A

Project Report

On

"GREENHOUSE MONITORING AND CONTROLLING SYSTEM"

Submitted to

KIT'S COLLEGE OF ENGINEERING (AUTONOMOUS) KOLHAPUR,
AFFILIATED TO SHIVAJI UNIVERSITY, KOLHAPUR

IN PARTIAL FULFILMENT FOR THE REQUIREMENT FOR THE

DEGREE OF

BACHLOR OF TECHNOLOGY

In

Electronics & Telecommunication Engineering

Submitted By

Miss. Patil Namrata Narayan (2122010008)

Miss. Mugade Sanjyoti Sambhaji (2122010170)

Miss. Chavan Aishwarya Balasaheb (2122010194)

Miss. Godase Vaibhavi Pandurang (2122010165)

Under The Guidance Of

Prof. P. D. Sawant

KOLHAPUR INSTITUTE OF TECHNOLOGY'S
COLLEGE OF ENGINEERING
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DEPRTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
K.I.T's COLLEGE OF ENGINEERING (Autonomous), KOLHAPUR.
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DECLARATION

I hereby declare that, the thesis entitled "Greenhouse Monitoring and Controlling System" completed and written by me has not formed earlier has basis for the award of any degree or similar title or any other University or examining body. Further, I declare that I have not violated any of the previsions under the acts of Copyright/Privacy/Cyber/IPR etc. amended from time to time.

Place: Kolhapur

Date:

Miss. Namrata Narayan Patil

Miss. Sanjyoti Sambhaji Mugade

Miss. Aishwarya Balasaheb Chavan

Miss. Vaibhavi Pandurang Godase

CERTIFICATE

I hereby certify that the work which is being presented in the BTech. Project Report entitled **“Greenhouse Monitoring And Controlling System”,** in partial fulfilment of the requirements for the award of the **Bachelor of Technology in Electronics & Telecommunication Engineering** and submitted to the Department of Electronics & Telecommunication Engineering of Kolhapur Institute of Technology's College of Engineering, Kolhapur is an authentic record of my work carried out during a period from **July 2023 to April 2024** under the guidance of **Mr. P. D. Sawant,** Assistant professor, Electronics & Telecommunication Department, KITCOEK. The matter presented in this Project Report has not been submitted by me for the award of any other degree elsewhere.

Namrata Patil   Sanjyoti Mugade   Aishwarya Chavan   Vaibhavi Godase

This is to certify that the above statement made by the students is correct to the best of my knowledge.

Prof. P. D. Sawant Project Guide	Dr. A. L. Renke Project Coordinator
Dr. Y. M. Patil Head of E&TC	Dr. M. B. Vanarotti Director

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Yours Sincerely,

Miss. Patil Namrata Narayan

Miss. Mugade Sanjyoti Sambhaji

Miss. Chavan Aishwarya Balasaheb

Miss. Godase Vaibhavi Pandurang

ABSTRACT

The greenhouse monitoring and controlling can be done by using various technologies. The purpose of this project is to identify field conditions and offer field-related information. This includes an ARM7 processor, an LCD display, a GSM, and a few sensors. LCD will be used for field displays. A Subscriber Identity Module (SIM) that a user can communicate via this SIM-Number which is included in the GSM module. The corresponding sensor instantly activates in response to a specific command issued by the user, reads the current reading, sends the results to the user's mobile device, and displays the information on the field's LCD panel. If required, the appropriate action will be taken right away. Because of the automatic working of this project, it reduces the manpower.

Keywords—ARM7 LPC2148 Microcontroller, Sensors, GSM Modem, User Mobile phone

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Chapter1:

Introduction

1.1 Introduction:

The use of technology has led to significant changes in the agricultural industry, with farmers adopting advanced techniques to improve crop yield, quality, and efficiency. One of the most significant advancements in this area is greenhouse farming, which provides a controlled environment for optimal plant growth. By precisely managing factors such as pH levels, soil moisture, water levels, temperature, humidity, and light intensity, greenhouse cultivation can help increase productivity. In recent years, the integration of microcontroller-based systems with sensor technologies has made it possible to monitor and control greenhouse environments in real time.

Figure 1.1 Greenhouse System

This project uses an ARM 7 Microcontroller. The system integrates six essential sensors, including pH, soil moisture, water level, temperature and humidity, PIR, and Light Dependent Resistor (LDR), and a GSM Modem along with SIM. The primary goal of the project is to develop a reliable, cost-effective, and scalable solution for greenhouse management that meets the increasing demand for sustainable agricultural practices. By utilizing the capabilities of the ARM 7 Microcontroller and sensor technology, the project aims to optimize resource utilization, enhance crop productivity, and reduce environmental impacts associated with traditional farming methods. This system provides a solution for the optimization of water use, security of the greenhouse, determining the nature of soil and weather monitoring.

1.2 Problem Definition:

Nowadays, in many countries people are more centralized towards towns because farming is not an easy task and farmers don’t get enough earnings through farming. Recent statistics shows us that the growth rate of farmers in India has slowed down over decade and causing the fall in rice production. By automation of agricultural processes, people can easily monitor cultivation process from time to time even when they are not available in the field.

The most common problems faced in agriculture fields are need for regular manual irrigation, detection of disease associated with plants, effects on abnormal plant growth and safety of the crop field.

Chapter 2:

Literature Survey

2.1 Present Theories:

The project is thus carried out using ARM7TDMI core with the help of GSM technologies. This project finds application in domestic agricultural field. In civilian domain, this can be used to ensure faithful irrigation of farm field, since we have the option of finding out moisture level of soil in a particular area.

2.1.1 Automated irrigation system using wireless sensor network:

Joaquin Gutierrez, Juan Francisco Villa-Medina, "Automated irrigation system using wireless sensor network and GPRS module", VOL.63 No.1, January 2014 An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants.

The automated system was tested in a sage crop field for 136 days and water savings of up to 90% compared with traditional irrigation practices of the agricultural zone were achieved. Three replicas of the automated system have been used successfully in other places for 18 months. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited and geographically isolated areas.

2.1.2 A Prototype for agricultural intrusion detection wireless sensor network:

Sanku Kumar Roy, Sudip Misra, "A Prototype for agricultural intrusion detection wireless sensor network", Conference Paper, June 2015.The attack of animals in the agricultural land and the theft of crops by humans cause heavy loss in cultivation. In this work, we propose a hardware prototype using Wireless Sensor Network (WSN) for intruder detection in an agricultural field. The proposed system is named Agricultural Intrusion Detection (AID). It helps to generate alarms in the farmer's house and at the same time transmits a text message to the farmer's cell phone when an intruder enters into the field.

Chapter 3: Methodology

3.1 Block diagram

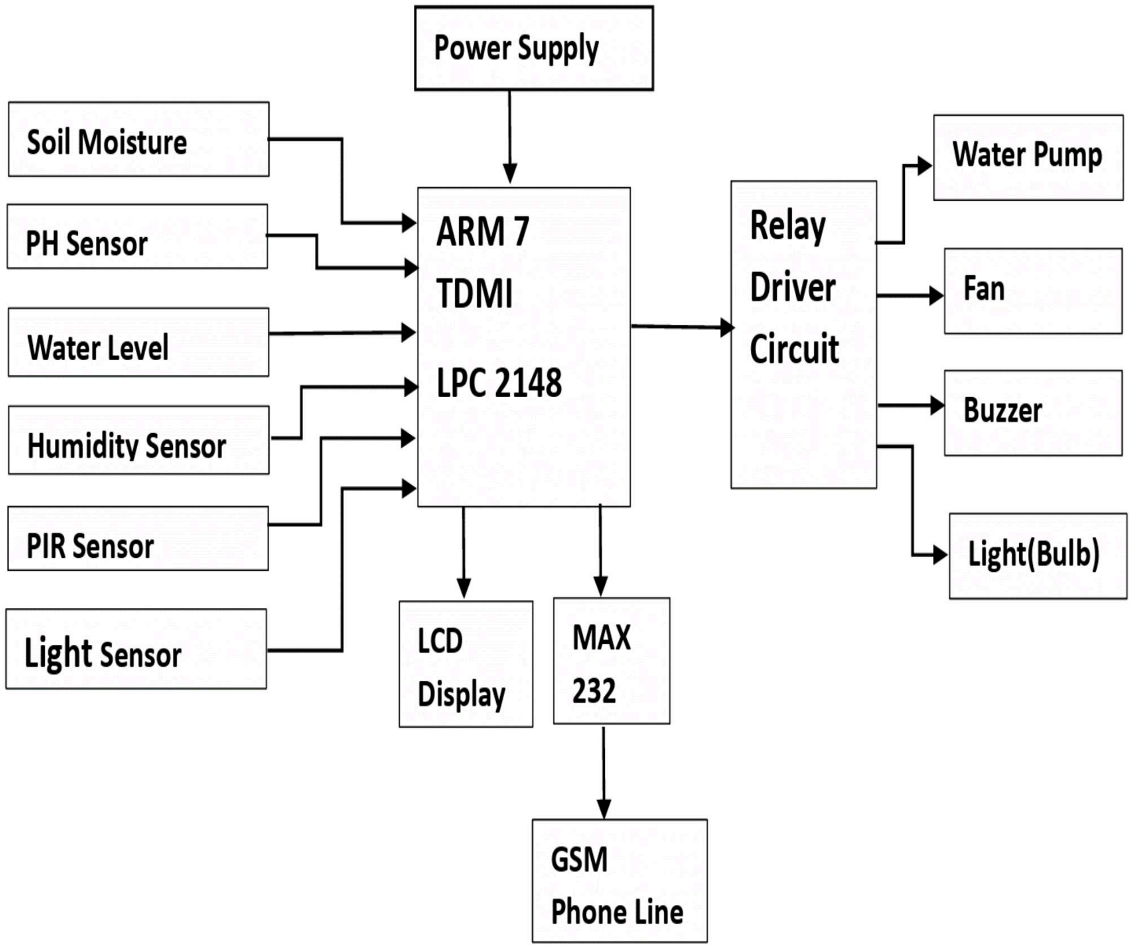

Figure 3.1 Block Diagram

This system includes a microcontroller, sensors and a GSM phone line. If one of the parameters of the sensors exceeds the safety threshold that must be maintained to protect the crop. These sensors detect the change and the microcontroller reads it from the data on its input ports after the microcontroller's ARM 7 ADC converts it to digital form. The microcontroller then takes the necessary actions using relays until the divergent parameter is reset to the optimal level. However, since the microcontroller is used as the heart of the system, it makes installation cheap and efficient. This system consists of various sensors, namely soil moisture, humidity, temperature, pH, PIR, water level and light sensors.

