Real-Time Weather Based Smart Sprinkler System

By Dr. Dillip Kumar Barik, Associate Professor, VIT, Vellore Campus, Tamil Nadu- 632014

INTRODUCTION

1.1 Overview

Sustainable development of water resources depend on the judicious use of water. It should be thought as a precious resource and there must be regulation to impose social crime, when there is wasting of water. But, most of time water being wasted e.g. supply of water to the crops or field, when it is raining. It happens in few golf course, because to maintain the course green, automated sprinkler or drip system have installed to reduce the human load. Generally, automated sprinkler system operates with respect to time. That is, if it has programmed to start operate at a particular time frame, it will switch on at that particular time even if it's raining. Since water is a precious resource we need to use it very carefully. The Internet of things will make the system more efficient and smart and unnecessary loss of water can be avoided. The smart sprinkler system uses data from soil sensor, current weather report and human command. Where human command is having the highest priority. We can automate watering plants by switching it on when the moisture content in soil is less. But when there is prediction of rain, watering the plants can be delayed by one or two days to reduce the consumption of the water. Here we used weather information supplied by open weather information to know the weather in future days. If there is a chance for the rain to occur the watering system will be delayed till the soil state goes form dry to very dry. If we can delay watering the plants by analysing the weather report this problem can be avoided.

1.2 Purpose

To conserve water and avoid losses of water, which is very much precious resources now a days. If we don't think about the value of water now, in future generation may not get sufficient water to drink.

LITERATURE SURVEY

2.1 Existing problem

Most of the available IoT based open source precision irrigation systems are theoretical with lack of proof of concept experiences. Either they are too generic or too specific. They do not explicitly address easy system deployment for facilitating replicability and streamlining the deployment of new systems. There are some isolated initiatives not necessarily connected to the existing platforms and architectures such as FIGARO project which aims to increase water productivity and improving irrigation practices through precision irrigation, but, not directly involving IoT [1]. Similarly in a case study [2], specially designed with limited IoT enabled precision agriculture and ecological monitoring domains system developed for collecting data. Agri-IoT [3] is a theoretical IoT-based framework for data analytics and real-time processing for smart farming that shares some similarities with SWAMP. In the last years, much has been said about the prospective uses for IoT combined with cloud-based services and big data analytics. In Europe, there is a current concern to understand the challenges and compelling impacts of IoT in large-scale pilots for smart agriculture. Brewster et al. discuss the deployment of those large-scale pilots for IoT in agriculture and describe technologies and solutions that might be present in some agrifood domains, such as dairy, fruit, arable crops and meat & vegetable supply chain [4]. FIWARE has been used as a computing platform for many IoT-based applications for smart farming. Rodriguez et al. [5] compiled a short literature review and presented the Agricola platform for precision farming. López-Riquelme et al. presented an implementation of FIWARE for a specific scenario of precision irrigation in agriculture in the south of Spain [6], however, it is focused on a specific use case, providing details of devices and equipment, as well as irrigation techniques. In contrast, this paper presents an architecture and a platform based on FIWARE, as well as configurations for system deployments in four scenarios. Fog computing is a fairly new paradigm aimed at dealing with challenges related to the huge amount of data that will be generated with the increasing utilization of IoT-based systems [7]. A new technological trend to implement the fog is container-based virtualization, which provides a lightweight alternative to traditional hypervisors [8]. FIWARE Generic Enablers are also distributed as Docker containers in order to be used in the SWAMP fog computing approach. FogFlow provides a programming model for IoT-based applications for smart cities distributed over the cloud and the fog located in the network edge [9]. Even though FogFlow is integrated into FIWARE, the SWAMP project takes a clean approach and uses directly the components provided by FIWARE, in combination with new components developed specifically for the SWAMP precision agriculture scenarios whenever needed.

2.2 Proposed solution

In the proposed solution the soil moisture levels in the golf course should be continuously monitored, updated to IBM IoT platform and store the data in Cloudant DB. By considering the weather forecasting details from the open weather map, the system should control the sprinklers automatically. Develop a mobile App to visualize the soil moisture and weather parameters.

