**Lab Report: Automatic Plant Irrigation System with Remote-Controlled Shade**

1. **Objective**

The aim of this project is to design and implement an automatic irrigation system that monitors soil moisture levels and activates a water pump when the soil is dry. Additionally, the system features a remote-controlled shade mechanism, allowing manual control of sunlight exposure for plants. An LCD display provides real-time soil moisture data and system status.

1. **Introduction**

Water scarcity and inefficient manual irrigation are major challenges in agriculture and gardening. An automatic irrigation system optimizes water usage by supplying water only when required. In this project, a soil moisture sensor monitors soil humidity, and an Arduino Uno microcontroller controls a water pump through a relay. An LCD display shows moisture percentage and pump status. Furthermore, a servo motor-controlled shade can be opened or closed using an IR remote, allowing flexible sunlight management for plant growth.

1. **Components Used**

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| 1 | Arduino Uno – Main controller |
| 2 | Soil Moisture Sensor – Detects soil moisture levels |
| 3 | Relay Module – Controls water pump (isolates high current) |
| 4 | Water Pump – Pumps water to the plant when soil is dry |
| 5 | 16x2 LCD Display with I2C – Displays soil moisture and pump status |
| 6 | Servo Motor – Opens and closes the plant shade |
| 7 | IR Receiver Module – Receives commands from IR remote to control shade |
| 8 | IR Remote Control – Manually controls shade movement |
| 9 | Breadboard & Jumper Wires – For connections |
| 10 | Power Supply – USB or external 5V supply |

1. **Methodology**

1. Sensor calibration to map moisture values.

2. Pump control using relay when moisture falls below threshold.

3. LCD for real-time display of soil moisture and pump status.

4. Servo motor for shade control via IR remote.

5. Code implementation using Arduino IDE with LiquidCrystal\_I2C, Servo, and IRremote libraries.

1. **Arduino Code**

The complete Arduino code is included in the documentation and GitHub repository for this project. It handles soil moisture monitoring, pump control, LCD display, and remote-controlled shade operation.

1. **Applications**

• Home gardening and indoor plants

• Greenhouses for automated irrigation

• Small-scale agricultural fields

• Water conservation systems

1. **Advantages**

• Saves water by irrigating only when needed

• Reduces manual labor

• Provides real-time monitoring via LCD

• Allows manual sunlight control for sensitive plants

1. **Limitations**

• Dependent on power supply for continuous operation

• Soil moisture sensors may require recalibration over time

• IR remote range is limited (line-of-sight required)

1. **Future Enhancements**

• Add GSM/Wi-Fi module for remote monitoring via mobile app

• Implement automatic sunlight detection for shade control

• Integrate solar power for energy efficiency

1. **Conclusion**

The project successfully automates plant irrigation based on soil moisture levels and provides manual shade control through an IR remote. This system minimizes water wastage, reduces human intervention, and can be extended for larger agricultural applications. It serves as a prototype for smart farming and sustainable gardening solutions.