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CS5053NI/CC5068NI– Cloud Computing & IoT

Smart Irrigation System Using Soil Moisture

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Group members

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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Acknowledgement

Firstly, we would like to convey our sincere gratitude to our module leader, Mr. Sugat Man Shakya, and our module tutor, Mr. Ayush Pradhanang sir, for their encouragement to complete our IOT project and for helping us in every possible way. We would also like to thank all the other supporting workforce members who helped us supply the tools that were needed; without them, we would not have been able to perform our task effectively.

Additionally, we are grateful to our parents for their continuous support and reinforcement. And great appreciation to every group member for their immense dedication and teamwork.

Abstract

Large tracts of land are used by most farmers, making it extremely challenging to access and monitor every part of these areas. Uneven water drops are a possibility occasionally which results in low-quality crops, and further reduces profits. In this case, the latest IoT-powered smart irrigation system is beneficial and makes farming easier.

There is a lot of room for the Smart Irrigation System to automate the entire system. Here, we're constructing an Internet of Things-based irrigation system with a DHT11 sensor and an ESP8266 NodeMCU module.

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1. Introduction

Since agriculture is our primary source of food and other raw materials, it is regarded as the foundation of human existence. A nation's state of economic development depends on agricultural growth. With this method, moisture sensors are positioned at the plant's root zone and close to the gateway unit, which processes the sensor data and sends it to the controller, which then regulates the water pump. Numerous processes that involve variables like soil moisture, brininess, humidity, temperature, concentration, etc. use this system (Roshan P, n.d.).

In addition to updating the irrigation status, the soil must overcome irrigation system defects and land based on soil humidity. For plants to grow to their full potential, the soil's water content must be appropriate. In addition, water is a necessary component of life (Roshan P, n.d.).

1.1 Current scenario

In the context of Nepal, an enormous percentage of the population works in agriculture, especially in the terai region of Nepal, which is the source of the Nepalese economy and contributes substantially to the country's GDP. To increase agricultural productivity and guarantee food security in Nepal, smart irrigation systems are very essential.

The Ministry of Agriculture and Livestock Development estimates that irrigation accounts for about 28% of all the land in Nepal that is farmed. This implies that since most farmers depend on rainfall to grow their crops, they are more susceptible to weather-related hazards like droughts.

The goal of the government of Nepal is to create both large- and small-scale irrigations systems, such as groundwater irrigation, gravity-fed systems, and Small-scale irrigation projects.

Since the beginning of planned development at the government level, as well as since the farmers themselves have done so for ages, the government of Nepal has made investments in the growth and development of irrigation infrastructure throughout the nation.

1.2 Problem Statement and Project as a solution

It would prove to be tedious for the farmers to inspect the condition of each square meter of their farmland. The effort that they could dedicate for inspection of their whole of the farmland could be redirected to a more productive work. The prototype on a large scale would greatly alleviate the burden of the farmers. The farmland would be self-sustaining in irrigation aspect.

Automatic irrigation is not the only benefit gained through the upscaling of the prototype. Farmers could inspect the temperature and humidity levels nearby the crops from a single station. Overall, the upscaling of this prototype should greatly minimize the workload of the farmers.

2. Aims and Objectives:

2.1 Aim

The aim of the Smart Irrigation System using Soil Moisture Sensor and ESP8266 NodeMCU is to automate and optimize the irrigation process for agricultural fields by using IoT technology. The system consists of a soil moisture sensor, a DHT11 Temperature and Humidity Sensor, a water pump, a relay module, and an ESP8266 NodeMCU module. The system can measure the soil moisture level, the air temperature and humidity, and control the water pump based on the sensor data and the predefined threshold values. The system aims to improve the crop productivity, save water resources, and reduce human labour.

2.2 Objectives

- Automate and optimize the irrigation process for agricultural fields by using IoT technology.
- Measure the soil moisture level, the air temperature and humidity, and control the water pump based on the sensor data and the predefined threshold values.
- Send the sensor data to an online server such as ThingSpeak, where the user can monitor and analyse the land condition from anywhere in the world.
- Improve the crop productivity, save water resources, and reduce human labour.