THEORITICAL ANALYSIS

3.1 Block diagram

Project Flow:

- Configure and connect the online simulator to publish temperature, humidity and soil moisture values to IBM IoT Platform.
- Create a Node-RED flows to get the data from IBM IoT platform and store it in Cloudant DB.
- Create HTTP API's in Node-RED to send the sensor data to mobile app and also to get the commands from mobile application.
- Create a mobile app to visualize the sensor parameters and also to get the open weather data.
- Configure the mobile app to send commands to IBM IoT Platform to control the sprinklers based on the sensor values and weather details.

The block diagram of the proposed project is shown in Fig.1.

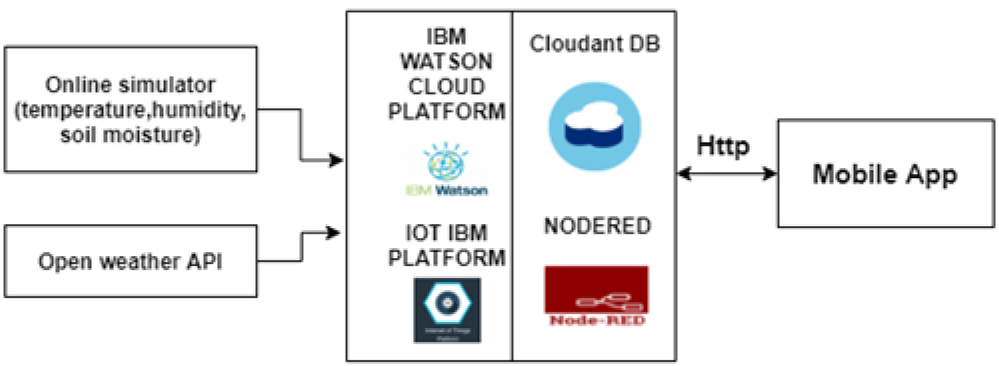


Fig. 1. Block Diagram of the proposed project

3.2 Hardware / Software designing

Hardware Components:

Soil Moisture Sensor:

*S*oil moisture sensor sense the soil volumetric of water content based on the dielectric constant. The soil dielectric constant and water content are directly proportional. As dielectric constant increases, the water content also increases. This is due to the dielectric constant of water that has larger soil component than the other soil components including air. It consists of a pair of electrodes that used to measure the resistance of the soil. Higher the resistance and lower the moisture content of soil [10].

Temperature Sensor:

LM35 is the temperature sensors used to measures the ambient temperature. Its operating temperature is -55^{0}c to 150^{0}c. It is low cost and gives low impedance output. The mechanical damage of sensor is protects by using sensor enclosure and membrane that filter to protect the sensor from dust, dirt, and water spray [11].

Humidity sensor:

Y-HS-220 Sensor is used to convert the humidity into voltage. The operating range is 30 to 90 % RH. It can be used in weather monitoring application. The following features are available in the humidity sensor.

Features:

Rated Voltage: DC 5.0V; Current Consumption: <-3.0mA; Operating Temperature Range: 0-60°C

Operating Humidity Range: 30-90%RH; Storable Temperature Range: -30°C ˜ 85°C; Storable humidity range: within 95%RH, Standard output voltage: DC 1.980 mV (at 25°C, 60%RH), Accuracy: ± 5% RH (at 25°C, 60%RH)

Software Components:

The Ardunio software can be used for this project design. It gives more number of libraries and a powerful tool to make simple program. In this project Red Node and IBM Cloud has been used to develop the prototype.

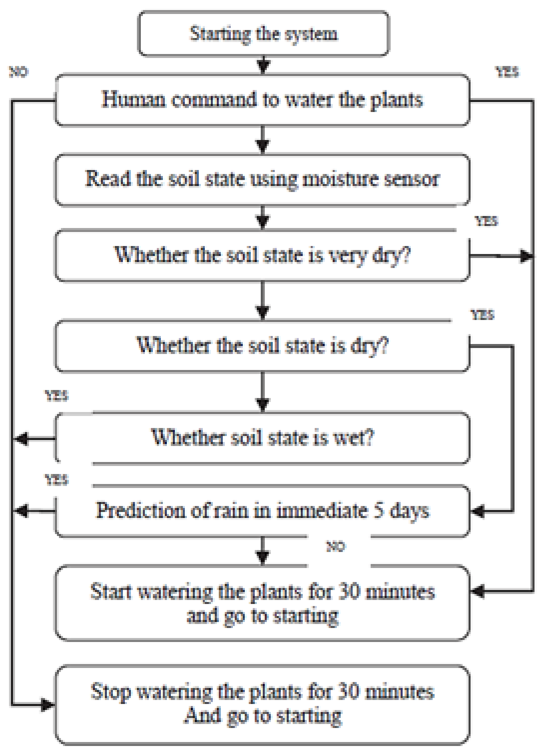
EXPERIMENTAL

INVESTIGATIONS

In this project no any experiment has performed. It has developed for learning tool and can be applied to the field with proper installation of hardware and software.