3.2 Hardware and software

3.2.1 LPC2148 ARM7:

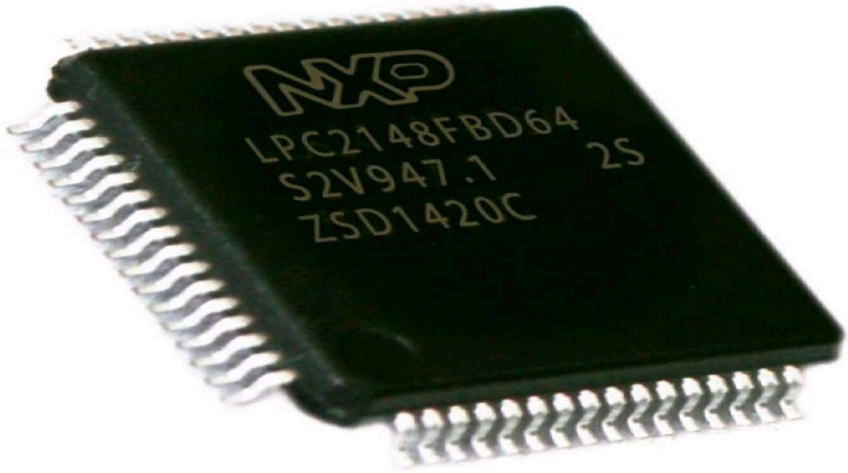

Figure 3.2.1 LPC2148 Microcontroller

The LPC2148 microcontrollers are based on a 32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support that combine microcontroller with embedded high speed flash memory upto 512 kB. A 128-bit wide memory interface and unique accelerator architecture 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. This board is powered by USB port and does not need external power supply. It is ideal for developing embedded applications involving high speed wireless communication (Zigbee / Bluetooth / WiFi), USB based data logging, real time data monitoring and control, interactive control panels etc. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. n this system, sensors are used to analyse moisture & water content of agriculture field. This is completely based on scientific methods and using this we can observe agriculture field continuously. The real-time atomization system, we are developing is an alternative and efficient method for Agriculture. This system reduces water usage in any agriculture land. It also increases yields and quality by controlling watering to land. The system reduces human effort and it is also easy to use project.

Features of LPC2148

The main features of LPC2148 include the following.

- The LPC2148 is a 16 bit or 32 bit ARM7 family based microcontroller and available in a small LQFP64 package.
- ISP (in system programming) or IAP (in application programming) using on-chip boot loader software.
- On-chip static RAM is 8 kB-40 kB, on-chip flash memory is 32 kB-512 kB, the wide interface is 128 bit, or accelerator allows 60 MHz high-speed operation.
- It takes 400 milliseconds time for erasing the data in full chip and 1 millisecond time for 256 bytes of programming.
- Embedded Trace interfaces and Embedded ICE RT offers real-time debugging with high-speed tracing of instruction execution and on-chip Real Monitor software.
- It has 2 kB of endpoint RAM and USB 2.0 full speed device controller. Furthermore, this microcontroller offers 8kB on-chip RAM nearby to USB with DMA.
- One or two 10-bit ADCs offer 6 or 14 analogs i/ps with low conversion time as 2.44 μs/ channel.
- Only 10 bit DAC offers changeable analog o/p.
- External event counter/32 bit timers-2, PWM unit, & watchdog.
- Low power RTC (real time clock) & 32 kHz clock input.
- Several serial interfaces like two 16C550 UARTs, two I2C-buses with 400 kbit/s speed.
- 5 volts tolerant quick general purpose Input/output pins in a small LQFP64 package.
- Outside interrupt pins-21.
- 60 MHz of utmost CPU CLK-clock obtainable from the programmable-on-

- chip phase locked loop by resolving time is 100 μs.
- The incorporated oscillator on the chip will work by an exterior crystal that ranges from 1 MHz-25 MHz.

3.2.2 GSM Module:

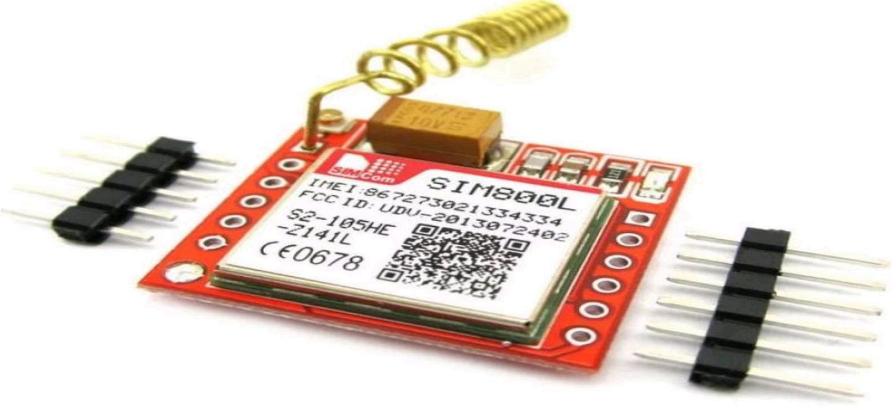

Figure 3.2.2 GSM Module

1. SIM 800L
2. Power supply 3.4V ~4.4V
3. Frequency bands - Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900
4. Transmitting power
    1) Class 4 (2W) at GSM 850 and EGSM 900
    2) Class 1 (1W) at DCS 1800 and PCS 1900

5. Temperature range
    1. Normal operation: -40°C ~ +85°C
    2. Storage temperature -45°C ~ +90°C
6. SMS
    a. MT, MO, CB, Text and PDU mode
    b. SMS storage: SIM card
    c. SIM interface Support

3.2.3 Sensor:

1. PH Sensor:

Figure 3.2.3 (i) PH Sensor

The PH sensor measures the hydrogen-ion activity in water- based solutions, we usually use it to measure the PH of a liquid. It is widely used in the chemical industry, the pharmaceutical industry, the dye industry, and scientific research where acidity and alkalinity testing is required. The drive board in this kit support both 3.3V and 5V system.

1. Operating voltage - 3.3V/5V
2. Range - 0-14PH
3. Resolution - ±0.15PH（STP）
4. Response time - ＜1min
5. Probe Interface - BNC
6. Measure temperature - 0-60℃
7. Internal resistance - ≤250MΩ（25℃）

2. **PIR Sensor:**

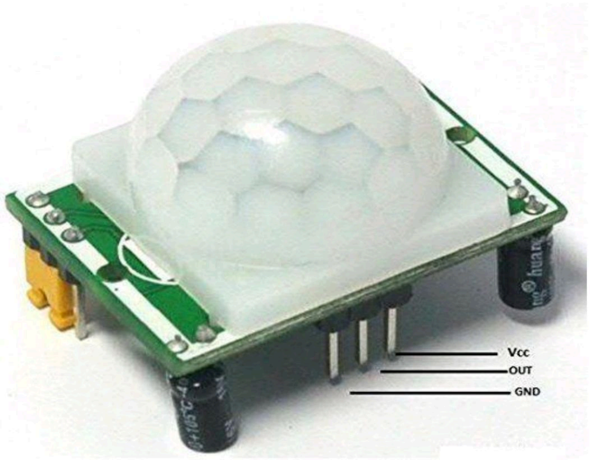

Figure 3.2.3 (ii) PIR Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range.

1. Input Voltage- DC 4.5V ~ 20V
2. Static Current - <50uA
3. Output Signal - 0V / 3V (Output high when motion detected)
4. Sensing Range - 7 meters (120-degree cone)
5. Delay time - 8s ~ 200s (adjustable)
6. Operating Temperature -15℃ ~ +70℃
7. Dimensions - 24mm*32mm*25mm (Height with lens)

3. **Water level Sensor:**

Specifications of Sensor:

1) Operating voltage: DC3-5V
2) Operating current: less than 20mA
3) Sensor Type: Analog
4) Detection Area: 40mmx16mm

5) Operating temperature: 10℃-30℃
6) Humidity: 10% -90% non-condensing

Figure 3.2.3(iii) Water Level Sensor

4. Soil Moisture Sensor:

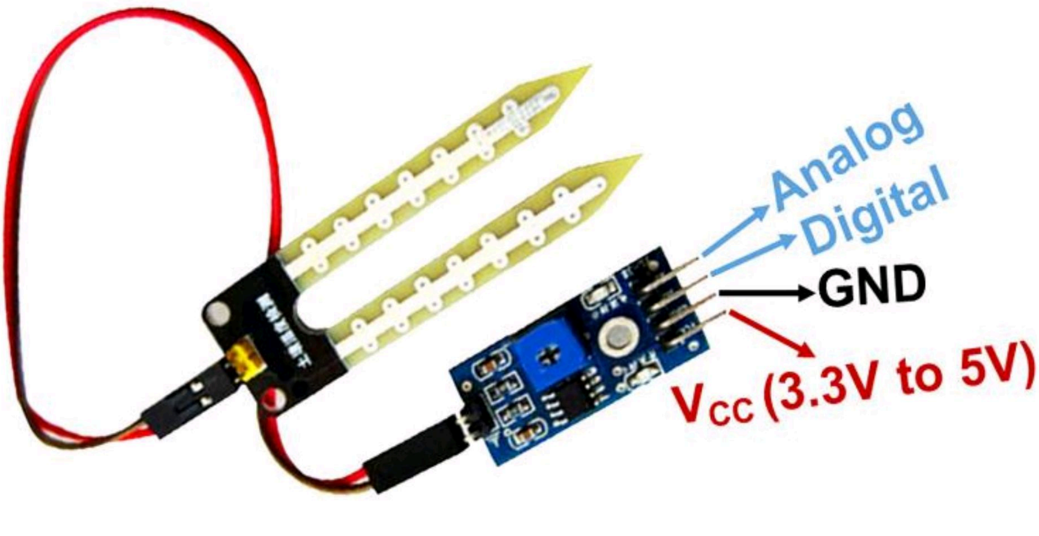

Figure 3.2.3(iv) Soil Moisture Sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons.

