

Department of Electronic & Telecommunication Engineering
University of Moratuwa



EN2560 IoT Design and Competition
Project Report: IoT Empowered Garden Watering System

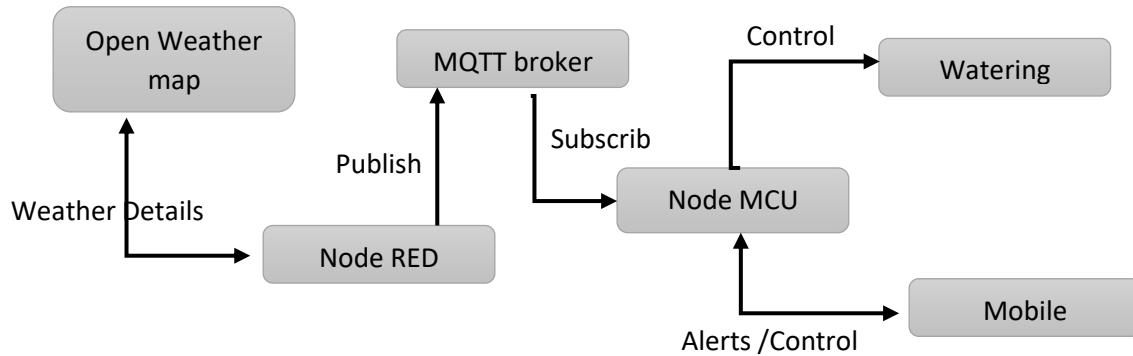
Group 05

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Problem

Most of the plants needed to be watered and maintained a proper moisture level and the sunlight in the soil to be grown up well. Due to busy schedules, people can't spend considerable amount of time to treat their gardens. Because of that, home gardens are looking less attractive day by day and it eliminates another way to relax their minds.

Conceptual Overview



Data Source

- Open Weather Map API is used to get real time weather information of a given location.
- An NTP server is used to build a local clock.

Methodology

Node MCU Functionalities

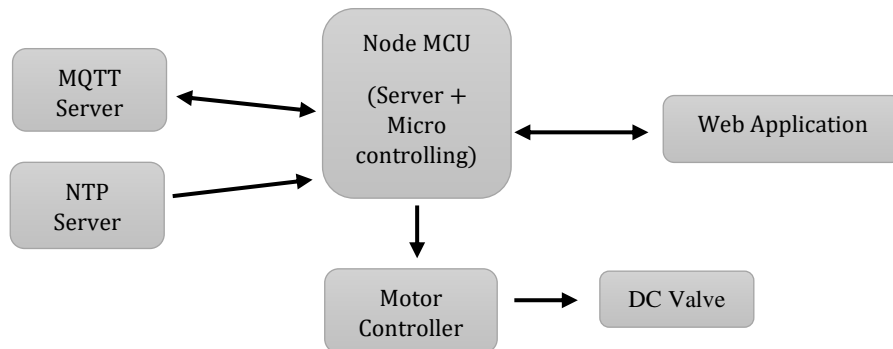
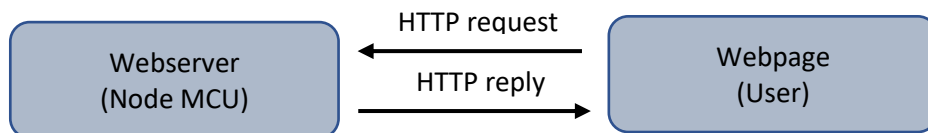


Fig: Connectivity diagram between Node MCU and other blocks.

1. Web Application and Node MCU Connectivity



Webserver is implemented in the Node MCU.

According to the HTTP requests sent by the user, operations are carried out.

- Location set up data sent by the user is sent to the Node RED and receive the weather details.
- Received weather data sent to the webpage.
- According to the selected method, watering is done.

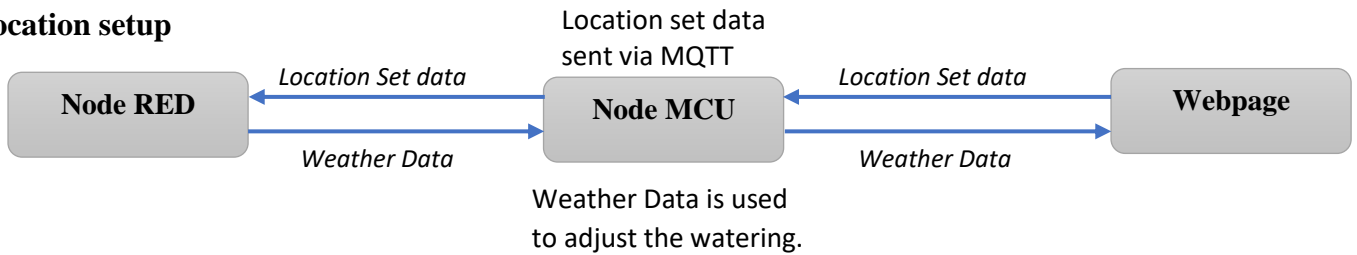
Webpage is designed using HTML, CSS and JavaScript.

