Siddaganga Institute of Technology, Tumakuru

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Report on

Intelligent Irrigation Control System For Agriculture Using lpc2148

Activity Based Learning-2 (ABL-2)

for

S4EII02-ARM MICROCONTROLLER

By

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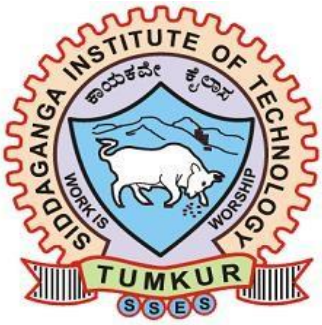

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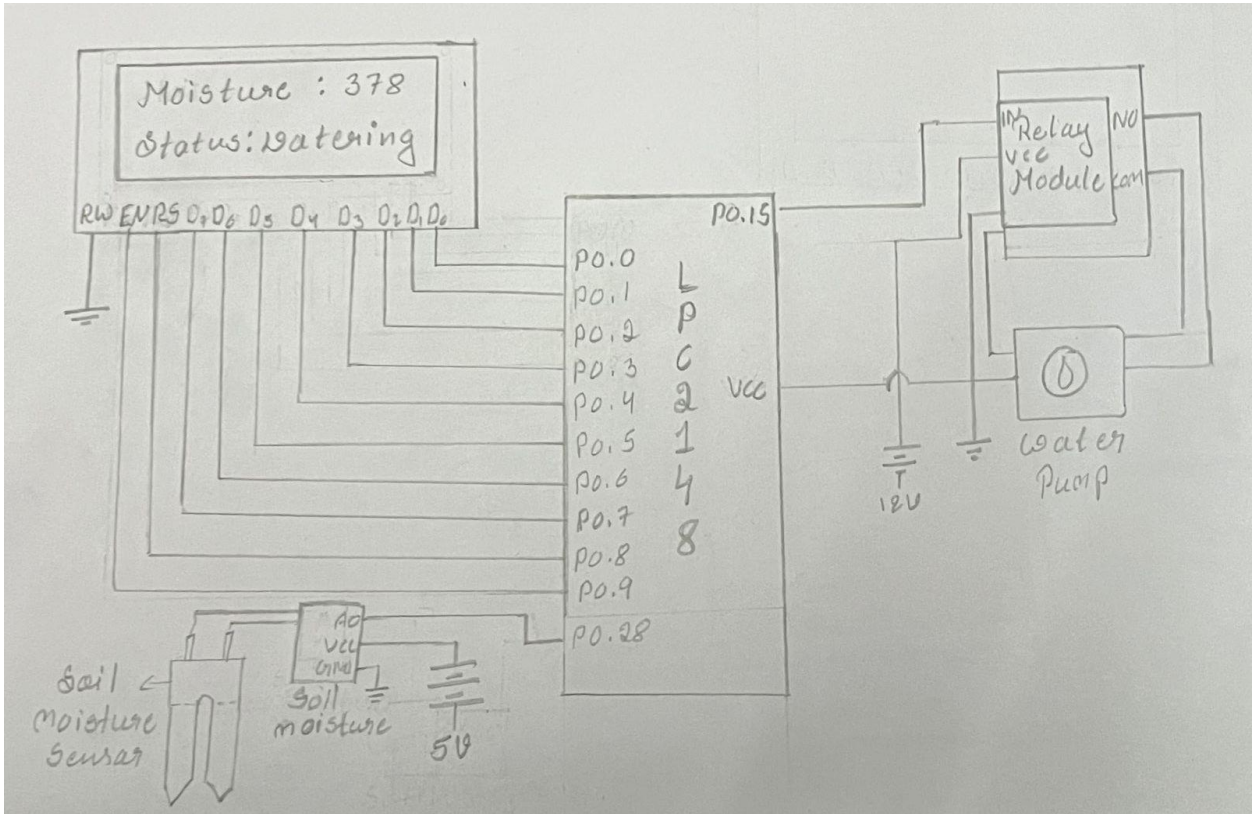
1. Introduction