5. **Humidity Sensor:**

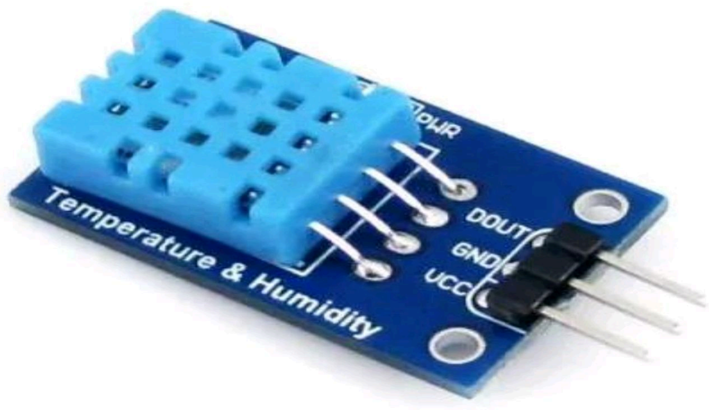

Figure 3.2.3(v) Humidity Sensor

Table. 1 Specifications of Humidity Sensor

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
			8 Bit	
Repeatability			±1%RH	
Accuracy	25℃		±4%RH	
	0-50℃			±5%RH
Interchangeability	Fully Interchangeable			
Measurement Range	0℃	30%RH		90%RH
	25℃	20%RH		90%RH
	50℃	20%RH		80%RH
Response Time (Seconds)	1/e(63%)25℃, 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature				
Resolution		1℃	1℃	1℃
		8 Bit	8 Bit	8 Bit
Repeatability			±1℃	
Accuracy		±1℃		±2℃
Measurement Range		0℃		50℃
Response Time (Seconds)	1/e(63%)	6 S		30 S

3.2.4 Output Devices:

1. **Relay:**

   Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

   Single-Channel Relay Module Specifications

   1) Supply voltage – 3.75V to 6V
   2) Quiescent current: 2mA
   3) Current when the relay is active: ~70mA

4) Relay maximum contact voltage – 250VAC or 30VDC
5) Relay maximum current – 10A

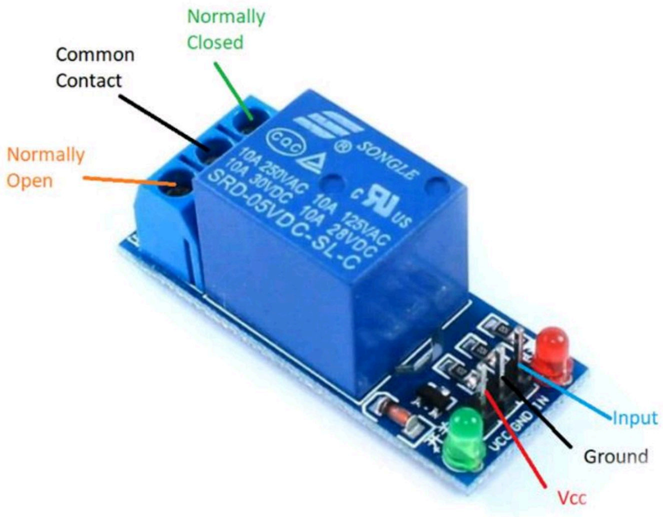

Figure 3.2.4 Relay Module

2. Water pump
3. Buzzer
4. Fan

3.2.5 LCD Display:

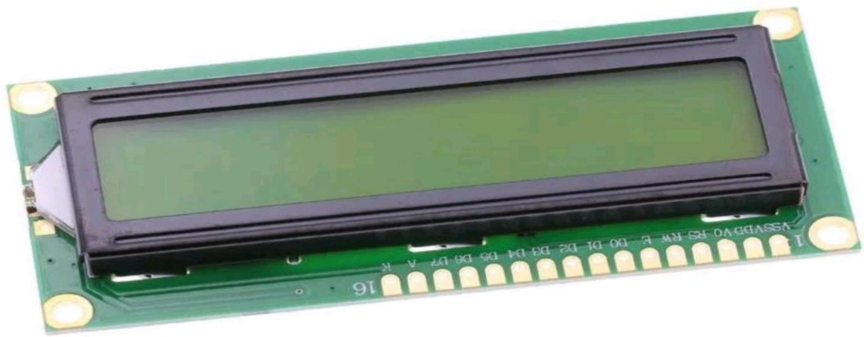

Figure 3.2.5 LCD Display

Model: LCD1602

1.Character Colour: Black

2.Backlight: Gray

3.Supply voltage: 5V

4.Dimensions (L x W x H) mm.: 80 x 36 x 10

3.2.6 **Power Supply**:

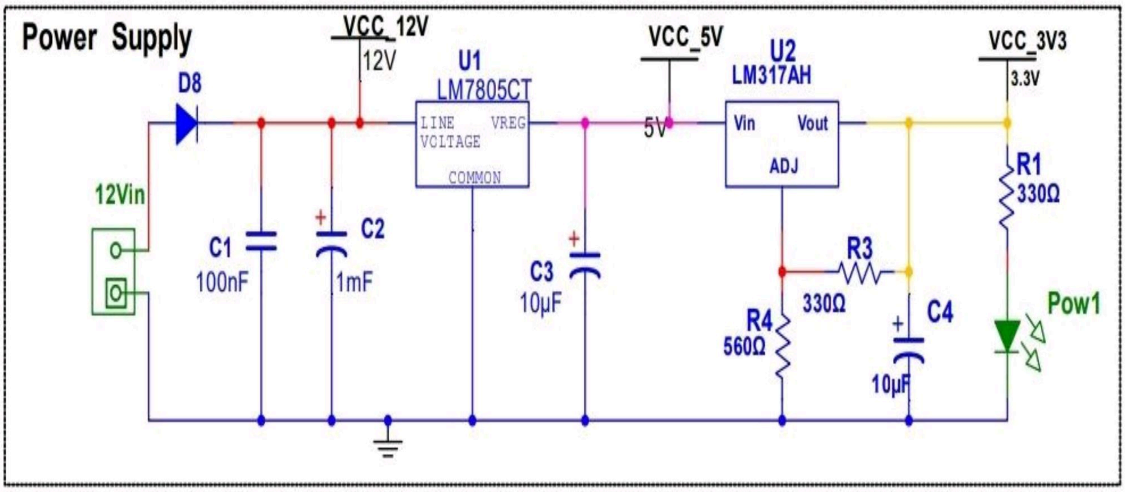

Figure 3.2.6 Design circuit diagram for Power Supply

3.2.7 Software Keil:

Keil is a German software subsidiary of Arm Holdings. It was founded in 1982 by Günter and Reinhard Keil, initially as a German GbR. In April 1985 the company was converted to Keil Electronic GmbH to market add-on products for the development tools provided by many of the silicon vendors. Keil implemented the first C compiler designed from the ground-up specifically for the 8051 micro controller.

Keil provides a broad range of development tools like ANSI C compiler, macro assemblers, debuggers and simulators, linkers, IDE, library managers, real-time operating systems (currently RTX5) and evaluation boards for over 8,500 devices. In October 2005, Keil (Keil Electronic GmbH in Munich, Germany, and Keil Software, Inc. in Plano, Texas) were acquired by Arm. Since the merger with Arm, the company is still active in providing products and services.

