Department of Electronic and Telecommunication Engineering
University of Moratuwa

EN1190: Engineering Design Project

PROJECT REPORT
AUTOMATED PLANT WATERING SYSTEM

Group EN-04

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Abstract

The Automated Plant Watering System is designed to be used in home gardening to water plants when the moisture level in the soil drops below a certain level. Our main objective for this project is to provide a perfect solution for the problem that we identified, and the product that we develop should be cost-effective, easily repairable, and durable. In order to realize the design, we used software such as CircuitLab, Altium, and SolidWorks. The circuit simulation is checked using the CircuitLab simulator. The PCB design is done using the Altium software, and the enclosure is designed using SolidWorks software.

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1. Introduction

Due to the prevailing economic crisis in our country, we are facing unprecedented food shortages, so there is an urgent need to increase the national production rate to overcome food scarcity and malnutrition among children. To suppress this food crisis, the government has advised the public to engage in home gardening. “Amid the fuel crisis and looming food crisis, the government has decided to declare Friday as a holiday for State employees except for those who are engaged in providing essential services and to allow them to engage in agricultural activities in their home gardens." - [published on DailyMirror 15th June 2022]. By doing home gardening, people will get their daily essential nutrition at a minimum cost. But it appears to many (government and private sector workers) as an unthinkable task to manage this among their busy schedules because home gardening is something that needs continuous monitoring and extensive care.

So, as undergraduates of the Electronic and Telecommunication Department, University of Moratuwa, our main aim was to create a product that can be used as a solution to this problem. At the same time, we were very much concerned about the cost, because the device that we are constructing should be affordable for everyone, including low-income receivers.
Our product can water plants when the moisture level in the soil drops below a certain level (which can be adjusted by the user) and notify the user to refill the watering container.

Figure 1.1 depicts a block diagram of the device

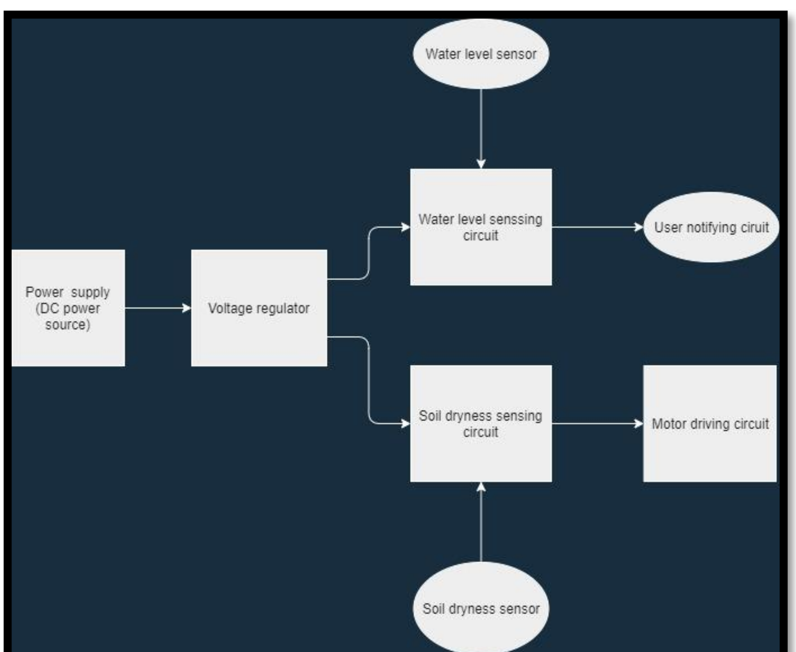

Figure 1.1: Block Diagram of the device

2. Method

2.1. Overview

The development of this project was done in four stages. They are,

1. Simulation
2. Breadboard Implementation
3. Designing and Fabricating the PCB
4. Enclosure Design

2.1.1. Simulation

Initially, the circuit was made in the CircuitLab simulator, an online tool. It was tested by checking the voltage across the circuit elements and current through the components, and we ensured that the circuit was working properly.

