Automatic Irrigation Monitoring System Using Android Based Application

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***Abstract*—The irrigation system is a method that ensures that all plants get enough water for growth. However, due to the climate exchange, especially in dry season, the soil tends to lose its moisture. Although the Automatic irrigation system has been applied in the agriculture sector, water consumption and energy cannot be controlled through this system due to the system operated under time delay. Usually, farmers only can switch on or off the system manually depends on the weather. Therefore, this paper introduced the automatic irrigation system using android based application wireless communication. The system has a distributed wireless network of soil-moisture, humidity and temperature sensors. As the technology is growing and changing rapidly, Long Range (LoRa) communication helps to upgrade the technology where automation is playing an important role in human life. Using this system, the monitoring and controlling irrigation can be done via Android application and web server from any location.**

***Index Terms*—Irrigation; Android-Based; Long Range (LoRa); Wireless Communication.**

I. INTRODUCTION

Plant irrigation system is defined as a water distribution method to the entire farm. Use of technology in the field of agriculture plays an important role in increasing the production as well as in reducing the extra manpower efforts, water and fertilizer requirement.

Last few years, the automatic irrigation system has been applied as a solution for plant irrigation problem. There is an existing project on plant irrigation using 8051 microcontrollers. However, the disadvantage of using 8051for this application are signal processing ability and operating speed is not as good as the Arduino. Also, it has a limitation on memory as this controller has only one serial port therefore interfacing more sensors becomes difficult [1]. Another disadvantage of this existing method is it does not display any parameter values remotely, but just controls the pump action [2]. Besides that, another project discusses is Automation System for irrigating plants which is using two wires for moisture sensing. This kind of arrangement does not give accurate result compared to soil hygrometer humidity detection module [3]. There are lots of other small-scale demo projects for indicating automatic plant irrigation system using Arduino, but they are not capable and feasible enough to be implemented practically as they all have one or the other minor issues such as insufficient pump driver power, limited reservoir capacity, etc. [4]. Usually, this existing technique is operated based on time delay. Through this method, the water and power consumption cannot be controlled and require farmers to manually switch OFF the system during the rainy day [5]. Therefore, this project is proposed.

Automatic irrigation System with android based application provides the wireless monitoring system that can ensure the plants grow healthier by monitoring the soil moisture and current temperature via mobile application and web server from any location. The new data transmission technology, which is Long Range (LoRa) communication implemented in this project to transmit and receive the data from the sensors wirelessly. The implementation of this system can reduce water consumption and labors during watering the plants.

This proposed project is done to upgrade watering system with wireless monitoring technology for the plant. The given implementation works along with a cloud-based server and a mobile based device (ideally Android device) which helps the user to control the water pump and monitor the status of soil moisture and temperature of the plant every 15 seconds which is being monitored by the hardware device. The system will monitor and control the plants in real-time using embedded controller, web or cloud-based system and can be accessed through Android-based mobile phones. The environment parameters such as temperature and soil moisture are monitored using wireless communication. Solar panels are used for the wireless sensor module power supply. The data from the sensor modules will be transmitted and receive using Long Range (LoRa) wireless communication. Due to drastic climate change in these recent years has left farmers devastated, leaving them unable to produce crops yield throughout the year. With this particular system, farmers will be able to maintain a fertile farm and produce a stable crop yield thus generating income for the nation. This system can also save the amount of water used for irrigation as moisture sensor is used to make sure the water pump will be closed when the watering plant is completed.

II. DESIGN IMPLEMENTATION

This project provides automatic irrigation monitoring system using the Android-based application to the plants which helps in saving time, money and water. There are four modules used in this project, which are sensing module, controller module, communication module and an output module. As shown in Figure 1, the transmitter (node) system consists of sensing module, a controller module and a communication module. The sensing module includes the soil moisture sensor and a waterproof temperature sensor that will sink into the soil to measure the soil moisture level and temperature level. The receiver (base) system consists of the communication module, a controller module and output module as shown in Figure 2. The controller module is the main component. Arduino Uno board is used as a node system and Arduino Mega board in the base system as the controller module to manage the system. Referring to Figure

3, this system is created to identify whether there is need to water the plant. Further, logic and decision-making conditions help the soil moisture condition of the soil and it always maintains moisture and also the user gets the status of the soil moisture condition and motor on the mobile via the Android application.