3. Background

3.1 Expected Outcomes and Deliverables

This project involves building a smart irrigation system which will automatically water a pot when the moisture level of the soil drops below to a certain level. The device created is expected to minimize the effort required to water a plant to a considerable extent. A relay module is used to operate the solenoid water valve since the output voltage from the NodeMCU ESP 8266 does not exceed 3.3V. A 12V battery provides power to all the components. Data from the sensors is sent to a smart phone via the NodeMCU 8266 module. The room temperature and the surrounding humidity can be seen on the smart phone along with the moisture level of the soil. Different plant may require different soil moisture levels. The aim is to keep the soil moisture level within a certain range.

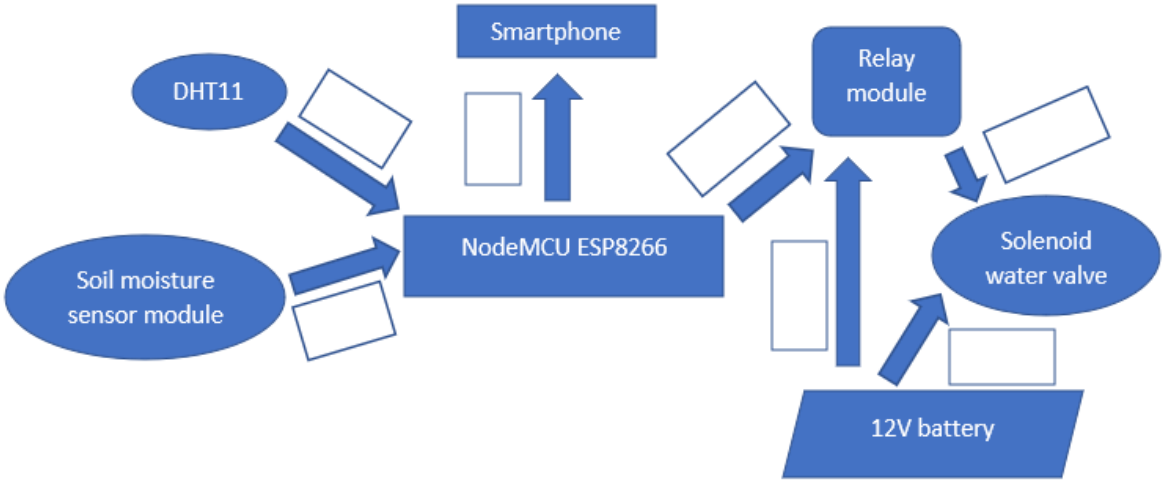

Figure 1: Diagrammatic System Architecture of Smart Irrigation System Using Soil Moisture

3.2 Requirement analysis

Described below are the hardware and software components needed for the completion of this project.

3.2.1 Hardware

- DHT11: This device is a temperature and humidity sensor that outputs both the values of temperature and humidity as serial data (Components101, 2021). In the context of this project, this sensor is to be used for measuring the surrounding temperature and humidity and sending the respective data to the smartphone simultaneously.

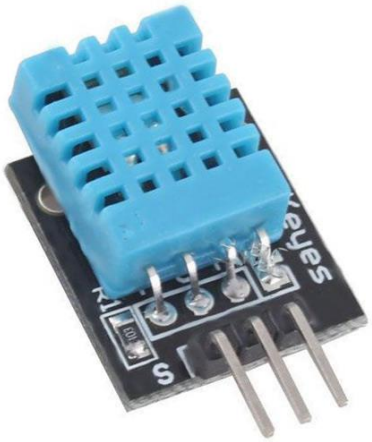

Figure 2: DHT11

- Soil moisture sensor module: This device is used to measure the water content of the soil and gives moisture level as the output (Components101, 2020b) In this project, this device is to be used for measuring the moisture of the soil and send the relevant data to the NodeMCU ESP8266 device. This data is also displayed on the smartphone.

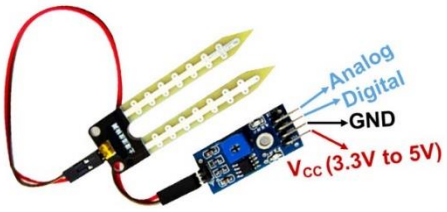

Figure 3:Soil moisture sensor module

- NodeMCU ESP8266: It is an open-source Lua based firmware and development board which is purpose made for IoT based devices (Components101, 2020a). In this project, this board collects data from the sensors before sending it both to the relay module and the smartphone.