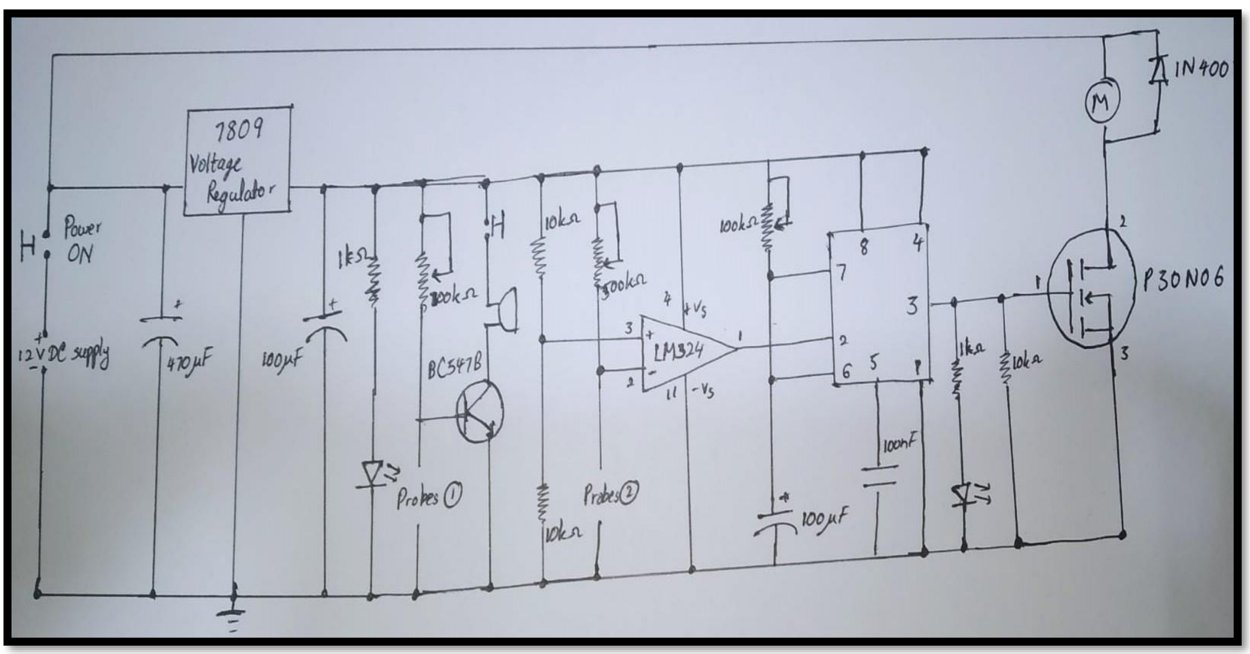

Figure 2.1.1.1: Circuit

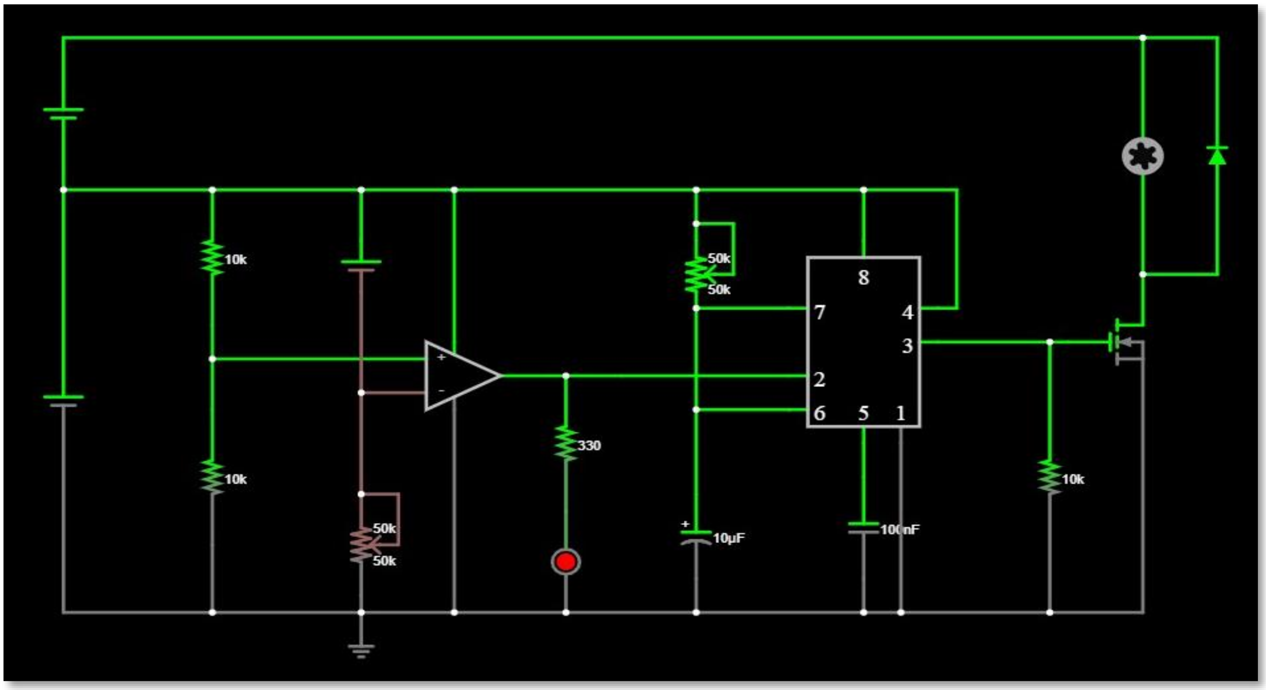

Figure 2.1.1.2: Simulation Diagram

2.1.2. Breadboard Implementation

The implementation of the circuit was done after the success of the online simulation. The figures 2.1.2.1 and 2.1.2.2 show the final implementations done at Analog Lab.

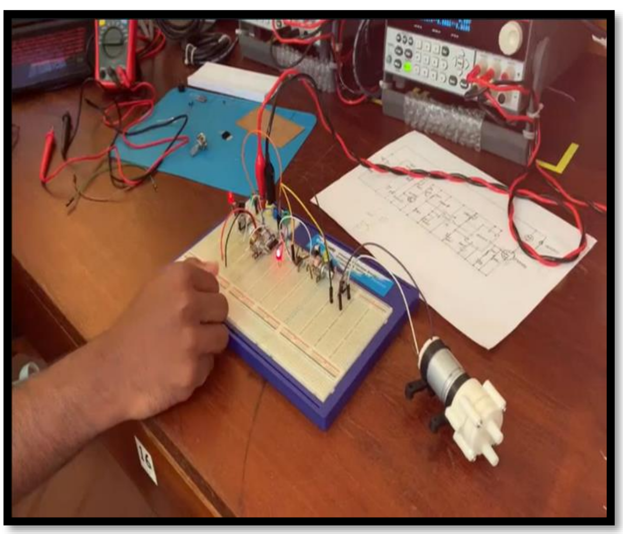

Figure 2.1.2.1: Breadboard Implementation

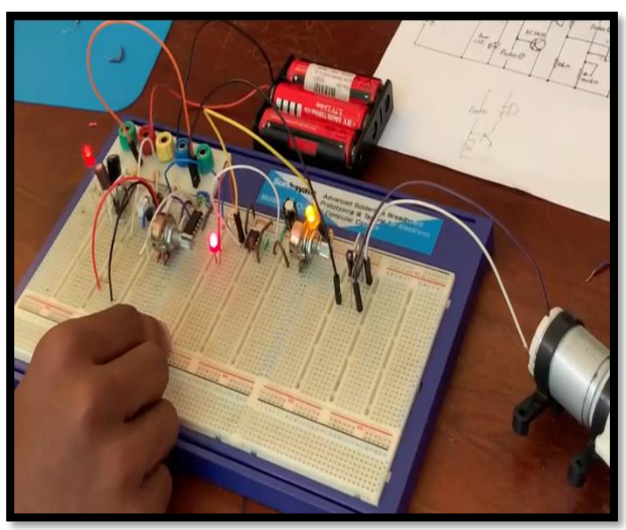

Figure 2.1.2.1: Breadboard Implementation

2.1.3. Designing and Fabricating the PCB

PCB design was done using Altium software. In the schematic design, all the components and connections were made according to our CircuitLab simulation. A 2-layer PCB layout was designed to add more compactness to the design. A 1 mm route width and a 0.8 mm (minimum value) drill hole size were selected for the design. By using an online PCB trace width calculator (DigiKey), we justify the trace widths used for the PCB design. We printed the PCB from a PCB manufacturer. PCB soldering is done by us at Analog Lab.