FLOWCHART

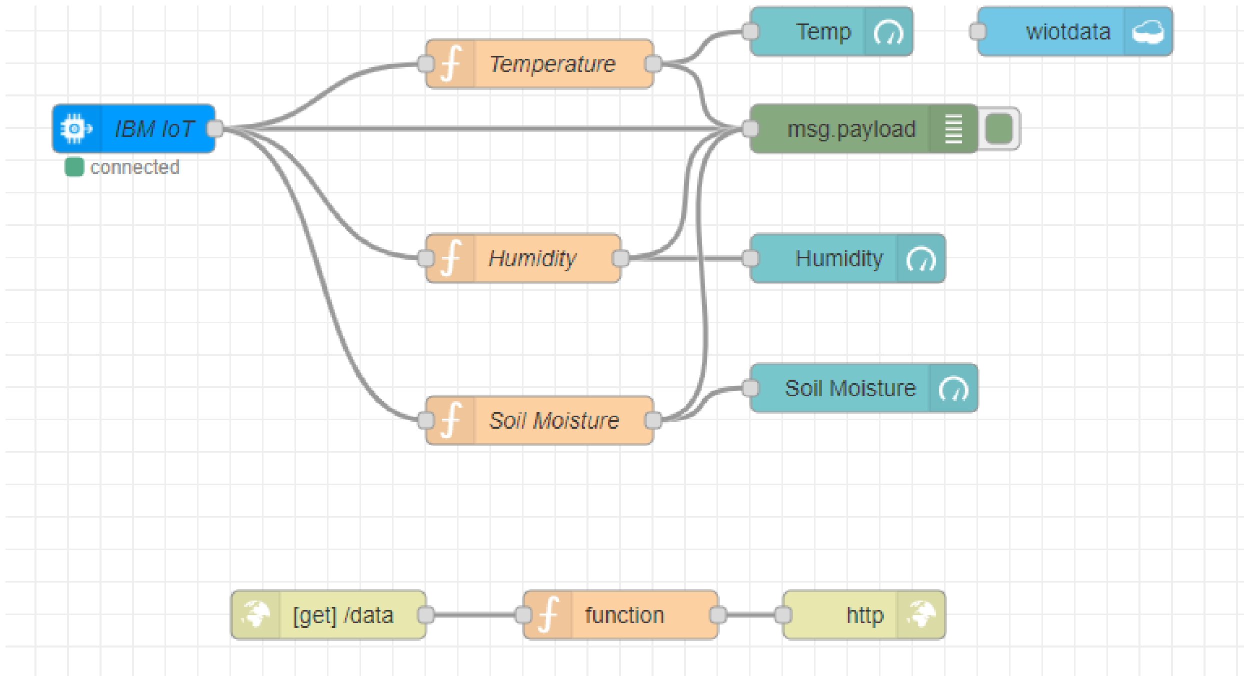
The flow chart of the proposed project can be presented as Fig. 2