Initially, the moisture and temperature sensor senses the soil. The output of the moisture sensor is in the analog form and the output of the temperature sensor is in digital form. The values are then sent to the Arduino Uno and then the data transmitted using the Lora transmitter to the LoRa receiver wirelessly which is connected with the Arduino Mega will decide the level of soil is wet or dry and according to the threshold value that has been programmed. If the soil is dry, microcontroller trigger the relay and water pump will switch on which leads the water to flow. On the other hand, the microcontroller turns the relay off to deactivate the pump if the soil is wet. At the same time, the data will be stored in the cloud server so that users can monitor the real-time status of the soil moisture, temperature and motor condition via the mobile application as shown in Figure 4.

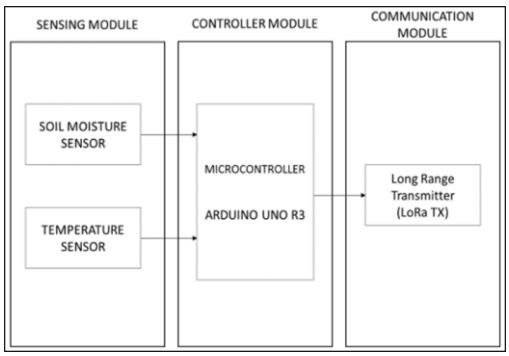

Figure 1: Transmitter (Node) Block Diagram of the System

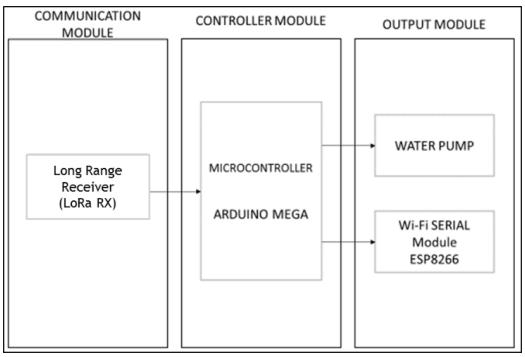

Figure 2: Receiver (Base) Block Diagram of the System

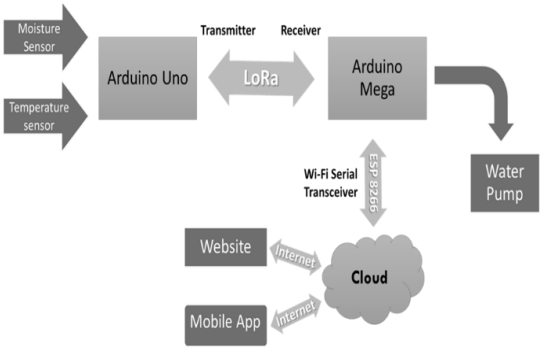

Figure 3: The Overall Block Diagram of the System

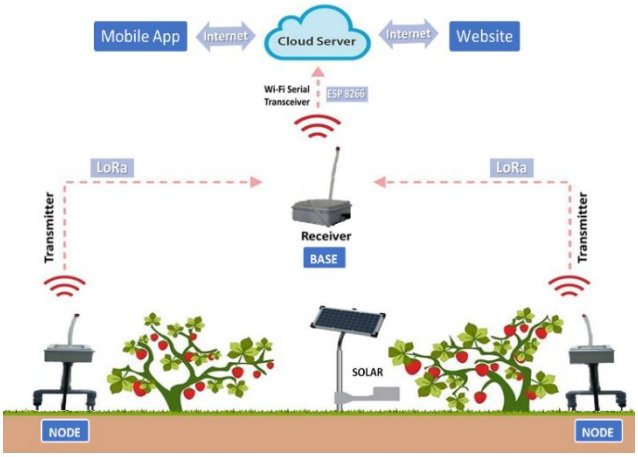

Figure 4: The Operation of the System

A. Algorithm

The automatic irrigation system using android based application wireless communication has been running follow specific algorithm as mention in Figure 5.

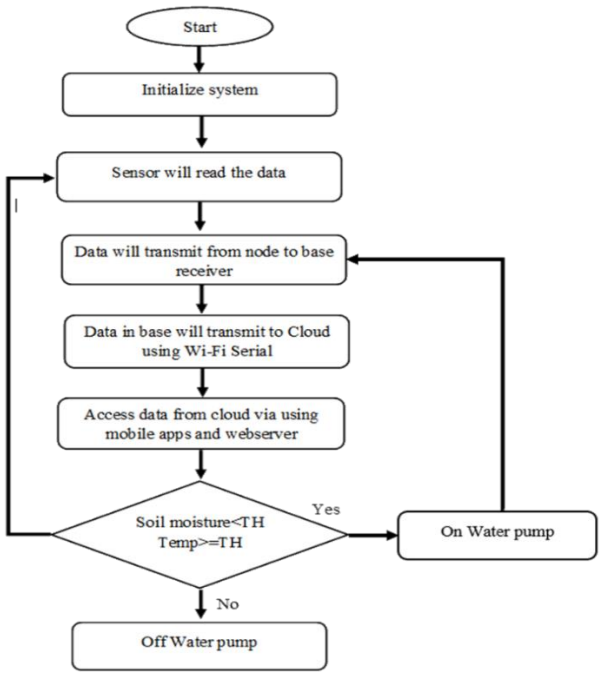

Figure 5: Automatic Irrigation Monitoring System Using Android Based Application Algorithm