This project introduces a smart drip irrigation system using the LPC2148 ARM7 microcontroller.
It automates water delivery based on real-time soil moisture levels.
A soil moisture sensor continuously monitors the dryness of the soil. When the moisture level falls below a predefined threshold, the system activates a water pump.
The pump is controlled through a relay module interfaced with the microcontroller.
A 16x4 LCD display shows soil status and pump activity in real time.
This setup ensures that plants receive water only when needed.
It significantly reduces water consumption and promotes healthy crop growth. The system is low-cost, reliable, and easy to implement in various agricultural settings.
It minimizes human effort by automating routine irrigation tasks. The use of embedded systems enhances precision and decision-making in farming.
Overall, this project supports smarter, eco-friendly, and data-driven agriculture.

2. Objectives

1. **To design and implement a smart irrigation system** that automates water supply based on real-time soil moisture levels.
2. **To utilize the LPC2148 ARM7 microcontroller** for processing sensor data and controlling irrigation hardware.
3. **To interface a soil moisture sensor** for accurate detection of soil conditions.
4. **To control a water pump via a relay module** based on soil moisture thresholds.
5. **To display real-time system status** such as soil moisture and pump activity on a 16x4 LCD.
6. **To reduce water wastage and manual labor** by automating the irrigation process.
7. **To promote smart and sustainable farming practices** through embedded technology

3. Interfacing Diagram



4. Components Used

Component	Quantity	Description
LPC2148 ARM7	1	Main microcontroller
16x4 LCD	1	Display soil & pump status
Soil Moisture Sensor	1	Detects soil dryness/wetness
Relay Module	1	Controls high-voltage pump
Water Pump	1	For irrigation
Power Supply (5V/12V)	1	For circuit and pump

5. Algorithm

- **Start**
- **Initialize**:
- Initialize LCD in 4-bit mode.
- Configure ADC channel (e.g., P0.28) for soil moisture input.
- Set P0.10 as output to control the relay.
- **Read Soil Moisture**:
- Read analog value from the soil moisture sensor using ADC.
- Convert ADC value to a digital moisture level.
- **Check Moisture Level**:
- If soil moisture < threshold (i.e., soil is dry):
  a. Turn **ON** relay (P0.10 = HIGH).
  b. Turn **ON** water pump.
  c. Display "Soil Dry – Pump ON" on LCD.
- Else (i.e., soil is moist):
  a. Turn **OFF** relay (P0.10 = LOW).
  b. Turn **OFF** water pump.
  c. Display "Soil Moist – Pump OFF" on LCD.
- **Wait** for a short delay (e.g., 2 seconds).
- **Repeat** from Step 3 continuously.
- **End**

6. Pin Connections:

- **LCD 16x4 (4-bit mode):**

  RS → P0.8

  EN → P0.9

  RW→GND

  D0-D7 → P0.0 to P0.7

- **Soil Moisture Sensor:**

  AO (Analog Output) → ADC pin (P0.28 for ADC1)

  VCC→5V

  GND→GND

- **Relay Module:**

  IN → P0.15

  VCC, GND as per power spec

  Relay NO/COM connected to pump

  Pump: Powered through the relay

- **Power Supply:**

  5V for logic

  12V for pump (if required)

7. Software Used

- Keil uVision (for programming LPC2148)
- Flash Magic (for loading hex file)