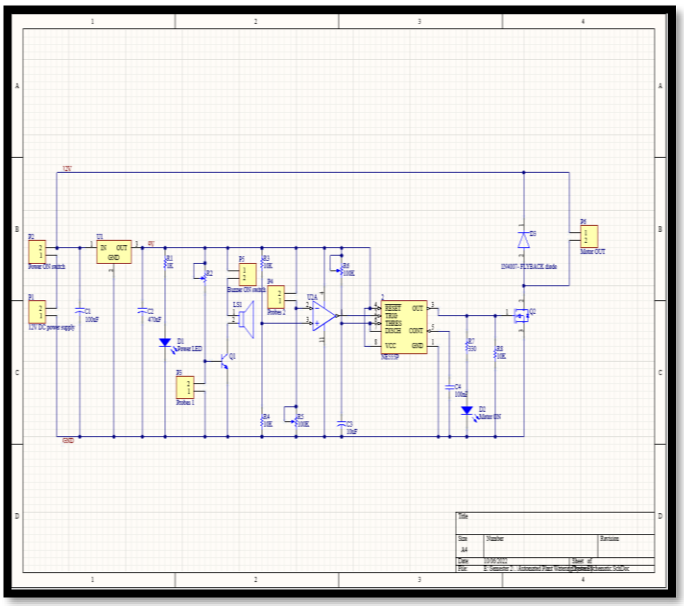

Figure 2.1.3.1: Altium Schematic Diagram

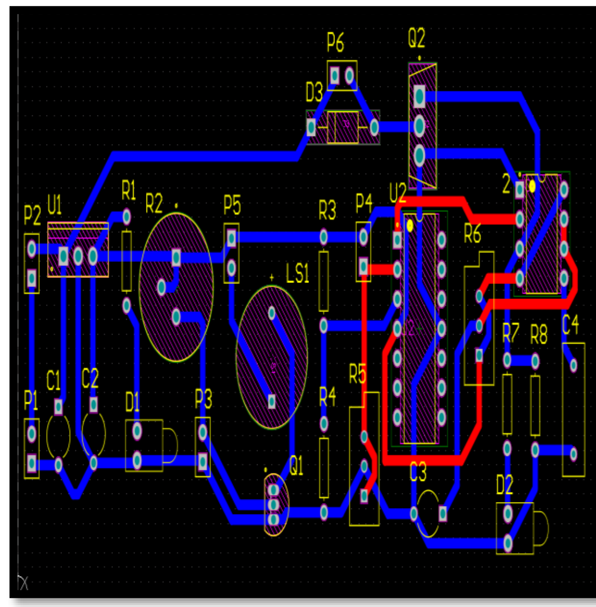

Figure 2.1.3.2: Altium 2D view of PCB

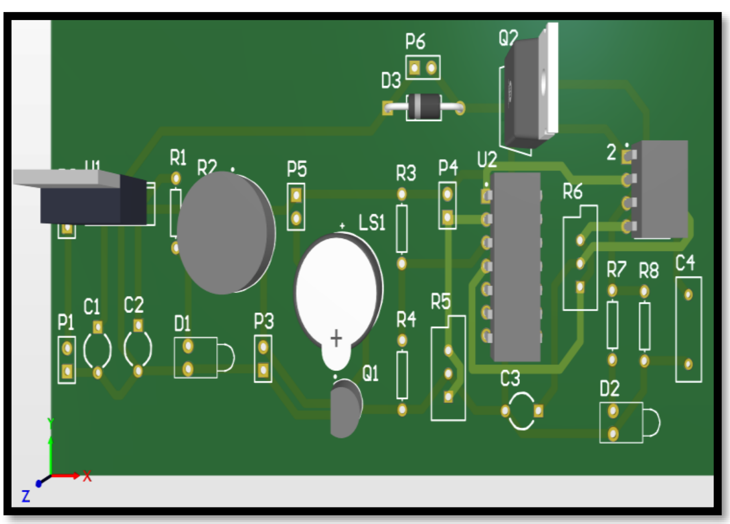

Figure 2.1.3.3: Altium 3D view of PCB

Figure 2.1.3.4: Printed PCB

2.1.4. Enclosure Design

An initial sketch for the enclosure design was constructed after the PCB design was finalized. The size of the enclosure only depends on the size of the PCB and other circuit components. So, it is not a massive enclosure. Thereafter, a SolidWorks design for the enclosure was created using the initial sketch as its basis.