The system is started with sensor detection of soil moisture and temperature. The moisture sensor is used to detect soil moisture. The output module from this sensor indicates high and low level depends on the condition of the soil. Therefore, the output is high if the soil in dry condition and change to a low level when the soil in wet condition. This output module has two parallel plates to detect the presence of moisture. Thus, it will act as a short circuit and allow current to flow through it if the soil becomes wet while acting as an open circuit when the soil is dry. Module operating voltage is between 3.5V to 5V. It has an adjustable sensitivity knob which can be adjusted according to different soil type [6]. Then, the temperature of the soil is measured using the waterproof temperature sensor. The power supply range is about 3V to 5V. It has capabilities to measure the level of temperature -55°C and +125°C. The accuracy over the range

is about plus minus 0.5°C. The pin definition for the waterproof temperature sensor are red wires used for VCC terminal, the yellow wire used for data transfer connection and the black wire is used for GND terminal. The information or input data are sent by a single wire interface, so only ground wire need to connect with the Arduino UNO board.

Meanwhile, the microcontroller is worked as the base to receive the data and another as a node to transmit the data to the cloud. Low power long range wireless transmitter (LoRa) is used to transmit the data due to its ability to transfer data from a long range. Normally, the coverage area is around 16km at the urban and around 5km at the suburban. So that at the suburban area the street light around the 5km range can be communicated and the data can be sent to the base station while in the urban area the street light around the 16km data can be sent to one base station[8]. The internet source can be acquired using Wi-Fi Serial purposely to transmit the data to the cloud. This Wi-Fi Serial is fixed with a base microcontroller which is easier to upload the data to the cloud and will be present on the webpage and mobile application [9], hence reducing the labor manpower for watering the plant. All data received has been monitored follow a set of the specification. If the values are less then threshold value, the water pump will be ON automatically and vice versa.

III. HARDWARE DEVELOPMENT

The prototype of this project consists of a solar panel, device body and the system container. The Node system placed in a waterproof plastic material box which consists of a microcontroller, LoRa with antenna, on/off switch and also both sensors. All the connection of the sensors was covered in the box to avoid any short circuit occur as in Figure 6.

Figure 6: Node System Container

Solar panel and battery fixed with node box. The solar panel is fixed on top of the box as in Figure 7 and the battery placed into the box as in Figure 8, so there is a hole drilled to connect both of these. Then, the hole is glued using silicon glue to avoid water flow into the box.

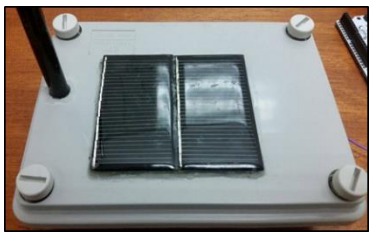

Figure 7: Solar Panel attached to node box

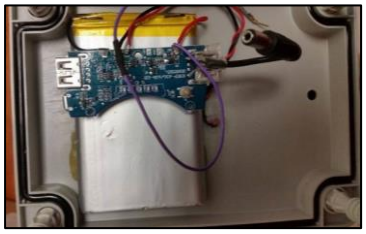

Figure 8: Battery attached with node box

Figure 9(a) shows a Node system which is contained with sensors. This system can be added more depends on the application. Meanwhile, only one base system as shown in Figure 9(b) operated as uploading system. It will send the data from one or multiple node systems to the cloud.

(a) (b)

Figure 9: (a) Full Node System (b) Base System

IV. RESULTS AND DISCUSSION

A. Result in Webserver

The webserver is created as a dashboard to display the result based on the input or sensor data obtain form microcontroller. An open-source platform called Thingspeak is used to store the data from the microcontroller. Thingspeak is an Internet of Things (IoT), a platform that allows collect and store sensor data in the cloud [10]. Other than that, the Figure 10 and Figure 11 are the monitoring graph for moisture and temperature that have been shown in webserver depends on the obtained data. There are several details which are level, day, date and time will appear when the user clicks on any data point in the monitoring graph.