User commands is sent to the Node MCU as HTTP requests.

- User sets up the location and send it to the Node MCU.
- User can set up the watering mode to either AUTO or MANUAL.

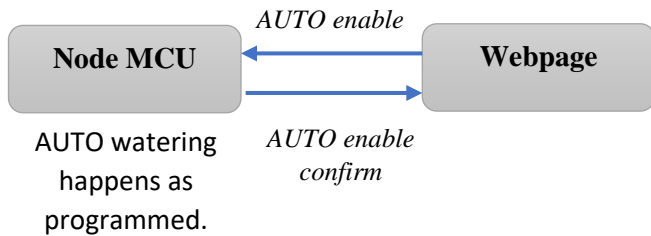
A Clock will be running in order to synchronize the sleeping schedule with the Node MCU. This will be further discussed later.

Location setup

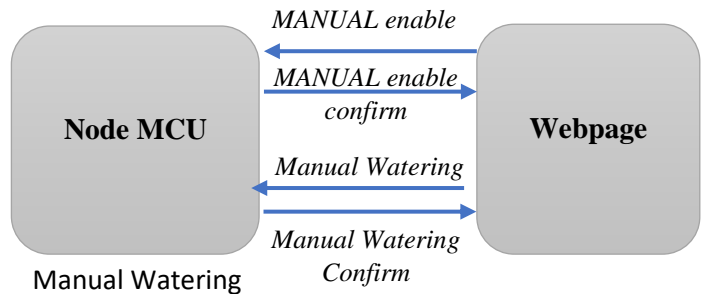


Watering

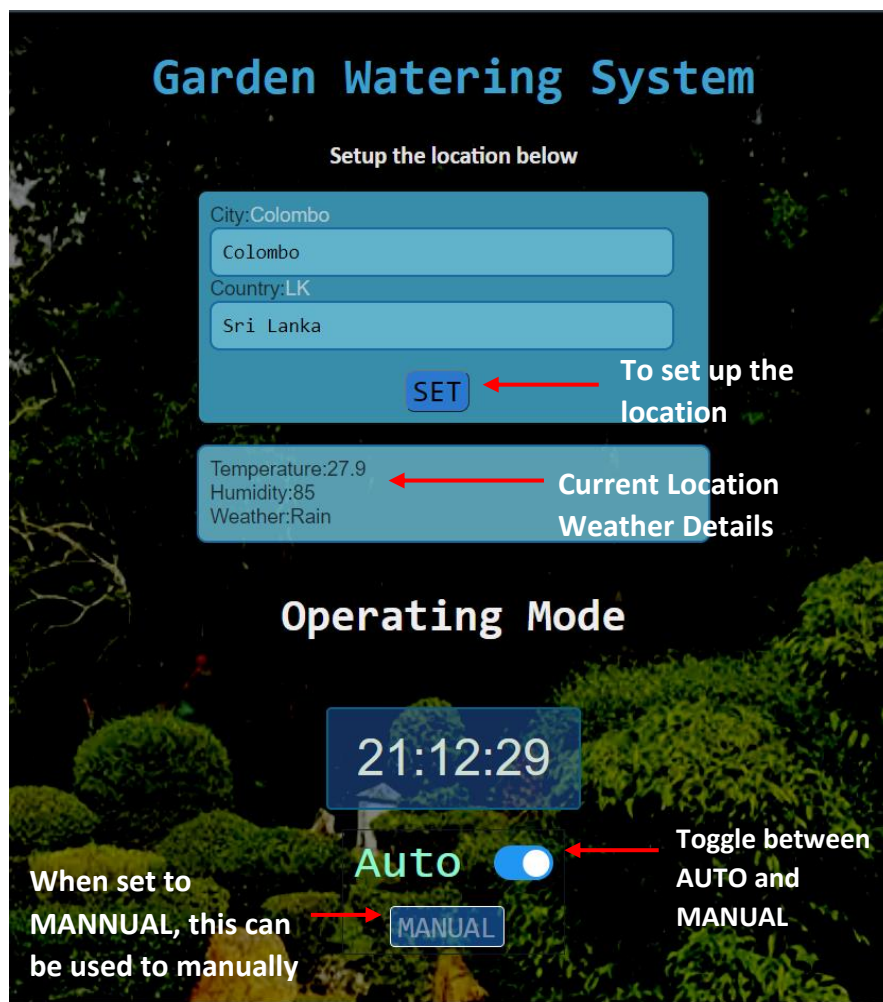
AUTO



MANUAL



Webpage



2. MQTT Server and Node MCU Connectivity

Location of the garden (City- Country) is sent to the Node Red through the MQTT server.

MQTT broker sends the published data from Node Red to the Node MCU. These data packets include the Temperature, Humidity, Weather type (Rain, Clouds, Sunny...), and the time zone of the garden.

3. NTP Server and Node MCU

NTP server is used to get the UTC time and a local clock runs on the Node MCU. Local time is calculated using the time zone information (how much time needs to be added to the UTC) sent by the Node-Red.

4. Node MCU - Server

Server runs on the Node MCU and it is accessible only inside the Local network because router doesn't have a public IP. This server contains the web page information, and it is capable of handling Get, Push, Requests. In this application we only use Get request and their responses to maintain the system.

5. Node MCU - Micro Controller