3.3 Circuit Diagram:

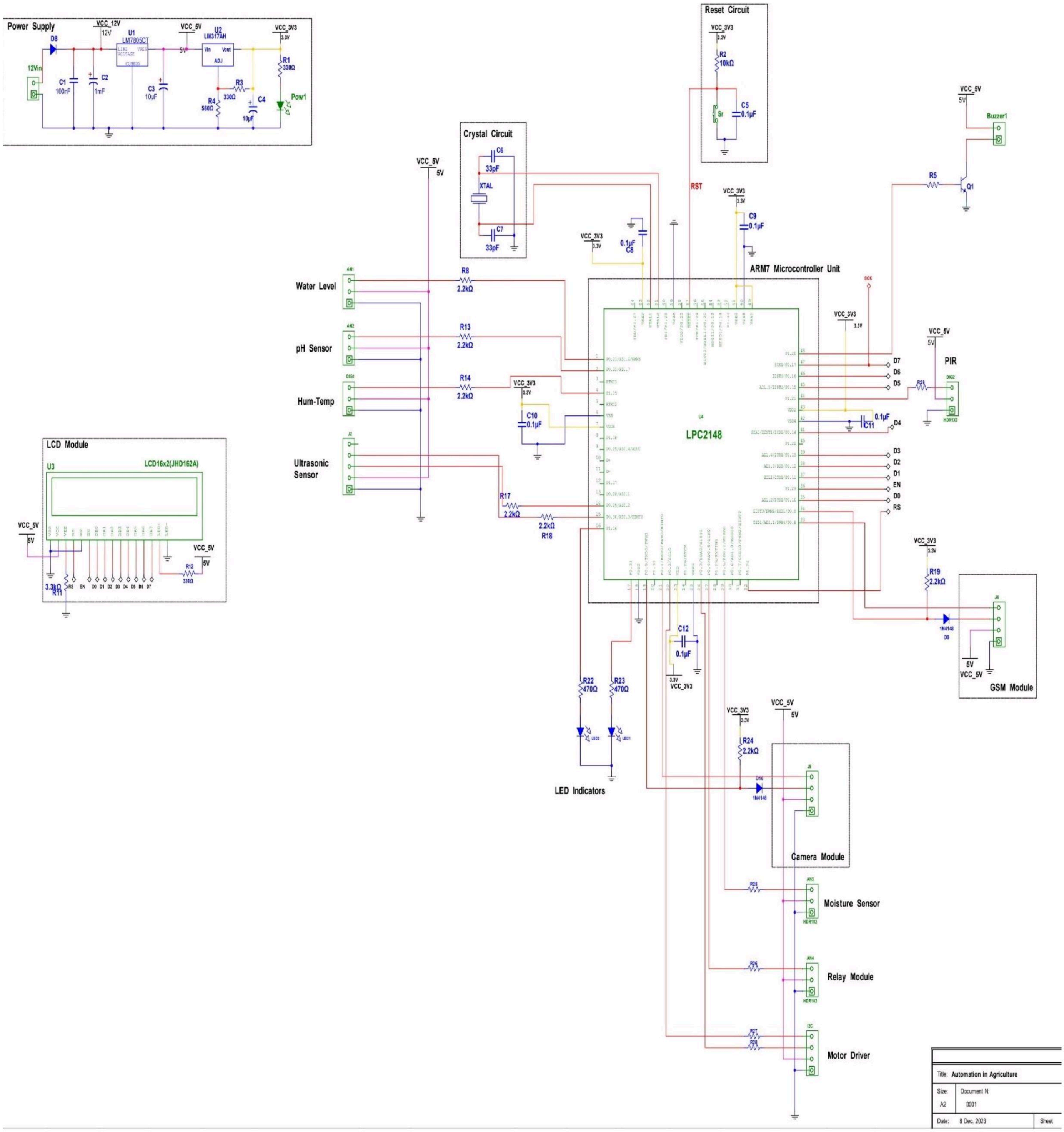

Figure 3.3 Circuit Diagram of Project

3.4 Flowchart:

3.4.1 Software Flowchart for Irrigation System

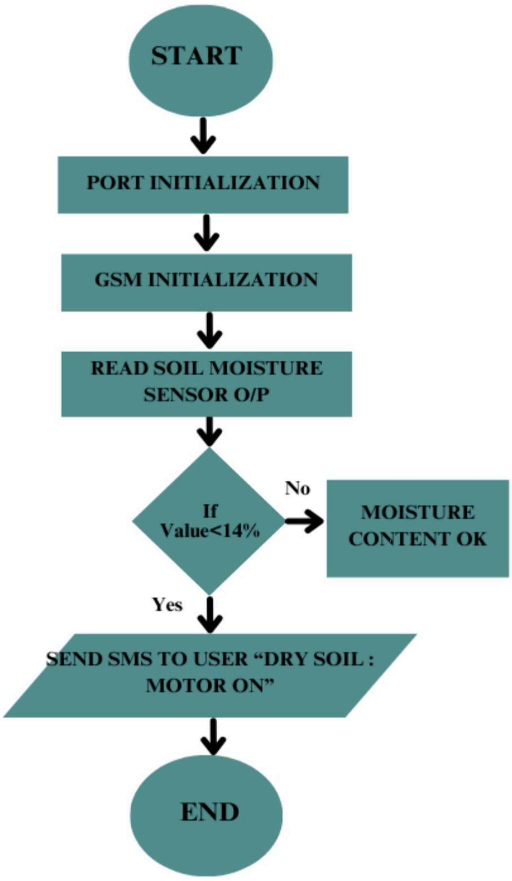

Figure 3.4.1 Flowchart for Irrigation System

The system determines the soil's nature by determining the various pH levels in the soil. The pH level can be acidic, neutral or alkaline. Soil pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most plants is between 5.5 and 7.0. The pH sensor is used to measure the pH of soil the sensor is connected to the ARM7 through in-built ADC. The pH value and the soil nature are displayed on LCD. Thus, by knowing the pH level in the soil, the farmer can decide which fertilizer can be used on the crops. The pH value will be sent to the user through GSM.

3.4.2 Software Flowchart for Weather Monitoring

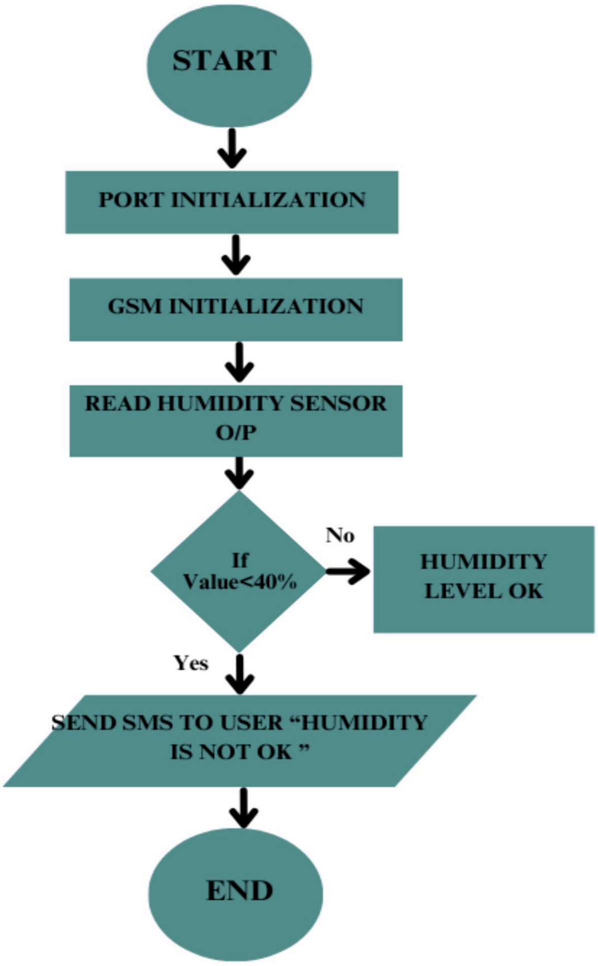

Figure 3.4.2 Flowchart for weather monitoring System

LDR, Temperature and humidity sensors are used to monitor weather conditions and depending on the input the fan and the light can be controlled. In the light detector, we use one LDR (light-dependent resistor). The resistance of LDR depends on the light intensity. When the light of the LDR changes, the resistance of the LDR also changes.

3.4.3 Software Flowchart for Intruder Detection

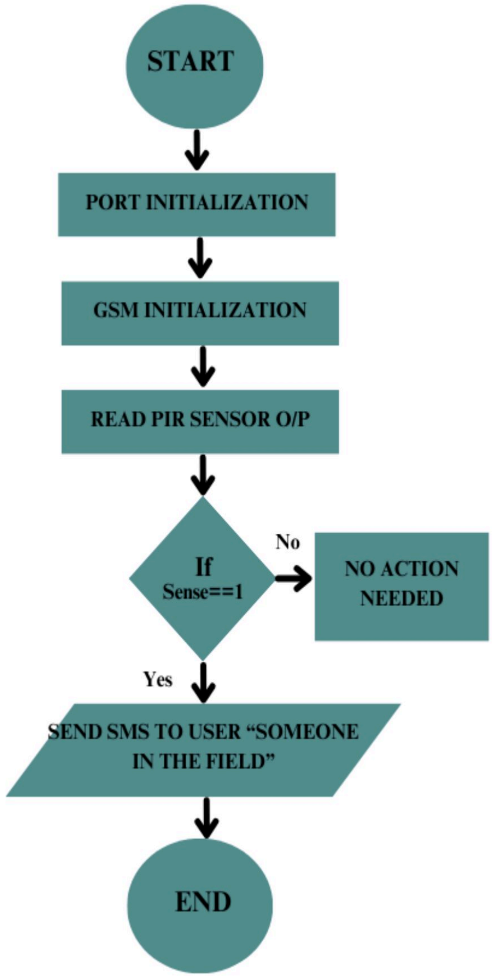

Figure 3.4.3 Flowchart for Intruder detection

Nowadays security in the agricultural field is very important. Intentional destruction or contamination of crops is a possibility that producers must guard against. A system has been designed to protect the crop in the field. The system is implemented which detects any intruder entering the field by using a PIR sensor. A PIR sensor can detect the motion.

3.4.4 Software Flowchart for Determine the Soil nature

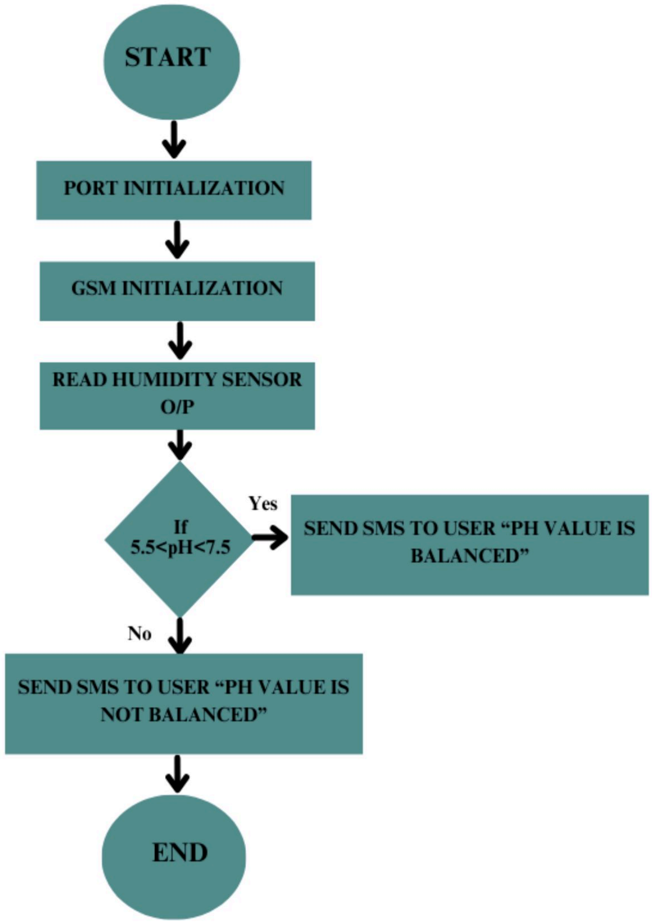

Figure 3.4.4 Flowchart for determining soil nature

This system uses water level and soil moisture sensors. A water level sensor is used to determine whether water is available in the tank or not. The soil moisture sensor checks the conductivity of the soil.

When the field is wet, the conductivity is higher and the resistance is lower.

When the field is dry, the conductivity is lower and the resistance is higher

The moisture value will be sent to the user through GSM. and depending on this we can turn ON/OFF the water pump/motor.