8.Program:

```
#include <lpc214x.h>
#include <stdio.h>
// LCD pin definitions (assuming inbuilt LCD on P0.0 - P0.7)
#define RS (1 << 8)  // P0.8
#define EN (1 << 9)  // P0.9
void delay_ms(unsigned int ms) {
unsigned int i, j;     for(i = 0; i < ms;
i++)        for(j = 0; j < 6000; j++);
}
void lcd_command(unsigned char cmd) {
    IO0CLR = 0xFF;     // Clear P0.0 - P0.7
    IO0CLR = RS;        // RS = 0 for command
    IO0SET = cmd;      // Send command to data
lines     IO0SET = EN;     delay_ms(1);     IO0CLR
= EN;     delay_ms(2);
}
void lcd_data(unsigned char data) {
    IO0CLR = 0xFF;     // Clear P0.0 - P0.7
    IO0SET = RS;        // RS = 1 for data
    IO0SET = data;     // Send data to data
lines     IO0SET = EN;     delay_ms(1)
IO0CLR = EN;     delay_ms(2);
}
 void lcd_init(void)
 IO0DIR |= 0xFF;              // P0.0 - P0.7 as output (D0-D7)
    IO0DIR |= RS | EN;       // RS and EN as output
delay_ms(20);     lcd_command(0x38);  // 8-bit, 2
lines, 5x7 dots     lcd_command(0x0C);  // Display
ON, Cursor OFF     lcd_command(0x06);  // Entry
mode     lcd_command(0x01);  // Clear display
delay_ms(2);
}
 void lcd_string(char *str) {
while(*str) {
lcd_data(*str++);
    }
}
```

```
        void lcd_gotoxy(unsigned char row, unsigned char col) {
         unsigned char pos[] = {0x80, 0xC0};
         lcd_command(pos[row - 1] + col - 1);
         }
         unsigned int read_adc(void) {
            PINSEL1 |= (1 << 18); // P0.28 as AD1.1
            AD1CR = (1 << 1) | (4 << 8) | (1 << 21); // Select channel 1, CLKDIV,
         PDN     AD1CR |= (1 << 24); // Start conversion     while (!(AD1GDR &
         (1 << 31))); // Wait for DONE     return (AD1GDR >> 6) & 0x3FF;  //
         Extract 10-bit result
         }
         int main(void) {
unsigned int value;     char
buffer[16];             lcd_init()
    IO0DIR |= (1 << 15); // P0.15 as output (Relay
control)           while(1) {         value = read_adc();
lcd_command(0x01); // Clear LCD         lcd_gotoxy(1,
1);         lcd_string("Moisture:");         sprintf(buffer,
"%d", value);         lcd_gotoxy(1, 11);
lcd_string(buffer);         lcd_gotoxy(2, 1);
                if (value < 400) {
         lcd_string("Status: WATERING");
                   IO0SET = (1 << 15); // Turn ON relay
                } else {
                   lcd_string("Status: OK      ");
                   IO0CLR = (1 << 15); // Turn OFF relay
                }
                delay_ms(1000);
             }
}
```

9. Working Principle

- The LPC2148 reads analog data from the soil sensor.
- If the analog value is below a threshold (e.g., dry soil), it triggers the relay.
- The relay turns ON the water pump.
- LCD displays the status.
- Once soil is moist, the pump is turned OFF.

10. Example Output Scenarios

Case 1: Soil is Moist

- LCD Output:

  Soil Status: Moist
  Pump Status: OFF
  Moisture: 780 (ADC Value) System Stable

- System Behavior:

  - Pump remains OFF
  - Relay is deactivated
  - LCD updates in real-time

Case 2: Soil is Dry

- LCD Output:

  Soil Status: Dry
  Pump Status: ON
  Moisture: 378(ADC Value) Watering

- System Behavior:

  - Pump is turned ON
  - Relay is activated
  - LCD indicates ongoing watering

11. Advantages

- Reduces water wastage.
- Requires minimal human intervention.
- Useful for precision agriculture.

12. Applications

- Agriculture
- Gardens and Lawns
- Greenhouses
- Smart Farming Projects

13. Conclusion

The Intelligent Irrigation Smart Drip System using LPC2148 successfully automates the watering process based on soil moisture levels. By integrating a soil sensor, relay module, and water pump, the system ensures efficient water usage and supports sustainable agriculture. Real-time monitoring via the LCD enhances system transparency and ease of use. This project reduces manual effort, conserves water, and promotes precision farming. It serves as a practical, lowcost solution for smart irrigation in both small-scale and large-scale agricultural applications.