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A Real time Implementation of Android Mobile based Smart Water-Saving Irrigation System in Precision Agriculture

K. Priyanka Gandhi[1], B. Rama Murthy [2], K. Tanveer Alam [3] N. Anju Latha [4]

Research Scholar, Department of Electronics, Sri Krishnadevaraya University, Anantapur, A.P, India[1]

Professor, Department of Instrumentation, Sri Krishnadevaraya University, Anantapur, A.P, India[2]

Assistant Professor(C), Department of Electronics, Rayalaseema University, Kurnool, Andhra Pradesh, India[3]

Teaching Assistant, Department of Instrumentation, Sri Krishnadevaraya University, Anantapur, A.P, India[4]

ABSTRACT: The present work proposed an Android mobile based embedded system for water saving irrigation system in precession agriculture. Irrigation is the method of synthetically providing water to land where crops are cultivated. In the present work one of the critical parameter of agriculture parameters is the soil moisture content measurement data sent to microcontroller provided by sensor. When the soil moisture of the land is below the threshold value, automatically the motor will be ON and as the soil moisture data attains the threshold value, automatically the motor will be switched OFF through the relay through which power will be given to motor. This system saves the water and avoid the presence of the farmer in the field helps in saving time and also risk. Hence to get optimum level of water, for increasing the productivity of crop is obtained from the developed Water-Saving Irrigation System. The developed system is tested and implemented successfully with Android Mobile.

KEYWORDS: Particle Photon Microcontroller with Wi-Fi module, Soil Moisture Sensor, Solid State Relay, AC Motor, Android Mobile.

I. INTRODUCTION

Agricultural irrigation is considered as the basis for the human life as it is the main source of food grains and other raw materials [1]. Irrigation is the best method for providing water to the roots of the plants. Growth in agricultural sector is necessary for the development of economic conditions of the country. The present era also the farmers are using the traditional methods of farming. Hence there is a need to implement modern science technology in the agriculture sector for increasing the crop yield. The problems faced by the traditional methods are based on discrete and wired method. It can be solved through the implementation of wireless method which provides a low-cost controlled irrigation system and a real-time monitoring of the field [2]. The present work is a system arrangement which will help reduce loss of water and thus has become a popular method wherein reduction of labor cost and increase in yield is witnessed. When the devices are activated, they read and give the output to the controller. The sensor readings are analog in nature, inbuilt ADC in the controller converts the analog signals into digital format [3]. Then the controller tends to access information of sensor data and the soil moisture data is sent to the cloud server and also client mobile App [4]. Applications are developed based on IoT including industrial processes, home appliances, health monitoring applications, smart homes, and smart cities [5].

II. LITERATURE SURVEY ON EARLIER WORKS

In this section some relevant works are discussed regarding the agriculture parameters using IoT and GSM technologies. The same is presented as the work describes about “Automated Irrigation System Using a Wireless

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Sensor Network and GPRS Module" developed with threshold values of temperature and moisture value in soil can be measured into a microcontroller-based gateway to control water quantity[9]. Joaquin Gutierrez et. Al. "Real- Time Automation and Monitoring System for Modernized Agriculture" The technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture [10]. Xiaohui Wang et. Al. "Farm management systems and the Future Internet era" In FMS (Forms Management System) architecture which utilizes future internet characteristics. The farmers will get easy access to information and advice through this architecture [11]. Alexandros Kaloxylos et. Al. "Application of Cloud Computing to Agriculture and Prospects in Other Fields" Cloud storage stores work history information, fertilizers distribution and environment information collected through sensors, collection and recording information. Authors have analyzed the collected data for correlation between environment, work and yield for standard work model construction. [12] Mitsuyoshi Hori et. Al.

III. IMPLEMENTATION OF HARDWARE AND SOFTWARE OF THE ANDROID MOBILE BASED WATER – SAVING IRRIGATION SYSTEM IN PRECISION AGRICULTURE

The block Diagram of the Android Mobile based smart water-saving irrigation system as shown in figure 1 and the schematic diagram in figure 2. The System consists of mainly the following units. They are

1. Soil Moisture Sensor (EC-5)
2. Solid State Relay
3. AC Motor
4. Particle Photon (Arm cortex M3 STM32F205)
5. Ubidots Cloud Server
6. Android Mobile

The description of each of these units and their interfacing aspects with Particle Photon are presented as below.