3.5 System Code:

Main.c File:

```
#include "Main.h"

U16 sendXbeeCnt = 0;

extern U8 enableRecMsg1;
U8 Rec_GSM_Data = 0;
U8 Rec_Ph_Data = 0;
U16 sensCnt = 0, smsCnt = 0;

U8 Rec_Other_Data = 0;
extern U8 curSerialDevice;
U8 gsmReady = 0;

U8 dispBuff[15];
U8 *strAdrr = NULL;
U8 cnt = 0;

U32 dhtData = 0;
U16     tmp = 0, hum = 0;
U16 waterLevel = 0, mois = 0;
U8 motn = 0;
U8 mot = 0;

U8 soilPhCmd[] = {0x01, 0x03, 0x00, 0x0d, 0x00, 0x01, 0x15, 0xC9, 0x00};
U16 phVal = 0;



int main (void)
```

```
{
InitializeSystem();

//          PrintString(0x80, (U8 *)" Automation in  ");
//          PrintString(0xC0, (U8 *)"Agriculture Sytm");
PrintString(0x80, (U8 *)"   Green House  ");
PrintString(0xC0, (U8 *)"Mon & Ctl System");

// Blink LED & buzzer
SetBit(LED1_OUT, LED1);
SetBit(LED2_OUT, LED2);
SetBit(BUZZER_PORT, BUZZER);
_delay_ms(500);
ClearBit(LED1_OUT, LED1);
ClearBit(LED2_OUT, LED2);
ClearBit(BUZZER_PORT, BUZZER);
_delay_ms(500);

//          USART0_Transmit_String_Logic("UART0", 0);
//          USART1_Transmit_String_Logic("UART1", 0);

_delay_ms(2500);
ClearLCD();
PrintString(0x80, (U8 *)"ARM7 - LPC2148 ");
_delay_ms(1500);
ClearLCD();

PrintString(0x80, (U8*)"Initializing GSM..");
_delay_ms(500);

gsmReady = 0;
if(Init_GSM() == 1)
{
```

```
        SetBit(LED1_PORT, LED1);
        PrintString(0x80, (U8*)"GSM Initialized..");
        _delay_ms(100);
        ClearBit(LED1_PORT, LED1);
        gsmReady = 1;
    }
    else
    {
        PrintString(0x80, (U8*)"GSM Error!!      ");
    }

    while(1)
    {
        UartReceiveHandler();                    // Serial data reception handling

        if(sensCnt > 200)                  // Read sensor data within 200 ms loop
        {
            sensCnt = 0;
            SetBit(LED2_OUT, LED2);

            // Send pH sensor command
            RS_485_TX_EN();
            _delay_ms(5);
            sendStrLenU1(soilPhCmd, 8);
            _delay_ms(2);
            RS_485_RX_EN();                // pH sensor reception enabled


            // Read water level
            waterLevel = ADC1Read(6);              // Read raw adc value
            waterLevel = GetWaterLevel(waterLevel);   //  Convert  into  some
            range
```

```
// Read temp & hum
dhtData = ReadDHT11_1();
hum = dhtData >> 24;            // Get High Byte of Humidity
tmp = (dhtData & 0xFF00) >> 8;       // Get High Byte of Temp
// Read PIR sensor
motn = TestBit(PIR_PIN, PIR);
// Read moisture
mois = ADC0Read(7);
mois = GetMoisture(mois);

// Compare with thresholds
if(waterLevel <= WATER_LEVEL_THRESH || tmp > 40)
{
	ToggleBit(BUZZER_PORT, BUZZER);
	ClearBit(RELAY_PORT, RELAY);              // Turn off motor
	mot = 0;
//			PrintString(0xC0, (U8*)"Water level low!");
//			_delay_ms(200);
}
else
{
	ClearBit(BUZZER_PORT, BUZZER);
}
//SetBit(RELAY_PORT, RELAY);
if(waterLevel > WATER_LEVEL_THRESH)
{
	if(mois >= MOISTURE_THRESH)
	{
		ClearBit(RELAY_PORT, RELAY);
		mot = 0;
	}
	else if(mois < (MOISTURE_THRESH - 50))
	{
```

```
            SetBit(RELAY_PORT, RELAY);
            mot = 1;
        }
}

// Display all sensor values
ClearLCD();
// Water level
itoa((char*)dispBuff, waterLevel, 10);    // Convert integer into ascii
PrintString(0x80, (U8*)"W:");
PrintStringWoAddr((U8*)dispBuff);
// Temperature
utoa((char*)dispBuff, tmp ,10);
PrintStringWoAddr((U8 *)" T:");
PrintStringWoAddr(dispBuff);
// Humidity
utoa((char*)dispBuff, hum ,10);
PrintStringWoAddr((U8 *)" H:");
PrintStringWoAddr(dispBuff);

itoa((char*)dispBuff, phVal, 10);          // pH
PrintString(0xC0, (U8*)"p:");
PrintStringWoAddr((U8*)dispBuff);

itoa((char*)dispBuff, motn, 10);           // Motion
PrintStringWoAddr((U8 *)" M");
PrintStringWoAddr((U8*)dispBuff);

itoa((char*)dispBuff, mois ,10);           // Moisture
PrintStringWoAddr((U8 *)" R");
PrintStringWoAddr(dispBuff);

itoa((char*)dispBuff, mot ,10);
```

```
            PrintStringWoAddr((U8 *)" T");                         // Motor
            PrintStringWoAddr(dispBuff);

            ClearBit(LED2_OUT, LED2);
        }
        // Send SMS after 1 min
        if(smsCnt > 60000)
        {
            smsCnt = 0;
            SendSensSms();                // Send values thr sms
        }
        _delay_ms(1);
        sensCnt++;
        smsCnt++;
    }
}

// Use this if different freq multiplication/division required
void PLL_Init(void)
{
 PLL0CON = 0x01;                 //Enable PLL
 PLL0CFG = 0x24;                 //2 = Divide by 2, 4 = Multiply by 5
 PLL0FEED = 0xAA;                //Feed sequence
 PLL0FEED = 0x55;

 while(!(PLL0STAT & 0x00000400)); //is locked?

 PLL0CON = 0x03;                 //Connect PLL after PLL is locked
 PLL0FEED = 0xAA;                //Feed sequence
 PLL0FEED = 0x55;
 VPBDIV = 0x01;                  // PCLK is same as CCLK i.e.60 MHz
}
```

```
void InitializeSystem(void)
{
MEMMAP = 0x01;                          //Map interrupt vectors to Flash (Very
IMP)
VPBDIV = 0x01;                          // PCLK same as FOSC (i.e. CCLK)
(APBDIV)
//      VPBDIV = 0x00;                          // APB bus clock (PCLK) is one
fourth of the processor clock (CCLK)
PLL0CFG = 0;
PLL1CFG = 0;
PLL0CON = 0;
PLL1CON = 0;

//      PLL_Init();

IO0DIR = 0;
IO1DIR = 0;
IO0PIN = 0;
IO1PIN = 0;
PINSEL0 = 0;
PINSEL1 = 0;
PINSEL2 = 0;

ClearBit(LED1_OUT, LED1);
ClearBit(LED2_OUT, LED2);

SetBit(LED1_DIR, LED1);                           // LED dir out
SetBit(LED2_DIR, LED2);                           // LED dir out

MakePinOutput(BUZZER_DDR, BUZZER);
MakePinOutput(RELAY_DIR, RELAY);

MakePinInput(PIR_DIR, PIR);
```

```
SetBit(MOTOR_DIR, MOTOR);
ClearBit(MOTOR_PORT, MOTOR);

MakePinOutput(SEL_TX_RX_DIR, SEL_TX_RX);                    //  For  RS-485
TX RX
RS_485_RX_EN();              // Enable reception

InitLCD();              // Commands to LCD

USART0Initialize(BAUDRATE_9600);              // For GSM
USART1Initialize(BAUDRATE_9600);              // For pH sensor

SetBit(PINSEL1, 11);
                        // Set P0.21 as analog i/p AD1.6 for Water level
SetBit(PINSEL0, 10); SetBit(PINSEL0, 11);          // Set P0.5 as analog i/p AD0.7
for Moisture sensor

ADC0Initialize();
ADC1Initialize();
// Use 12MHz or less crystal. By default crystal freq multiplied by 5.
// Tick "Memory Layout from Target Dialog" in target options to enable interrupt
operations
}

U8 UartReceiveHandler(void)
{
U8 statusCode = 0;
U8 *strPtr = 0;
if(Rec_Ph_Data == 1)
{
        // Frame format: <adrr cmd val>
        //
```

```
        _delay_ms(10);

        // Reply from ph sensor: 0x01 0x03 0x02 0x00 0x47 0xD8 0x15

        strPtr = (U8*)strchr((const char*)receiveBufferUART1, PH_SENS_ADDR);
        if(strPtr != 0)
        {
                _delay_ms(10);
                strPtr++;

                if(*strPtr == 0x03)
                {
                        //strPtr++;
                        phVal = ((U16)strPtr[2] << 8) + strPtr[3];
//                              utoa((char*)dispBuff, phVal ,10);
//                              USART0_Transmit_String_Logic("\rph Val:", 0);
//                              USART0_Transmit_String_Logic(dispBuff, 0);
                        statusCode = 1;
                }
        }

        Rec_Ph_Data = 0;
        receiveCounterUART1 = 0;
        receiveBufferUART1[0] = 0;
        //RS_485_TX_EN();
}

if(Rec_GSM_Data == 1)
{
//              sendStrU1("\rGSM:");
//              sendStrU1(receiveBufferUART0);
//              sendStrU1("\r");
```

```
        Rec_GSM_Data = 0;
        receiveCounterUART0 = 0;
        receiveBufferUART0[0] = 0;
}
return statusCode;
}


U8 smsBuf[250];
const U8 mobNum[] = "9119454991";

void SendSensSms(void)
{
ClearLCD();
PrintString(0x80, (U8*)"Sending SMS..");

smsBuf[0] = 0;

strcat(smsBuf, "WL: ");
itoa((char*)dispBuff, waterLevel, 10);
strcat(smsBuf, dispBuff);

strcat(smsBuf, "\r\nTemp: ");
itoa((char*)dispBuff, tmp, 10);
strcat(smsBuf, dispBuff);
strcat(smsBuf, "\r\nHum: ");
itoa((char*)dispBuff, hum, 10);
strcat(smsBuf, dispBuff);

strcat(smsBuf, "\r\npH: ");
itoa((char*)dispBuff, phVal, 10);
strcat(smsBuf, dispBuff);
```

```
strcat(smsBuf, "\r\nMotn: ");
itoa((char*)dispBuff, motn, 10);
strcat(smsBuf, dispBuff);

strcat(smsBuf, "\r\nMoist: ");
itoa((char*)dispBuff, mois, 10);
strcat(smsBuf, dispBuff);

strcat(smsBuf, "\r\nMotr: ");
itoa((char*)dispBuff, mot, 10);
strcat(smsBuf, dispBuff);

/*      utoa((char*)dispBuff, tmp ,10);
PrintStringWoAddr((U8 *)" T:");
PrintStringWoAddr(dispBuff);
utoa((char*)dispBuff, hum, 10);
PrintStringWoAddr((U8 *)" H:");
PrintStringWoAddr(dispBuff);

itoa((char*)dispBuff, phVal, 10);             // pH
PrintString(0xC0, (U8*)"p:");
PrintStringWoAddr((U8*)dispBuff);

itoa((char*)dispBuff, motn, 10);              // Motion
PrintStringWoAddr((U8 *)" M");
PrintStringWoAddr((U8*)dispBuff);

itoa((char*)dispBuff, mois ,10);              // Moisture
PrintStringWoAddr((U8 *)" R");
PrintStringWoAddr(dispBuff);

itoa((char*)dispBuff, mot ,10);
PrintStringWoAddr((U8 *)" T");                        // Motor
```

```
PrintStringWoAddr(dispBuff);

dtostrf(latlon[0], 2, 6, latBuff);
dtostrf(latlon[1], 2, 6, longBuff);
strcat((char*)smsBuff, (const char*)"Fuel is low.. Pump1: ");
strcat((char*)smsBuff, (const char*)neabyPetrol1);
strcat((char*)smsBuff, (const char*)"\r\nPump2: ");
strcat((char*)smsBuff, (const char*)neabyPetrol2);
_delay_ms(100);*/
Send_SMS(smsBuf, 0, (U8*)&mobNum[0]);
_delay_ms(2000);

PrintString(0xC0, (U8*)"SMS Sent..");
_delay_ms(1500);
}

void ISRSerial0Receive(void)
{
U8 receiveData = 0;
receiveData = U0IIR;
receiveData = RX0_REGISTER;                //read the current value in U0's
Interrupt Register which also clears it.

receiveBufferUART0[receiveCounterUART0] = receiveData;
receiveCounterUART0++;
receiveBufferUART0[receiveCounterUART0] = 0;
//Rec_Ph_Data = 1;
Rec_GSM_Data = 1;

if(receiveCounterUART0 >= MAX_RECEIVE_LENGTH)
        receiveCounterUART0 = 0;

VICVectAddr = 0;
```

```
}

void ISRSerial1Receive (void)
{
U8 receiveData = 0;

receiveData = U1IIR;
 receiveData = RX1_REGISTER;                 //read the current value in U1's
                                       Interrupt Register which also clears it.
receiveBufferUART1[receiveCounterUART1] = receiveData;
receiveCounterUART1++;
receiveBufferUART1[receiveCounterUART1] = 0;
//Rec_GSM_Data = 1;
Rec_Ph_Data = 1;

//if(receiveCounterUART1 >= MAX_RECEIVE_LENGTH)
        //receiveCounterUART1 = 0;
VICVectAddr = 0;
}
```

