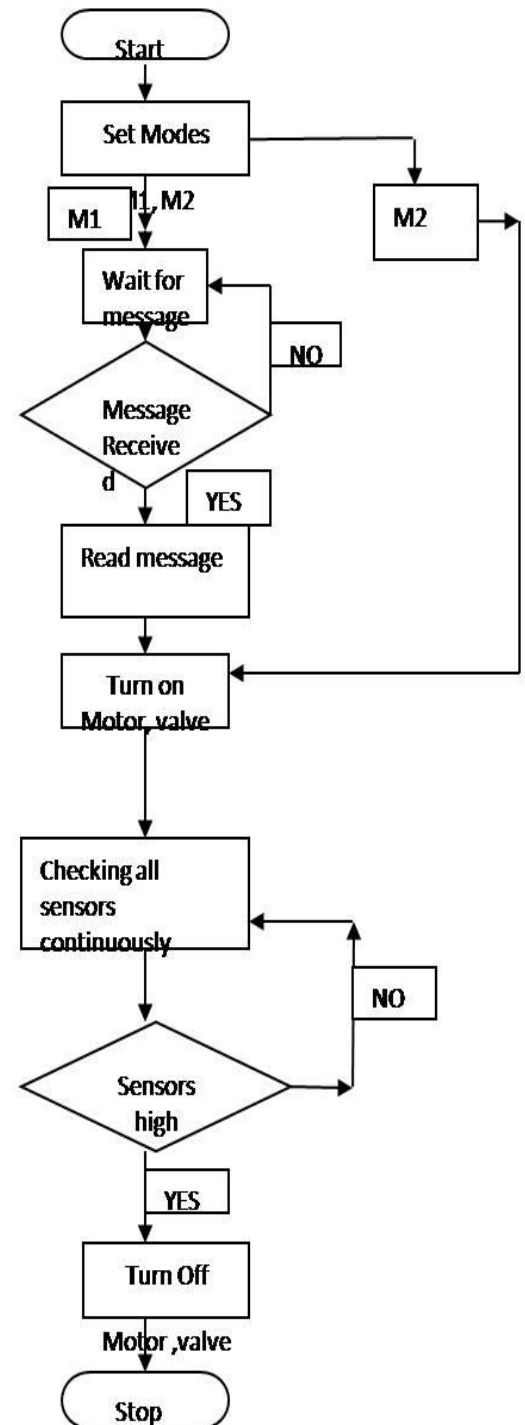


FIGURE1.1: FLOW CHART OF OVERALL SYETEM

V BLOCK DIAGRAM

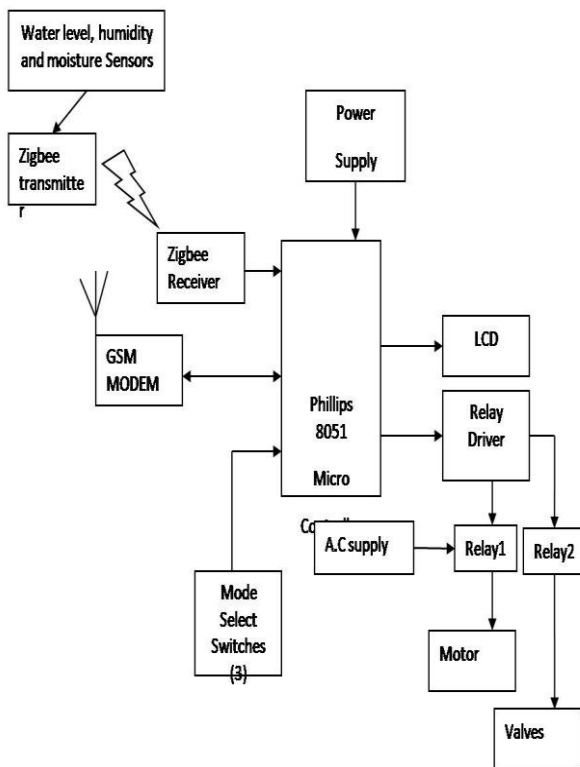


FIGURE 1.2: BLOCK DIAGRAM OF THE SYSTEM

VII RESULTS AND DISCUSSIONS

During the development stages the various units of the hardware are evaluated individually and as an integrated unit. The software is also tested using the KEIL uvision 4 simulator.

Flash Magic is used for EPROM burning.

The image below shows the code for message sending through modem.

```

p4.c
37     send(*a++);
38 }
39 void sendSMS(char * num ,char *message )
40 {
41     myprintf("AT");
42     send(0x0D);
43     delay();
44     myprintf("AT+CMGF=1");
45     send(0x0D);
46     delay();
47     myprintf("AT+CMGS=");
48     send("");
49     myprintf(num);
50     send("");
51     send(0x0D);    // FOR ENTER
52     delay();
53     myprintf(message);
54     send(0x1A);    // FOR CTRL + Z
55     delay();
56 }
57
58
59 main()
60 {
61     int j;
62     sw1=sw2=1;
  
```

Figure 1.3: keil uvision3 for 'c' programming

SIM 900 has been used as a GSM modem.

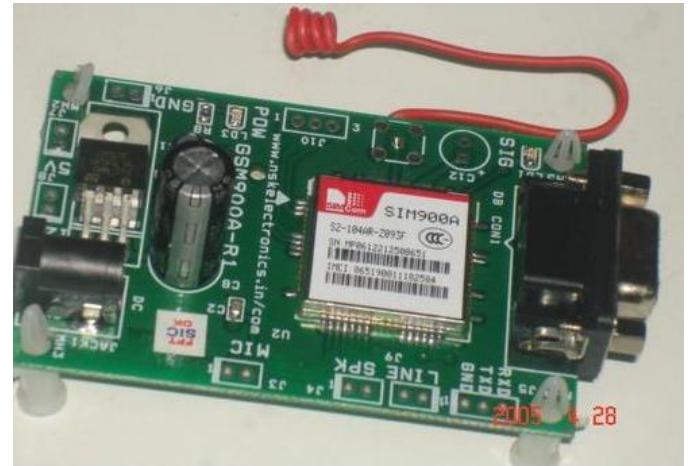


Figure 1.4 SIM 900 top view

VIII CONCLUSION AND FUTURE SCOPE

The system has been developed with a sole purpose to help the farmer in irrigating his field. The entire project is low cost and user friendly also it is completely a wireless system so no wiring is need at the farm. Since we are using Zigbee, it works on large areas also. It also reduces manpower and waste of water. The approach used in designing the whole system is simple, applicable and practical. This system is fully secured because the message send by the user is encrypted so any unauthentic person cannot operate this system.

This system can be used in chemical industries to monitor and control the liquid level from a distant location. It can be used to monitor various sub-sections in a plant simultaneously.

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