The enclosure is a very lightweight one with an easy-to-handle size.

- Color: White
- Material: Plastic
- Size: 140 mm X 90 mm X 45 mm

We printed the enclosure by using a 3D printer.

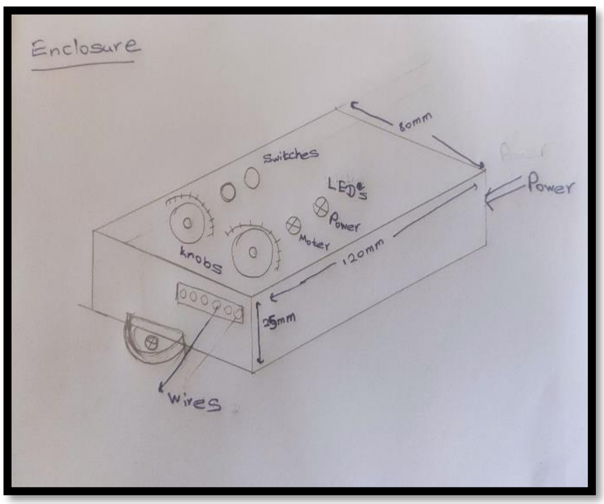

Figure 2.1.4.1: Initial Sketch

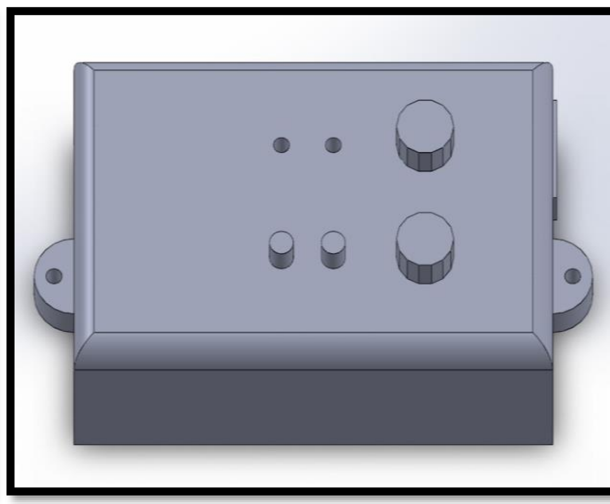

Figure 2.1.4.2: SolidWorks Initial design

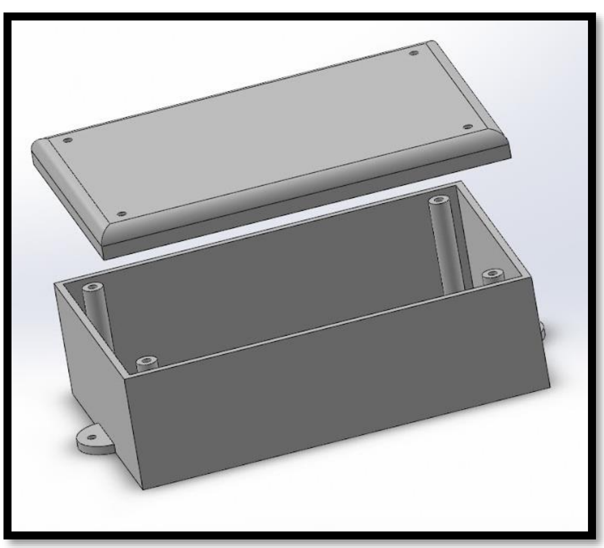

Figure 2.1.4.3: SolidWorks Final Sketch

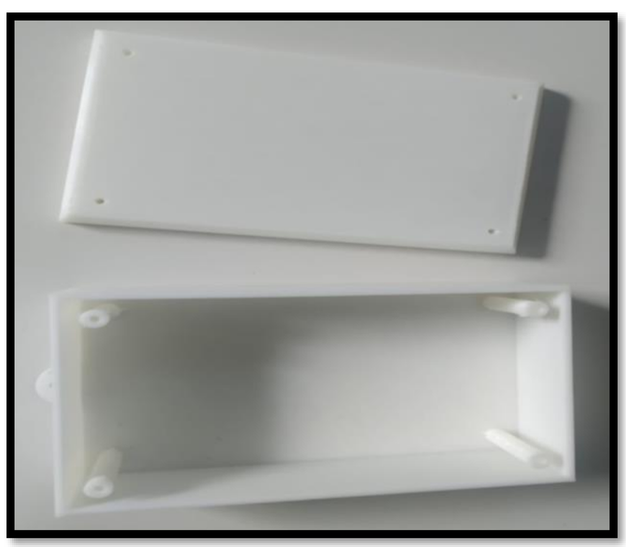

Figure 2.1.4.4: Printed Enclosure

2.2. List of Components

Components	Quantity
7809 Voltage regulator	1
300kΩ pots	1
BC547B transistor	1
9V buzzer	1
330Ω resistor	1
10kΩ resistors	3
100kΩ B potentiometers	2
100uF capacitors	2
470uF capacitor	1
100nF capacitor	1
LED yellow/red	2
1N4007 diode	1
NE555 timer	1
LM324 IC	1
P30N06 N channel MOSFET	1

2.3. Project Expenditure Account

Expenditures	Amount
Components	Rs. 1160
PCB print	Rs. 550
Enclosure 3D print	Rs. 2000
Total	Rs. 3710

2.4. User Interface

There is a push switch (Power On/OFF) to Power On the product. When the product is powered on, the LED (Power On) will be on. There are 2 knobs to control soil dry sensitivity and watering duration. The user needs to adjust the soil dry sensitivity according to the nature of the soil and the watering duration according to the nature of the plant. The other LED is for indicating that the motor is whether On or Off. The LED is On while the motor is On. Otherwise, it is Off. The other push switch is for controlling the buzzer. The buzzer is activated when the water level is low. If the user wants to deactivate the buzzer, they can do so using the push button. We label every UI control so that users will not get confused while using it, and it has a very easy-to-use UI.

2.5. User Manual

- Maintenance

After the user sets up the system, it doesn't need daily maintenance. But the user is required to check the sensitivity and timer once a month to protect the plants. The user should be aware of other impacting factors on plant growth. Our system is maintaining only the moisture level of the soil.

- Repair