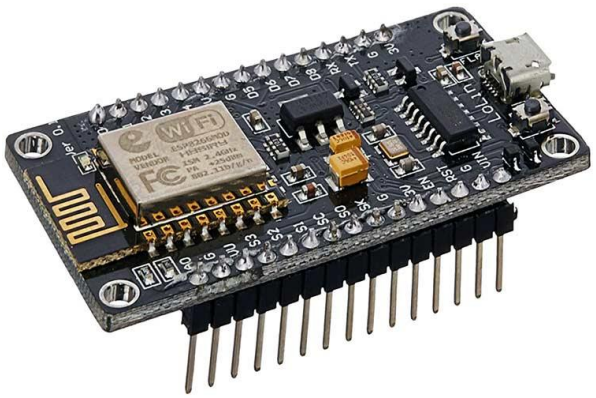

Figure 4: NodeMCU ESP8266

- Smartphone: A smartphone is a device used for variety of purposes which include but are not limited to sending or receiving calls, messaging, and browsing the internet. In this project, data from the NodeMCU ESP8266 board is displayed on the smartphone.

- 5V 10A Relay Module: Relays are devices which close or open a circuit after receiving electrical signals from external sources (components.omron.com, n.d.). In this project, the signal from NodeMCU ESP8266 board is sent to a relay which opens or closes the circuit consisting of the battery and the solenoid water valve.

Figure 5: Relay Module

- 12V Battery:
  A battery powers an electrical device. It converts chemical energy to electrical energy. In this project, a 12V battery is used to power the solenoid water valve and other electrical devices.

- Solenoid water valve:
  A solenoid valve is a device which is used to control flow rate of fluid (uk.rs-online.com, 2023). In this project, a water valve starts or stops pumping water to the pot depending on the moisture level of the soil.

Figure 6: Solenoid water valve

- Jumper wires:
  Jumper wires are wires that connect two points to each other without the need for soldering as they have connector pins at each end (Hemmings, 2018). In this project, many jumper wires are used to provide connection to the electrical devices.

Figure 7: Jumper wires

- Breadboard:

  A breadboard is a plastic board used for building and testing circuits (Components101, 2018). In this project, a breadboard is to be used to build the circuit for the IoT device.

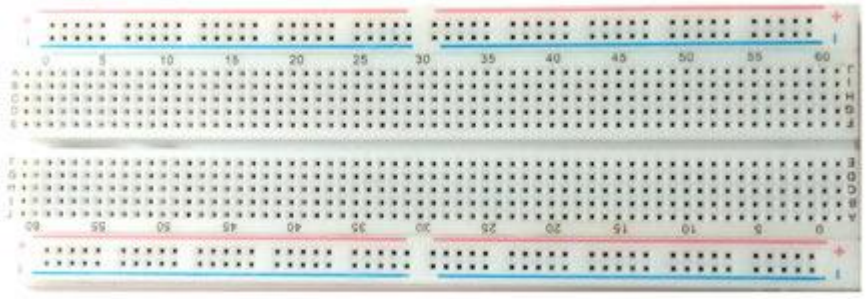

Figure 8: Breadborad

3.2.2 Software

- Arduino IDE: It is an IDE developed by Arduino which is to be used for programming electrical boards. In this project, this board will be used for programming the NodeMCU ESP8266 board.

- Blynk: Blynk is an application building application which is targeted towards IoT platform. In this project, this application will be used to develop UI elements for displaying relevant information related to the IoT project.

4. Individual Contribution plan

The group consists of five members, each assigned distinct tasks contributing to the project.