At the same time, Node MCU act as the micro controller of the watering system. Using collected data, it decides water or not, mode of watering and when to water. Additionally, it will sleep occasionally and wake up and rebuild connections automatically. This mechanism helps to reduce the power consumption.

This system has two watering modes. Switching between these two modes can be done only when the Node MCU is awake.

AUTO MODE

Watering happens twice a day, between 9am-10am and 4pm – 5pm, for a calculated time period.

$$\text{watering time} = \frac{\text{temp}}{10} + \frac{(100 - \text{hum})}{30} \text{ mins}$$

Watering will not happen if the weather type is Rain or Storm.

Sleeping Schedule

Node MCU goes to its light sleep mode at (2, 8, 14, ..., 57) minutes in every hour. It sleeps for 3 minutes wake up in (0, 6, 12, ..., 54) minutes in every hour. Briefly Sleep- Awake mechanism has a 6 minute time period. It awakes in first 3 minutes and sleeps in the second 3 minutes.

After watering happens, it automatically falls back to the sleeping schedule.

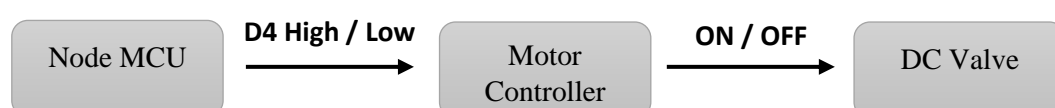
MANUAL MODE

User has the full authority to control the watering. When he presses the watering button once, system waters for 5 minutes.

No sleeping mechanism implemented because user has the full control of the system.

6. Motor Controller

When watering happens, Node MCU make its Valve (D4) pin High. This signal is given to a LM298n motor driver module and it switches on the 12V DC water valve.



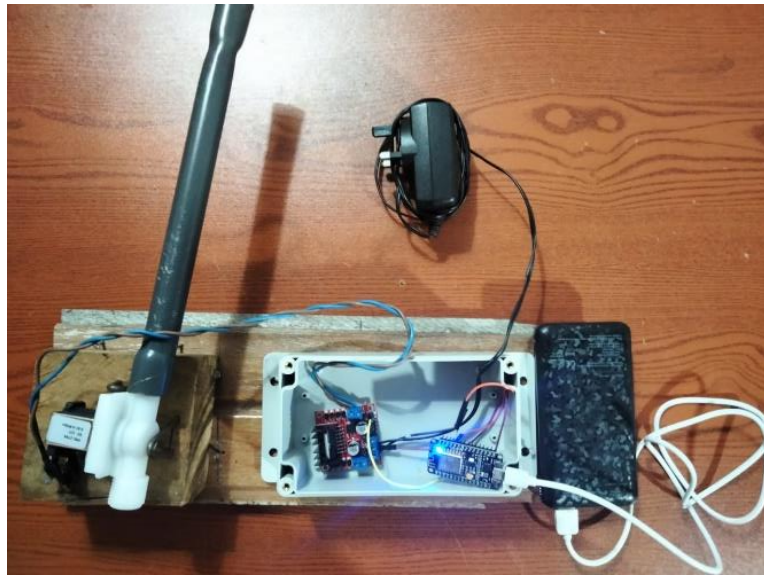
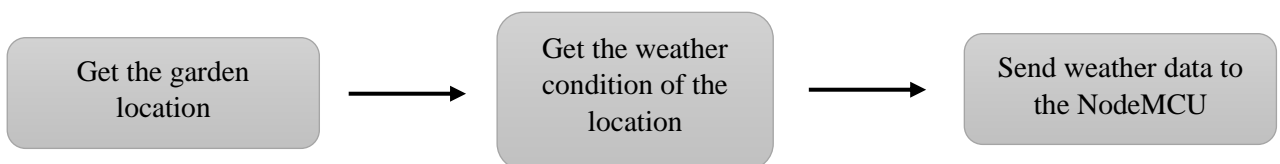