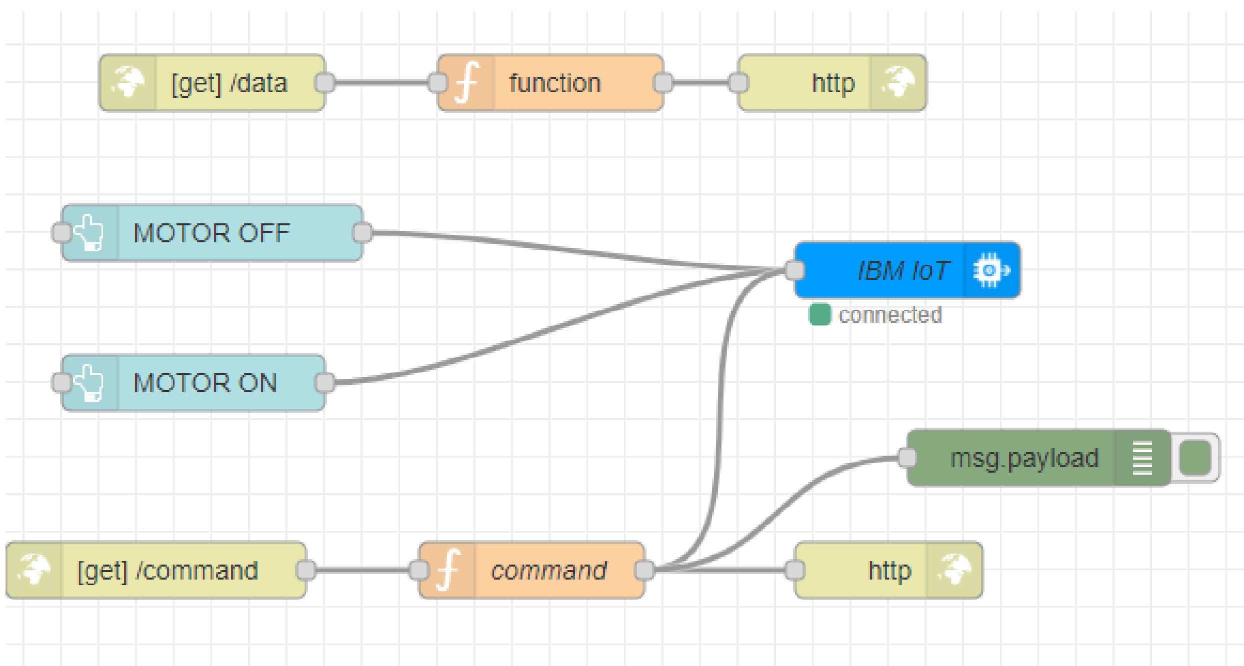


RESULT

In this project it has successfully completed the task whatever it has mentioned. As there is no any field application and it's just a prototype development of mobile app by using IBM Cloud, no results can be presented here.

Display Sensor data in UI based on Node Red:


Temperature
Temp