Student name	Role	Contribution
Prashamshsa Thapa	**Proposal**: Acknowledgement, Abstract, Introduction. **System Development Report:** Monitoring and verifying device work process.	20%
Nishant Jung Shah	**Proposal:** Current Scenario, Problem statement and project as a solution. **System Development Report:** Keeping data of the device and monitoring it.	20%
Gajendra Prasad Chaudhary	**Proposal:** Aim and Objective. **System Development Report:** Testing and Debugging code.	20%
Nirajan Shah (Team Leader)	**Proposal**: Background, Expected outcomes and deliverables, Requirement analysis. **System Development Report:** Implementation code into **NodeMCU** and managing hardware devices.	20%
Shosang Rumba	**Proposal**: Individual contribution Plan, Work breakdown structure, Appendix. **System Development Report:** Checking wiring between device and testing, monitoring it.	20%

This is the work break-down structure of our project which we are dived into five members.

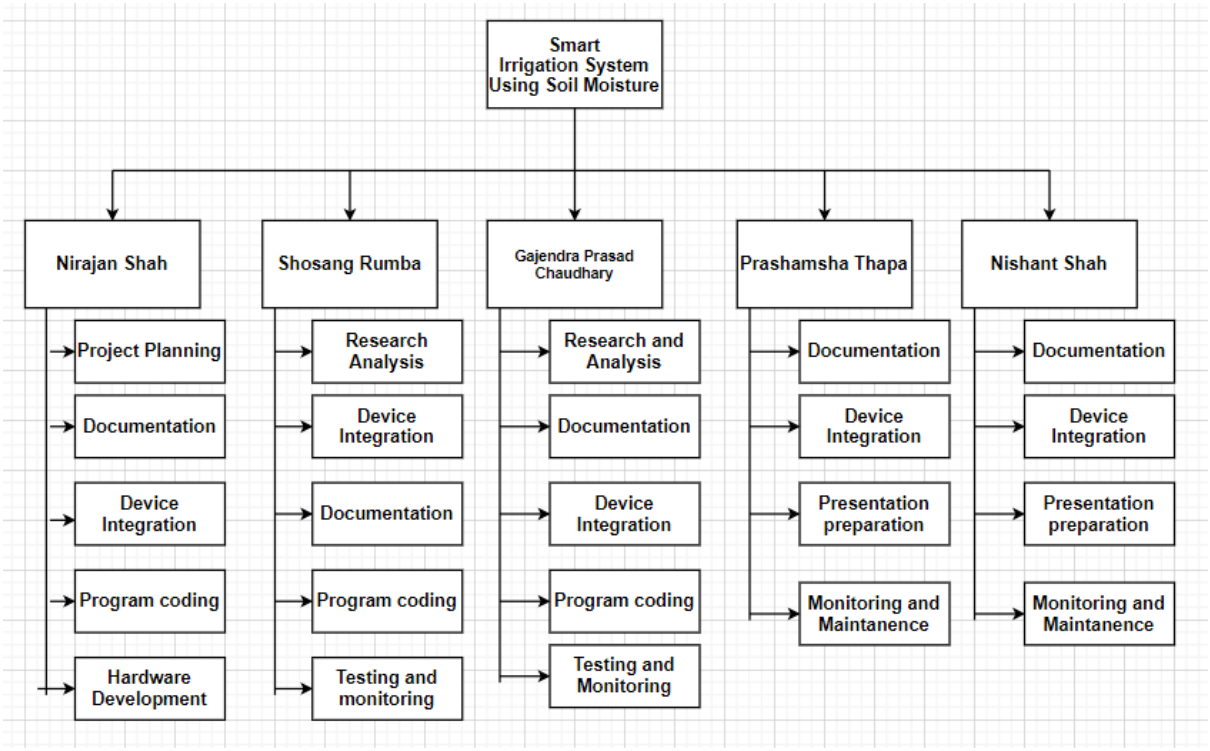

Figure 9: Work Break-Down Structure

5. Conclusion:

Throughout the report, we have pointed out the aims and objectives, requirements, and individual contribution plans for IoT-based Smart Irrigation Systems.

Most farmers in the country use a substantial portion of agricultural land, so it's very hard to find and follow every corner of major rural areas. There's a chance of uneven water sprinkles in some cases. This has led to poor-quality crops, which have resulted in financial losses. Smart irrigation using the latest Internet of Things technology in this scenario would be useful and make it easier to farm in substantial portion of agricultural land.