There is a power LED and a motor LED on the enclosure to indicate the power status and functional status of the motor to the user. If one of them does not work, then the user will need the help of a technician to troubleshoot it.

- Reuse/Recycle

Since we are using a plastic enclosure, the probability of damaging the enclosure is very low. So, even if the components have any failures, we can replace them with new ones or repair them and reuse the system. We are only using plastic, electronic components, and cardboard in our product. So, plastic and cardboard can be recycled. All the electronic components can be recycled unless they are refurbished /reconditioned (repaired, upgraded) and used again. We are using recyclable plastics for the enclosure, so we can recycle the enclosure and PCB. The PCB recycling machine is specially designed for recycling circuit boards to get the metal.

- Disposal

All the electronic components can be disposed of as e-waste as there are many ways to dispose of e-waste nowadays.

- Warranty

6 months warranty for the components and 12 months warranty for the product functionality.

3. Results

The product functions as whole and gives expected results. It is tested in different environments under adequate conditions and observed its functionality. It is aligned to send out to the market.

4. Discussion

The system can be powered by different sources of power like a power pack or solar cell with 12V output.
The motor can be freely upgraded by the user to suit their use case, the system is even capable of supporting a 230V AC motor with an adequate relay.
The design can withstand rugged use cases and can withstand vibrations up to certain level without losing functionality.
The design is easy to open, and trouble shoot even by an amateur electronic enthusiast ensuring the longevity of the product.
The system compromises low cost easily found electronic components making it profitable to repair.
The system can support a variety of plants that grow in different regions of the country simply by changing the dials settings in the UI.
We are hoping to minimize the production cost based on the targeted user's feedback and the related future work.

5. Bibliography

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