wiotdata
IBM IoT
connected
msg.payload
Humidity
Humidity
Soil Moisture
Soil Moisture
[get] /data
function
http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connected
MOTOR ON
msg.payload
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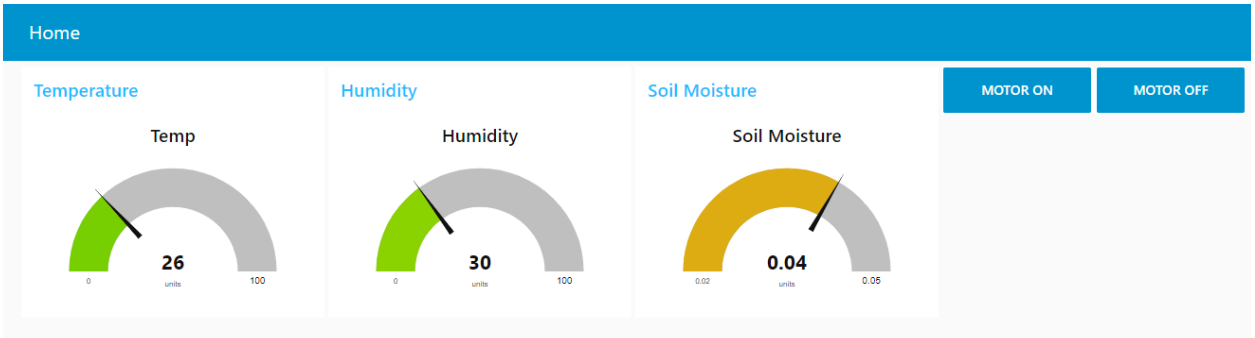
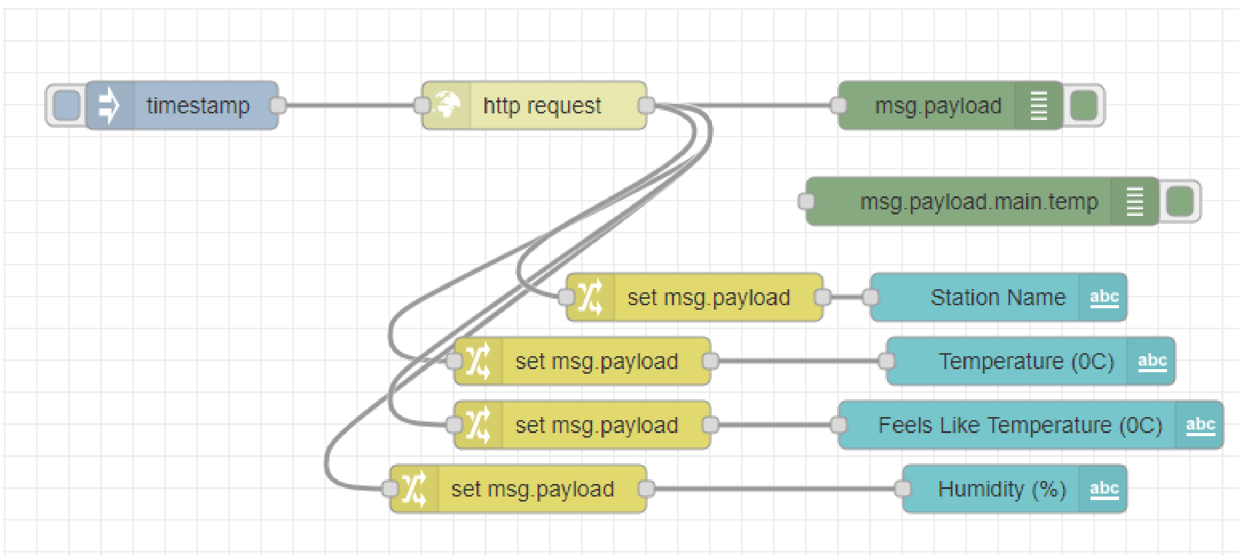
command
http