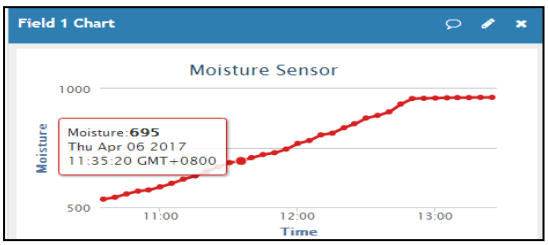

Figure 10: Moisture monitoring system

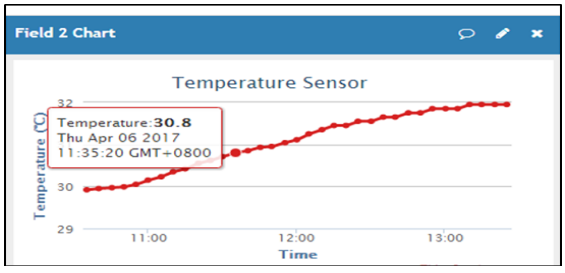

Figure 11: Temperature monitoring system

Table 1 shows few real data collected from the sensors that stored in webserver. The overall data will in stored in the webserver in an excel table format as shown in Table 1 which consist of date, time, entry number, moisture level, temperature level and also water pump status so that users can monitor the system easily. The range of the soil moisture level is 350Ω until 600Ω which is in wet condition and 601Ω to 999Ω which is in dry condition [11]. The water pump will be turned on when the sensor reading reaches a dry level and will be turned off in wet level.

Table 1
Data collection of temperature and moisture sensors

Date / Time	Entry No	Moisture Level	Temperature Level	Water Pump
2017-04-06 10:05:20	1	462	29.55	0
2017-04-06 10:10:25	2	486	29.68	0
2017-04-06 10:15:35	3	504	29.71	0
2017-04-06 10:20:20	4	511	29.85	0
2017-04-06 10:25:27	5	522	29.88	0
2017-04-06 10:30:24	6	533	29.91	0
2017-04-06 10:35:20	7	534	29.92	0
2017-04-06 10:40:20	8	542	29.95	0
2017-04-06 10:45:28	9	556	29.97	0
2017-04-06 10:50:21	10	568	29.99	0
2017-04-06 10:55:29	11	573	30.05	0
2017-04-06 11:00:23	12	586	30.15	0
2017-04-06 11:05:24	13	601	30.23	1
2017-04-06 11:10:22	14	618	30.35	1
2017-04-06 11:15:21	15	632	30.42	1
2017-04-06 11:20:26	16	651	30.55	1
2017-04-06 11:25:27	17	670	30.62	1
2017-04-06 11:30:28	18	688	30.71	1
2017-04-06 11:35:20	19	695	30.8	1
2017-04-06 11:40:22	20	709	30.85	1

B. Result in Mobile Application

An android application being developed to monitor the status of the soil moisture condition, temperature condition and also can control the water pump. This android application is created using MIT app inventor [12].

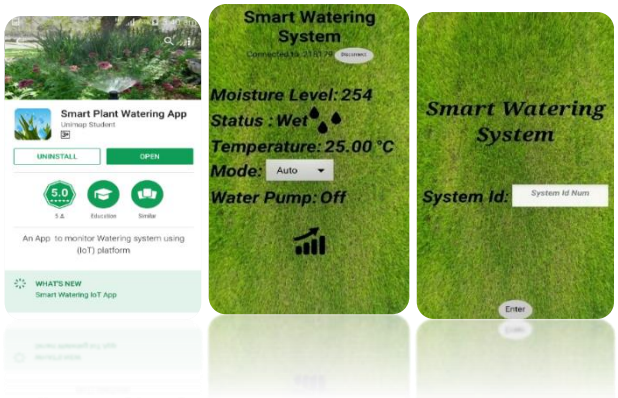

Figure 12: Android application for monitoring System

The features that are going to be in this Android application is shown in Figure 12. There are two screens in this mobile application which are screen 1 for entering the system id, screen 2 to monitor the current status of moisture and temperature level of the soil. Besides that, the status of water also pumps able to monitor on screen 2. This application also connected to the webserver to make user easy to monitor the graph of the system by clicking the graph icon. Then this application will connect to the webserver to receive the data through the internet. The developed application has been uploaded to google play store.

V. CONCLUSION

This paper presents Automatic Irrigation System with the Android-based application using Wireless Monitoring Technology which benefits in several ways, such as saving water, time, manpower and ultimately increase profit. It is a portable and convenient system which consists of a wireless web-based system, mobile remote application, wireless data transmit and receive system. The system would provide feedback control system which will monitor and control all the activities of drip irrigation system efficiently. The results were within the expected range and accurate. There was some delay in receiving data from the transmitter, but it can be overcome by using a high-quality transceiver. Using this system, users easily monitor their plant soil moistures, temperature level and water pump status from any location.

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