Chapter 4:

Result & Discussion

4. Result:

4.1 Simulation Results:

Interfacing of Temperature & Humidity Sensor with ARM

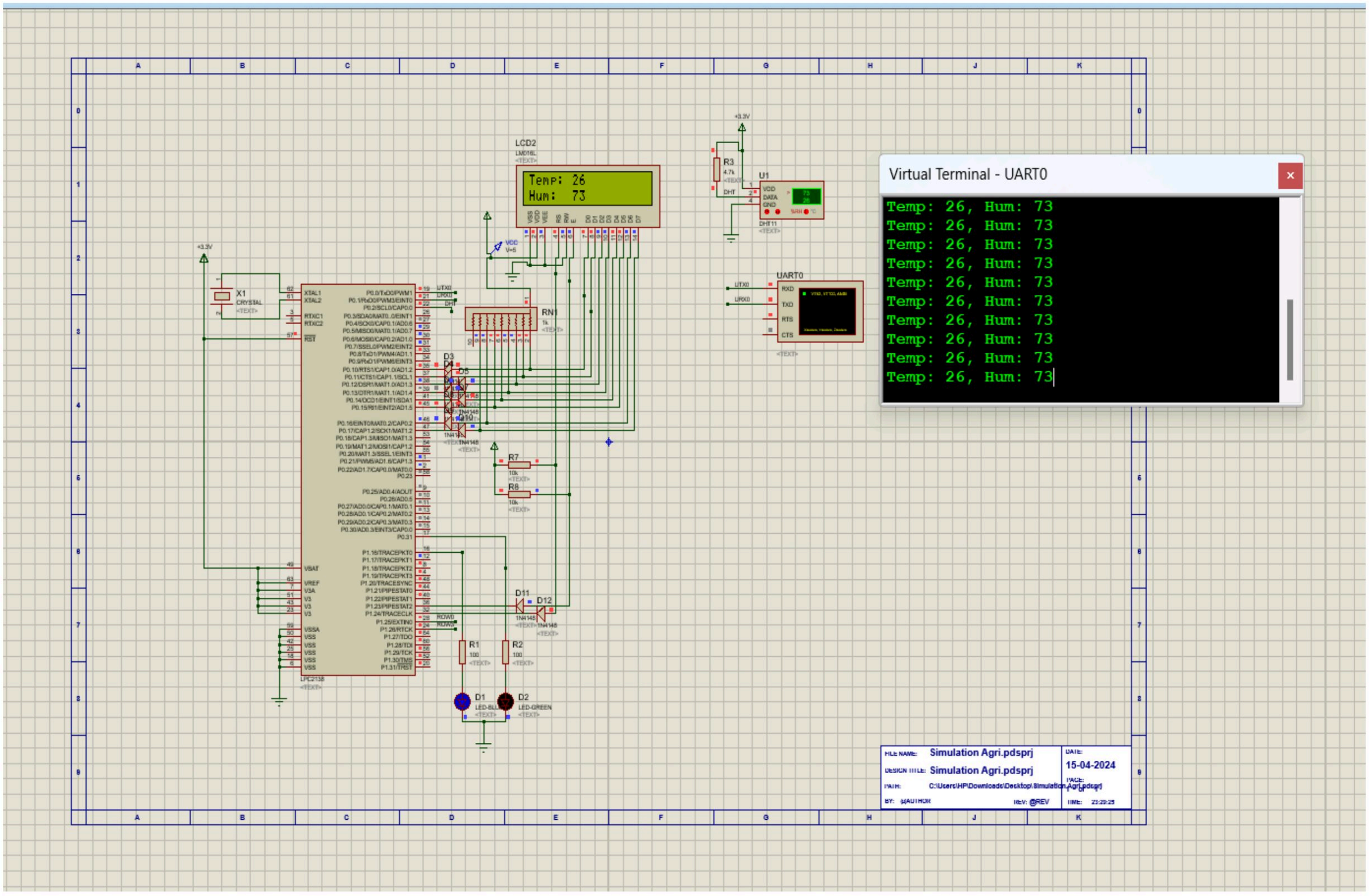

Figure 4.1 Simulation Results

4.2 Experimental Results:

1. Initialization of System

1) It includes:
2) LCD Initialization
3) GSM Initialization
4) Microcontroller chip “ARM-LPC 2148”

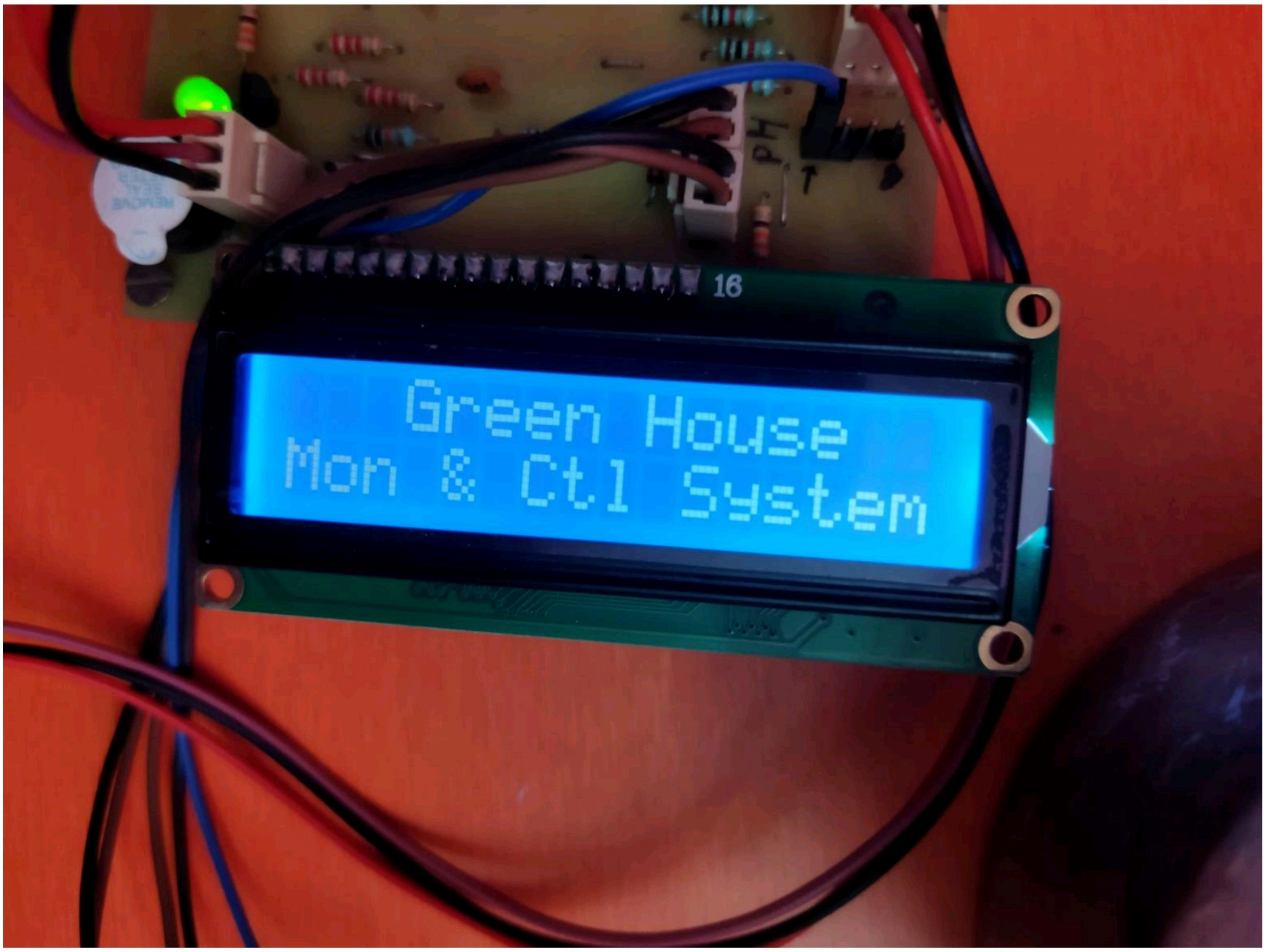

Figure 4.2.1 System Initialization Result

2. Display of All the readings on LCD & GSM

It includes:

‘W’ -Water Level

‘T’- Temperature in ^{O}C

‘H’- Humidity

‘P’- Ph Value

‘M’- Motion Detection status (0/1)

‘R’- Moisture level

‘T’- Motor status in (0/1)

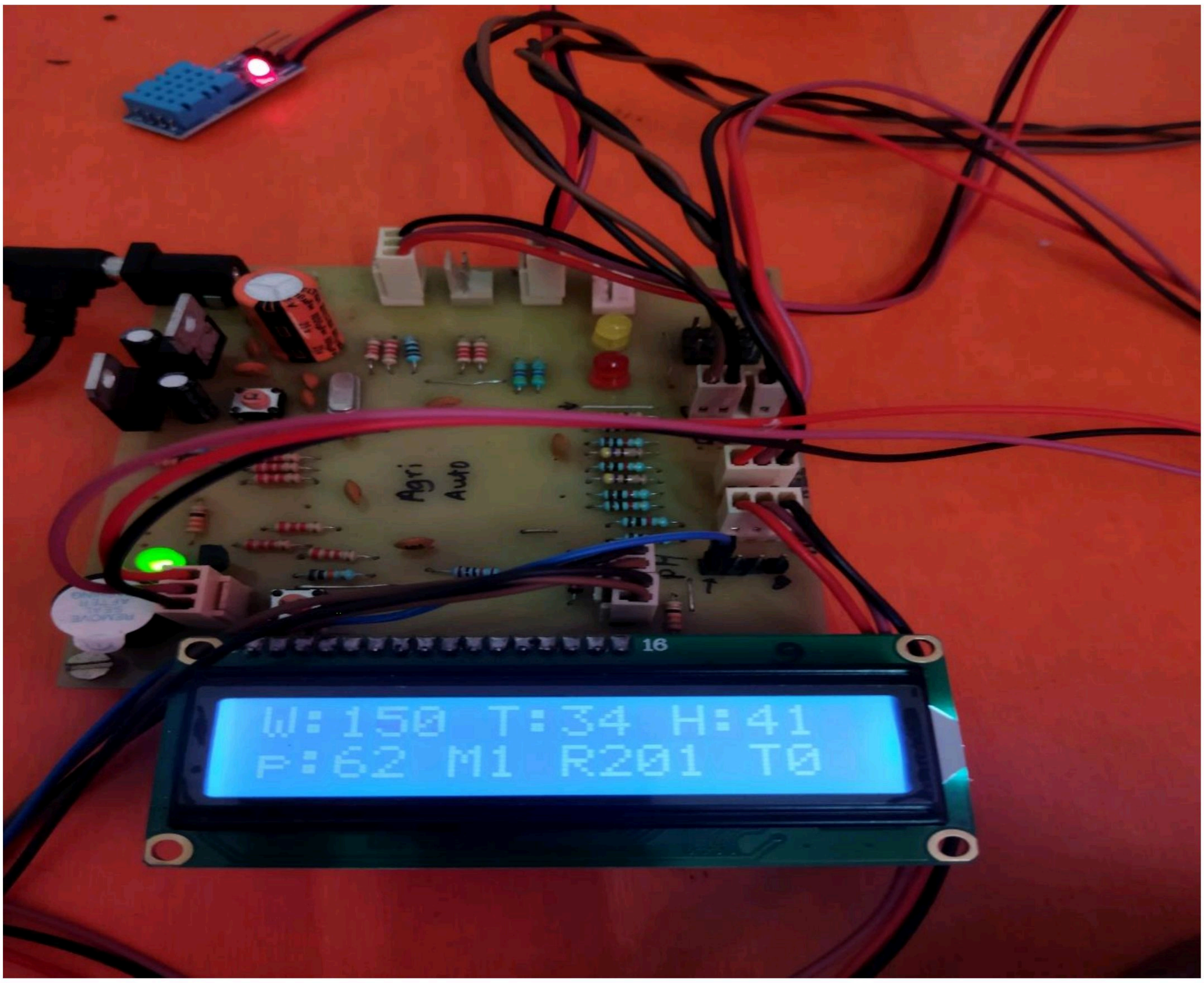

Figure 4.2.2 System Initialization Result

3. Display of All the readings on LCD & GSM

The overall system:

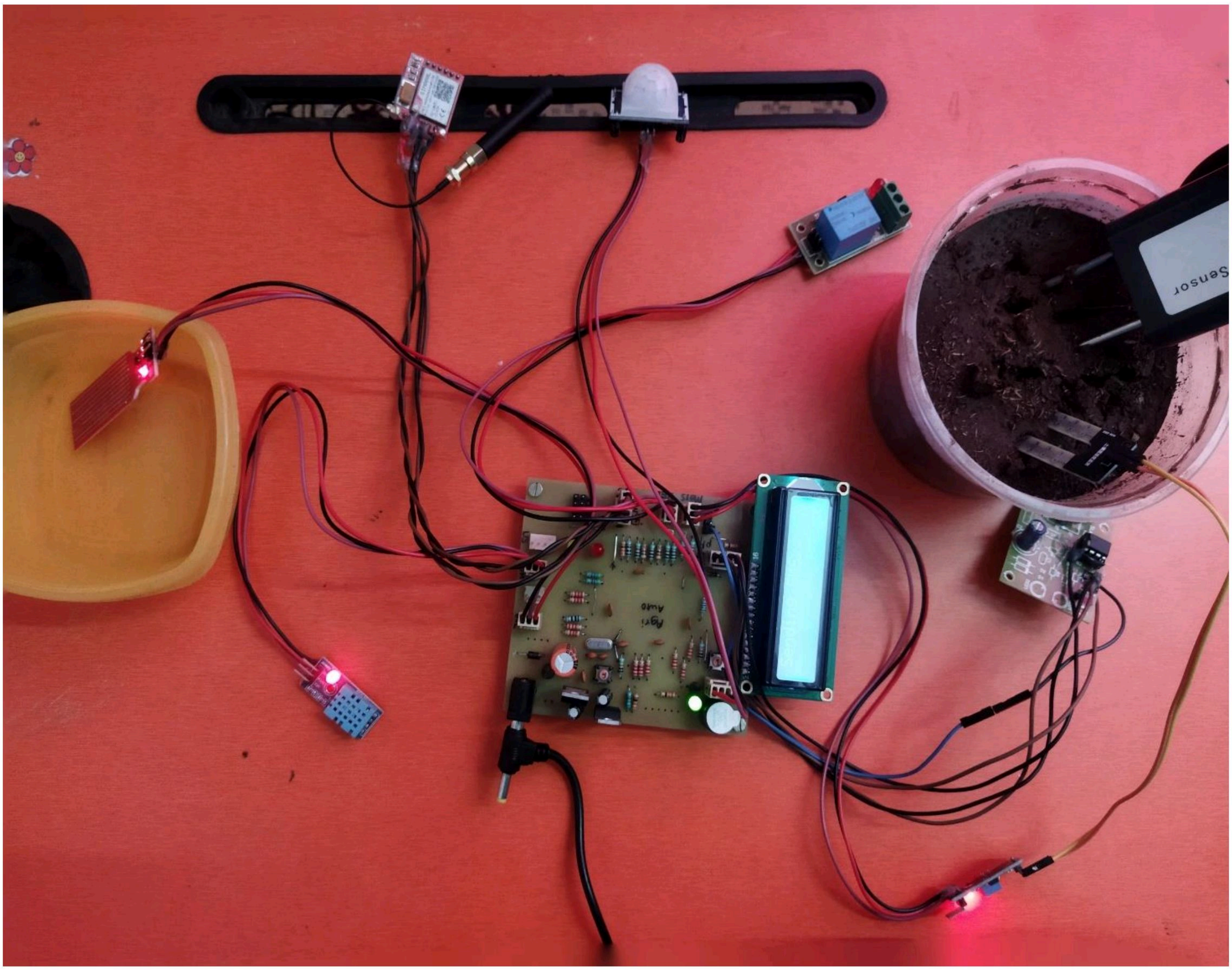

Figure 4.2.3 System Initialization Result

Results on Mobile Phone

Figure 4.2.4 GSM Results

Chapter 5:
Conclusion & Future Scope

CONCLUSION

The project is thus carried out using ARM7 TDMI core with the help of GSM technologies. This project is a prototype design that implements the solution for irrigation systems, monitoring plant growth, field security, and distant monitoring. The project that we have developed is just a prototype that acts as a preliminary version of a device and where we can extend the sensor for longer meters and a longer range. So, this can be developed in real-time application.

Total Cost - Rs.11,129

FUTURE SCOPE

1. This project is a prototype design that implements the solution for irrigation systems, monitoring plant growth, field security, and distant monitoring.

2. The project that we have developed is just a prototype that acts as a preliminary version of a device and where we can extend the sensor for longer meters and a longer range. So, this can be developed in real-time application.

3. Therefore, in future a system can be built that maintains the field on its own with the help of IoT functionality and an embedded robotic System that works in association with a water quality measuring system, to automatically maintain the various parameters of the field without affecting the life or growth of crops. This consequently leads to reduce the demand for manpower and an increase in the growth rate.