Using soil moisture sensors and DHT11 to detect the moisture and temperature of the soil will be our motive to stop uneven water sprinkles and make good-quality crops. Here, the sensors open/close the flow of water depending on the moisture of the soil.

This IoT system will be a great choice in terms of cost for the farmers to implement in their agricultural fields as well as very easy to understand.

6. Appendix:

We're installing an IoT irrigation system with the ESP8266 NodeMCU module, and a DHT11 sensor. It also sends data to the server for land conditions monitoring, so that water may be automatically irrigated when moisture levels are high in the soil.

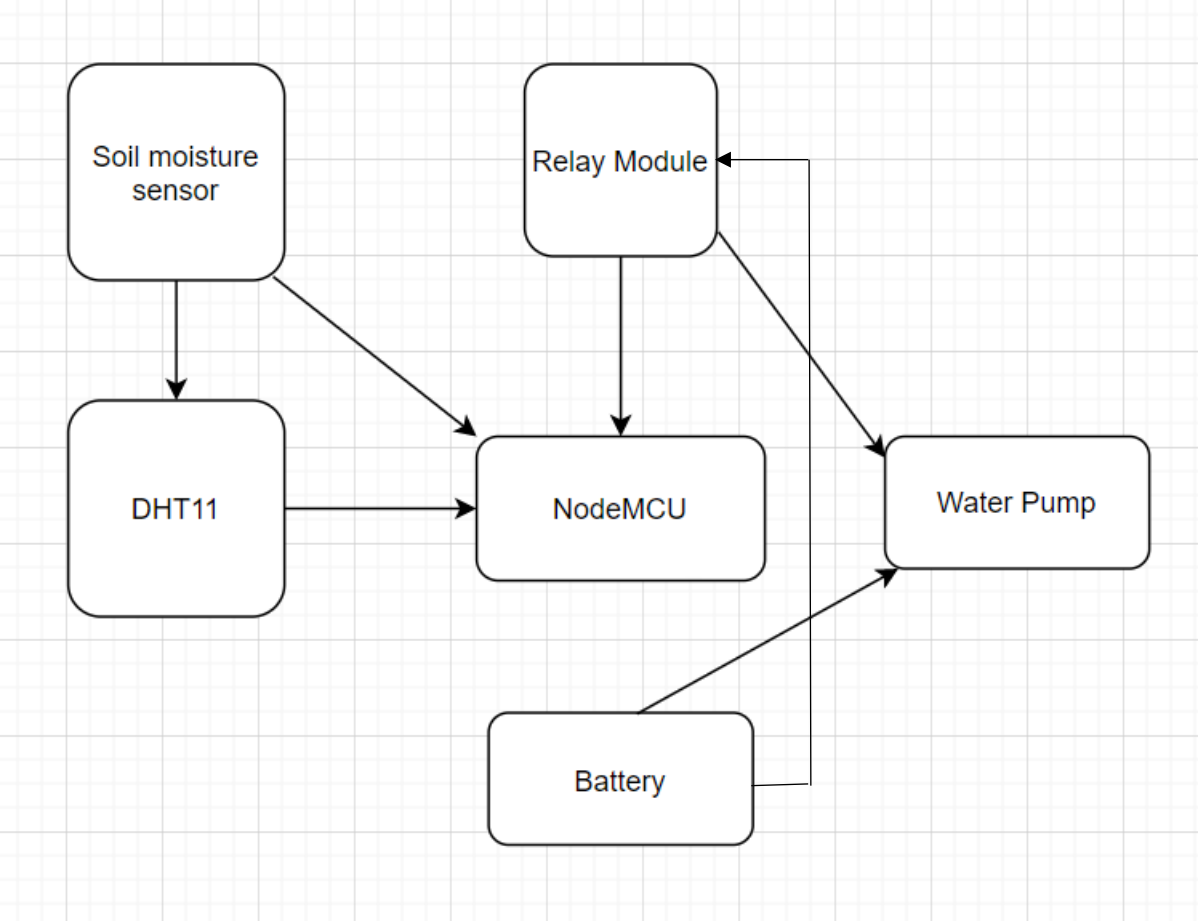

Figure 10: Block diagram of soil monitoring system