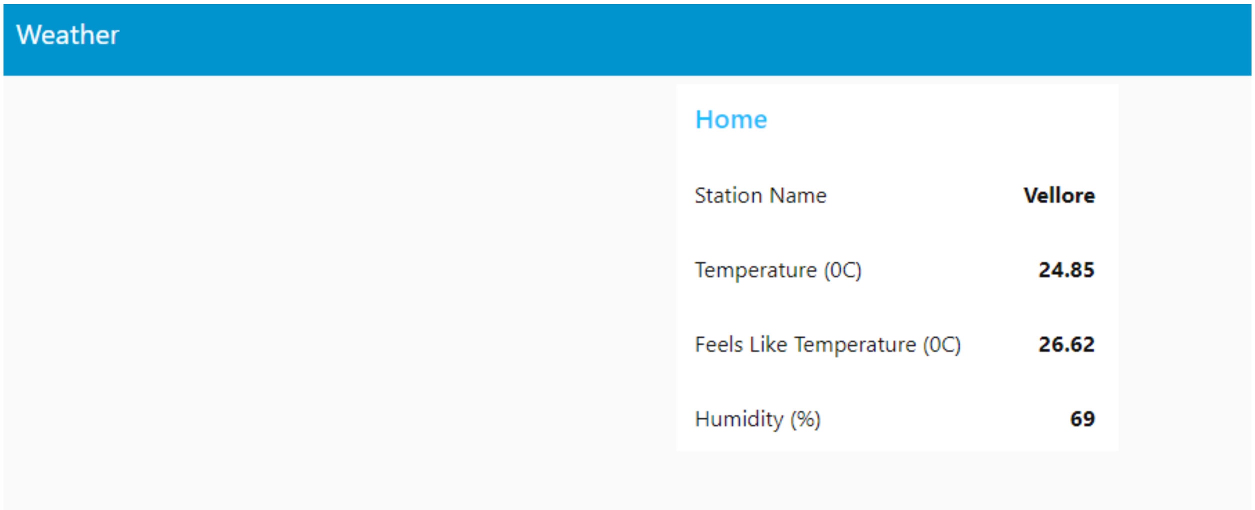
OUTPUT UI



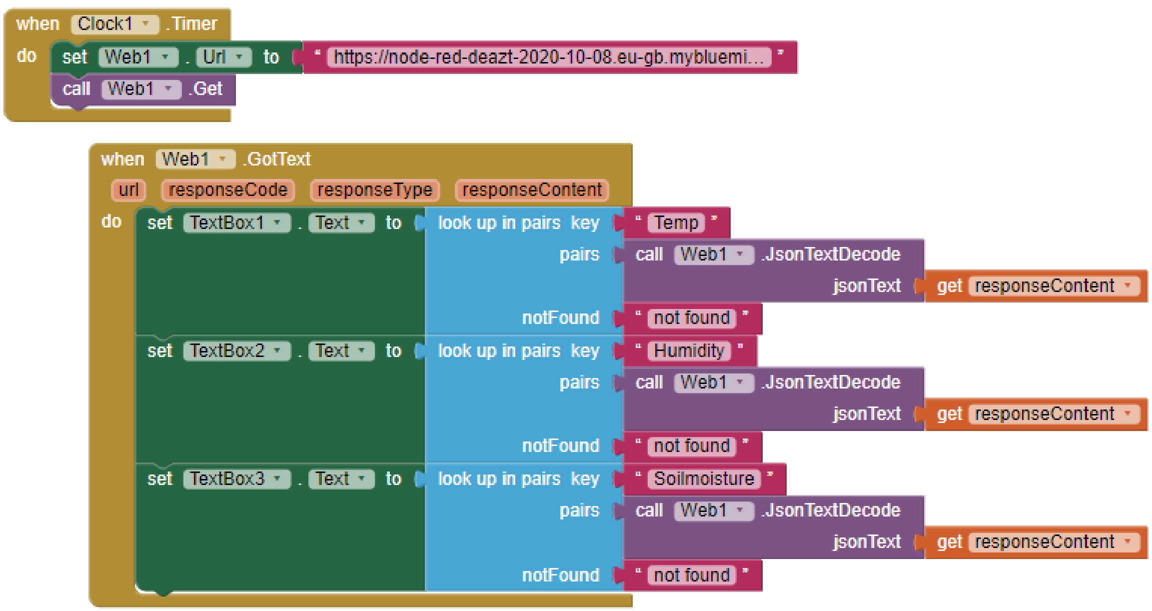
Node Red Flow for Call Open Weather Info Data