4. Along with this, we can use an NPK sensor and datasheet and depending on the values of nitrogen, phosphorus and potassium we can predict which crop can be taken in agriculture.

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Greenhouse Monitoring and Controlling System using ARM

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Abstract—The greenhouse monitoring and controlling can be done by using various technologies. The purpose of this project is to identify field conditions and offer field-related information. This includes an ARM7 processor, an LCD display, a GSM, and a few sensors. LCD will be used for field displays. A Subscriber Identity Module (SIM) that a user can communicate via this SIM-Number which is included in the GSM module. The corresponding sensor instantly activates in response to a specific command issued by the user, reads the current reading, sends the results to the user's mobile device, and displays the information on the field's LCD panel. If required, the appropriate action will be taken right away. Because of the automatic working of this project, it reduces the manpower.

Keywords—ARM7 LPC2148 Microcontroller, Sensors, GSM Modem, User Mobile phone

I. Introduction

The use of technology has led to significant changes in the agricultural industry, with farmers adopting advanced techniques to improve crop yield, quality, and efficiency. One of the most significant advancements in this area is greenhouse farming, which provides a controlled environment for optimal plant growth. By precisely managing factors such as pH levels, soil moisture, water levels, temperature, humidity, and light intensity, greenhouse cultivation can help increase productivity. In recent years, the integration of microcontroller-based systems with sensor technologies has made it possible to monitor and control greenhouse environments in real time.

This project uses an ARM 7 Microcontroller. The system integrates six essential sensors, including pH, soil moisture, water level, temperature and humidity, PIR, Light Dependent Resistor (LDR), and a GSM Modem along with SIM. The primary goal of the project is to develop a reliable, cost-effective, and scalable solution for greenhouse management that meets the increasing demand for sustainable agricultural practices. By utilizing the capabilities of the ARM 7 Microcontroller and sensor technology, the project aims to optimize resource utilization, enhance crop productivity, and reduce environmental impacts associated with traditional farming methods.

This system provides a solution for the optimization of water use, security of the greenhouse, determining the nature of soil and weather monitoring.

II. Block Diagram

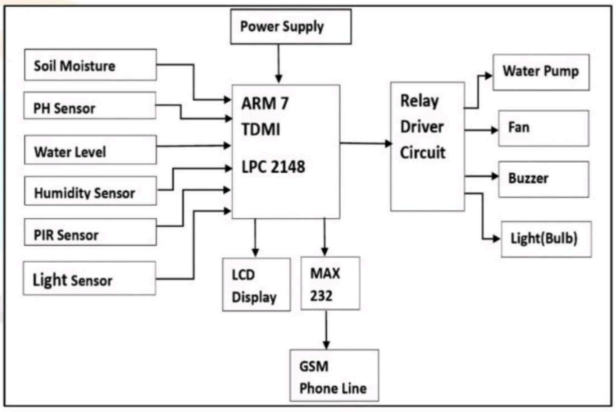


Fig. 1. Block diagram

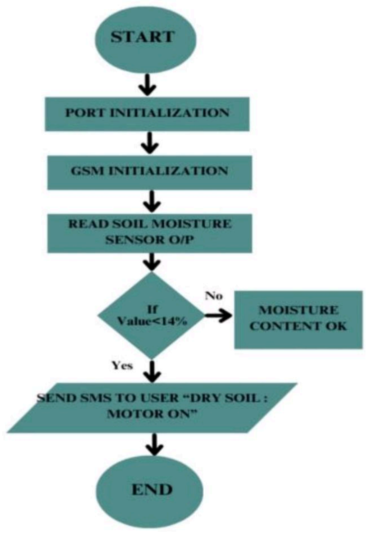
III. Implementation of System

This system includes a microcontroller, sensors and a GSM phone line. If one of the parameters of the sensors exceeds the safety threshold that must be maintained to protect the crop. These sensors detect the change and the microcontroller reads it from the data on its input ports after the microcontroller's ARM 7 ADC converts it to digital form. The microcontroller then takes the necessary actions using relays until the divergent parameter is reset to the optimal level. However, since the microcontroller is used as the heart of the system, it makes installation cheap and efficient. This system consists of various sensors, namely soil moisture, humidity, temperature, pH, PIR, water level and light sensors.

The whole system is divided into 4 sub-systems which are as follows:

A. Irrigation System

Software Design of Soil Moisture Sensor



This system uses water level and soil moisture sensors. A water level sensor is used to determine whether water is available in the tank or not. The soil moisture sensor checks the conductivity of the soil.

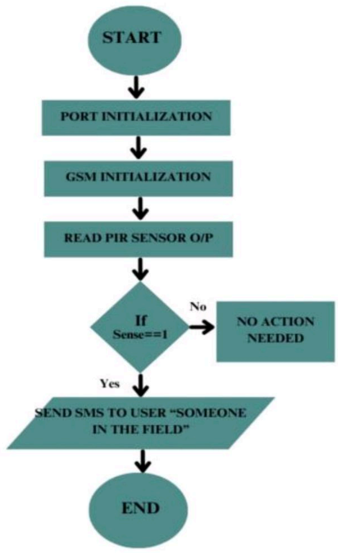
1) When the field is wet, the conductivity is higher and the resistance is lower.
2) When the field is dry, the conductivity is lower and the resistance is higher
   The moisture value will be sent to the user through GSM. and depending on this we can turn ON/OFF the water pump/motor.

B. Intruder Detection

Nowadays security in the agricultural field is very important. Intentional destruction or contamination of crops is a possibility that producers must guard against. A system has been designed to protect the crop in the field. The system is implemented which detects any intruder entering the field by using a PIR sensor. A PIR sensor can detect the motion.

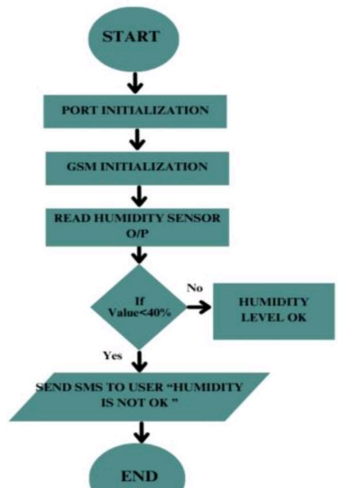
The PIR sensor is interfaced with the ARM7 microcontroller. Suppose if any intruder is detected then the buzzer will automatically turn on and the message "Intruder Detected" will be displayed on LCD and the message will be sent to the user through GSM.

Software Design of PIR Sensor



C. Weather Monitoring

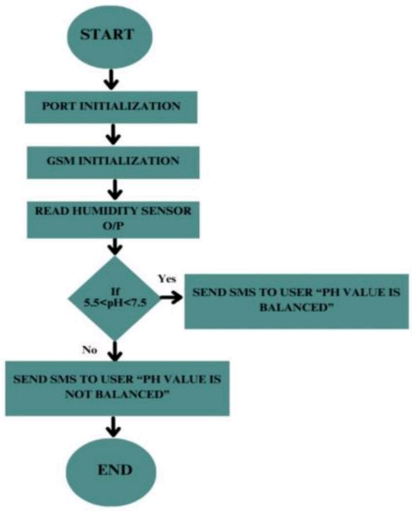
Software Design of Humidity Sensor



LDR, Temperature and humidity sensors are used to monitor weather conditions and depending on the input the fan and the light can be controlled. In the light detector, we use one LDR (light-dependent resistor). The resistance of LDR depends on the light intensity. When the light of the LDR changes, the resistance of the LDR also changes.

D. Determine the Soil nature

Software Design of pH Sensor



The system determines the soil's nature by determining the various pH levels in the soil. The pH level can be acidic, neutral or alkaline. Soil pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most plants is between 5.5 and 7.0. The pH sensor is used to measure the pH of soil the sensor is connected to the ARM7 through in-built ADC. The pH value and the soil nature are displayed on LCD. Thus, by knowing the pH level in the soil, the farmer can decide which fertilizer can be used on the crops. The pH value will be sent to the user through GSM.

IV. Result

1. Real-Time Monitoring: The implemented system successfully achieves real-time monitoring of greenhouse conditions, allowing users to access up-to-date information regarding temperature, humidity, soil moisture, and other relevant parameters.

2. Remote Accessibility: Leveraging GSM technology, the system enables remote access to greenhouse data via users' mobile phones. This functionality empowers users to monitor and control the greenhouse environment from anywhere with cellular network coverage.

3. User Interaction: Through the Subscriber Identity Module (SIM) integrated into the GSM modem, users can communicate with the system using their mobile phone numbers. This interaction mechanism facilitates seamless communication and command issuance to the greenhouse monitoring and control system.

4. Automated Response: Upon receiving user commands, the system autonomously activates specific sensors, retrieves current readings, and transmits the data to users' mobile devices. This automated response mechanism ensures prompt and accurate delivery of information, enhancing operational efficiency.

5. Data Visualization: The LCD display integrated into the system provides a visual interface for displaying field related information. Users can conveniently view sensor readings and other relevant data directly on the field's LCD panel, enabling quick assessment of greenhouse conditions.

6. Reduced Manpower: The automated functionality of the system significantly reduces the need for manual intervention in greenhouse operations. By automating monitoring and control tasks, the system minimizes manpower requirements and streamlines agricultural management processes.

7. Efficient Decision-Making: By providing timely and accurate field data, the system facilitates informed decision-making regarding greenhouse management. Users can promptly respond to changing environmental conditions and implement appropriate actions as needed, thereby optimizing crop cultivation outcomes.

V. Conclusion

The project is thus carried out using ARM7 TDMI core with the help of GSM technologies. This project is a prototype design that implements the solution for irrigation systems, monitoring plant growth, field security, and distant monitoring. The project that we have developed is just a prototype that acts as a preliminary version of a device and where we can extend the sensor for longer meters and a longer range. So, this can be developed in real-time application.

Future Scope

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3. Therefore, in future a system can be built that maintains the field on its own with the help of IoT functionality and an embedded robotic System that works in association with a water quality measuring system, to automatically maintain the various parameters of the field without affecting the life or growth of crops. This consequently leads to reduce the demand for manpower and an increase in the growth rate.

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