Fig: Hardware setup of the system

7. Node-RED

The Node-RED part of our system has three main stages, which are listed below.



- Using MQTT In node, we get the garden location from the MQTT broker.
- We use <https://test.mosquitto.org/> as our MQTT broker.
- To get weather information at the given location, we use the OpenWeatherMap node.
- <https://openweathermap.org/> Provides real-time weather details to the OpenWeatherMap node.
- Using the MQTT Out node, we send the weather details of the given location to the MQTT broker.
- NodeMCU then retrieves the weather details from the MQTT broker.

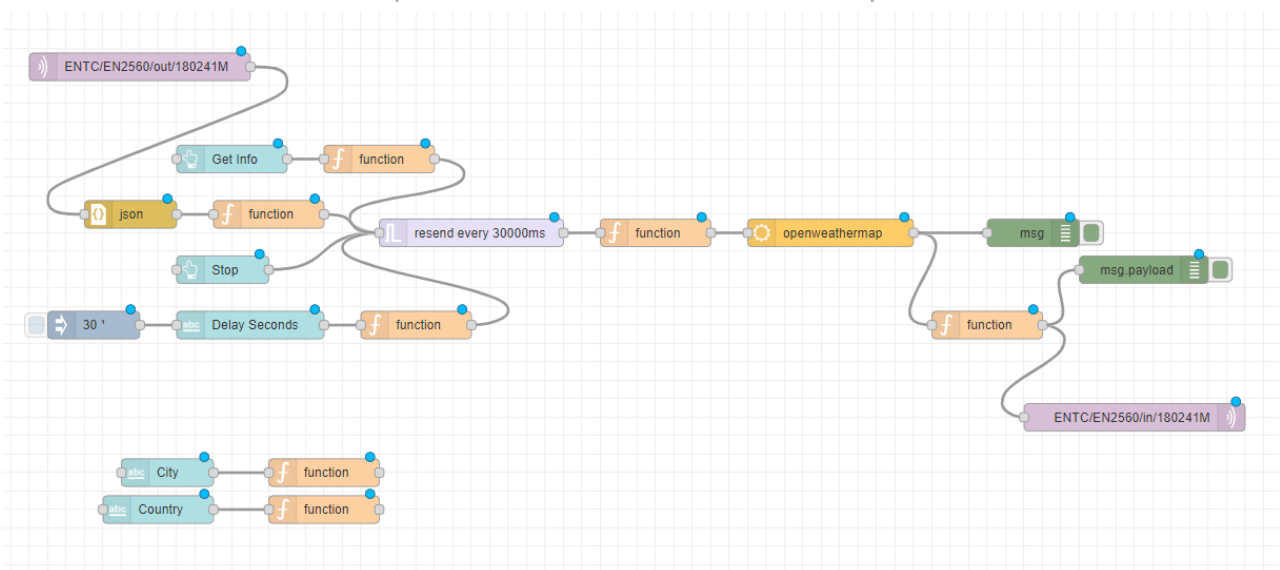


Fig: Node-Red flow

Node-RED to NodeMCU communication protocol stack

Application Layer	MQTT
Transport Layer	TCP
Network Layer	IPv4 / IPv6
Physical Layer	Wi-Fi : IEEE 802.11

NTP Server to NodeMCU communication protocol stack

Application Layer	NTP
Transport Layer	UDP
Network Layer	IPv4 /IPv6
Physical Layer	Wi-Fi : IEEE 802.11

Webpage to NodeMCU(Web Server) communication protocol stack

Application Layer	HTTP
Transport Layer	TCP
Network Layer	IPv4 /IPv6
Physical Layer	Wi-Fi : IEEE 802.11