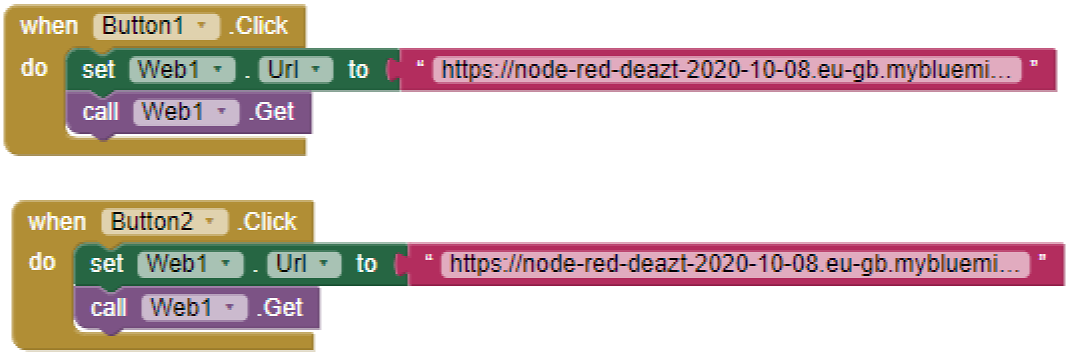


OUTPUT UI to Display Weather Data

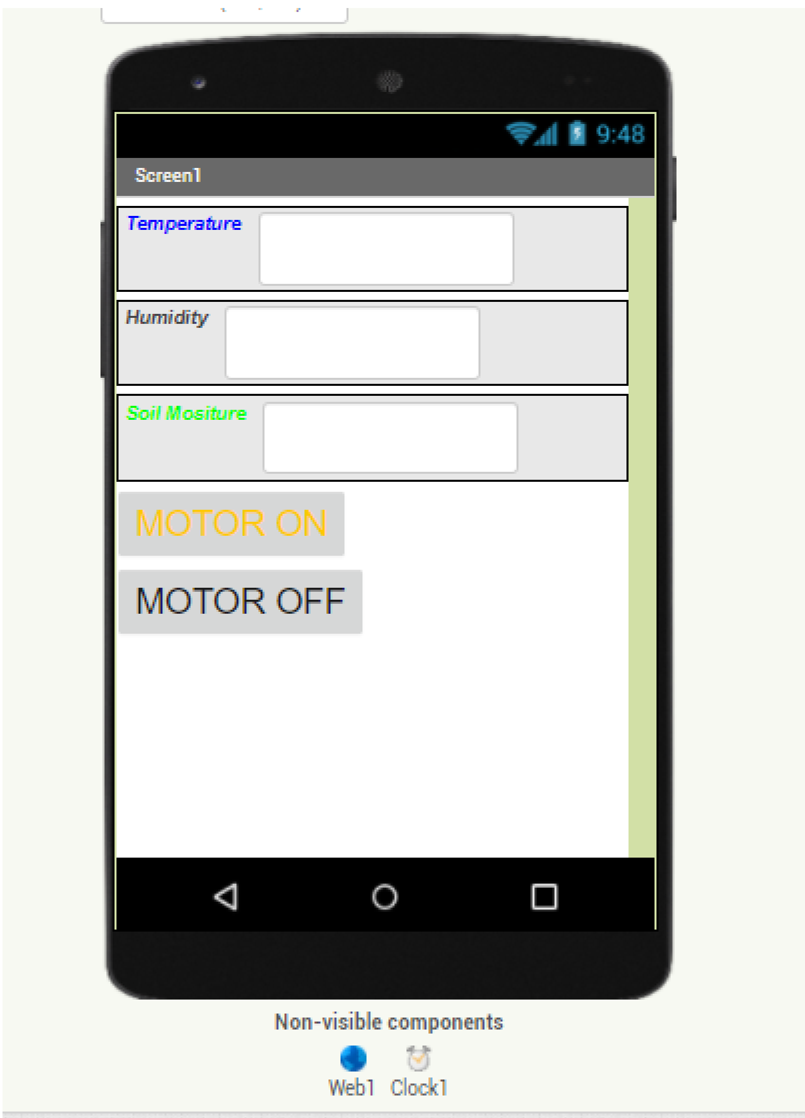


MOBILE APP DEVELOPMENT by MIT APP INVENTROR





DESIGN of MOBILE APP



ADVANTAGES & DISADVANTAGES

ADVANTAGES

- If this app can be developed properly and applied in field, then loss of water can be minimized in golf course. As watering can be done based on requirement.
- Not much human involvement is required, its fully automatic precision irrigation system.
- The golf course can be remain green throughout the year with minimum cost involvement.

DISADVANTAGES

- Initial investment will be more, but, less maintenance cost.
- Depends on weather information from third party, hence, limitation of the data source will impact to the result.
- It needs extension work to train common people and convince them to use.
- To keep it operate, good internet connection is required.

APPLICATIONS

If this prototype of automatic sprinkler system can deploy properly, then it will solve the problem of irrigation. This can be apply to all type crops and water loss during irrigation can be minimized. It will help to make water resources as sustainable. Because, water use in agriculture sector is the 2nd highest. This will be more user friendly and irrigation system can be operate from remote location by the means of mobile app.

CONCLUSION

The combination of sensors and software can make a fully automatic smart irrigation system. The precious resources i.e. water can be saved lots. There are many ways of mis-utilization of water during irrigation, which can be stopped. The timely watering can be done to the crop based on crop water requirement. This will lead to increase the productivity of the crop.

FUTURE SCOPE

The soil moisture will vary from place to place and also it depends on the soil type. Though there is not much variation of soil type in a particular field, still it is better to have more data point rather than a single point. In case multicropgrowing, again, water requirement is not same for all the crop. As the sensors are buried inside the soil, it’s very difficult to locate it again. To overcome this problems it is planned to devolve a soil moisture sensor boat, which will move along the field using GPS co-ordinates. By knowing the GPS coordinates, watering to the crop can be adjusted in case of multisoil and multicrop.

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APPENDIX

A. Source code to display Temp, Soil Moisture and Humidity as well as Motor On/Off

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B. Source code to read weather paremeters from Openweather (https://openweathermap.org/)

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