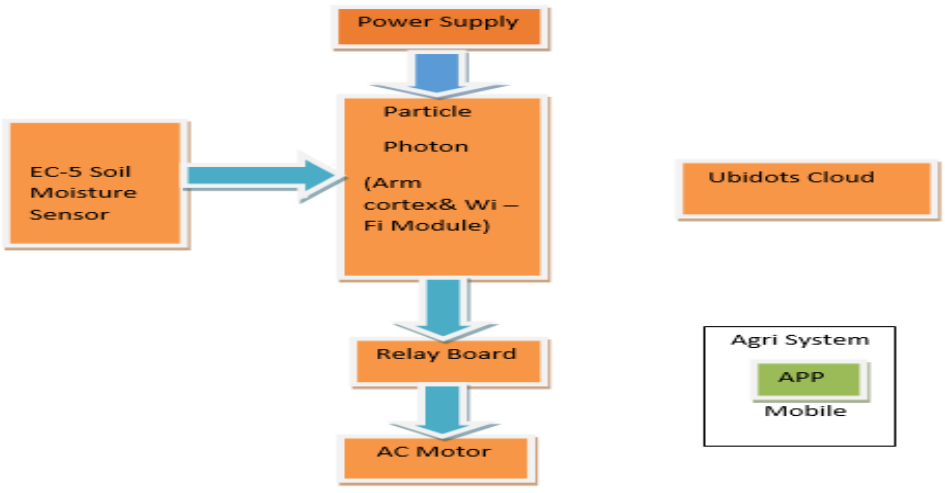

Figure 1: Block diagram of Android mobile based smart water- saving Irrigation system.

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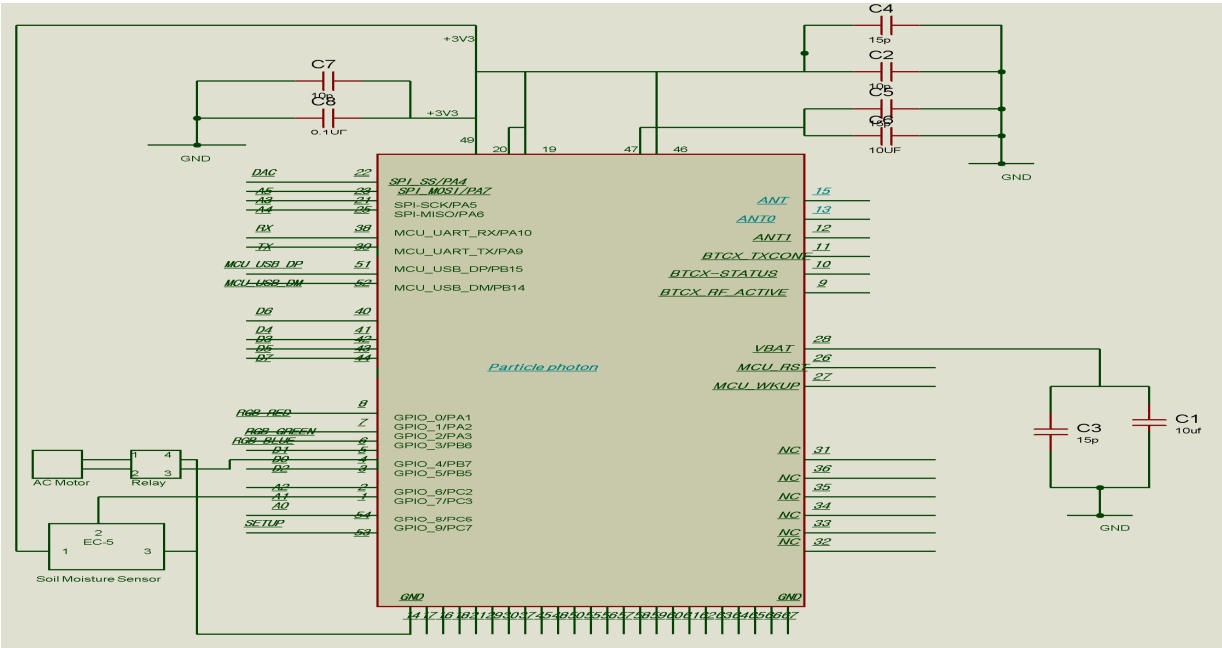

Figure 2: Schematic diagram of Android mobile based smart water- saving Irrigation system.

Figure 3: Prototype of Android mobile based smart water- saving Irrigation system.

3.1. Soil Moisture Sensor (EC-5)

In the present work soil moisture sensor (EC-5) is used to measure the soil moisture content in the field. Moisture is the presence of water or other liquid in a small quantity within a solid surface. The device enables to measure soil moisture accurately and affordably.

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Figure 4: Soil Moisture Sensor (EC-5)

The sensors produce an output voltage that depends on the dielectric constant of the medium surrounding the sensor and the output voltage is directly proportional to the water in the field. The sensor measuring moisture range from 0 to 100% VWC (Volumetric Water Content) with 375-1000mv and allows accurate measurement all types of soils.

3.2 Solid State Relay

In the present work solid state relay (SSR) as shown in figure 5 is used to drive the single phase Ac motor with sufficient current which interfaces with one of the I/O line of the particle photon microcontroller and single phase AC motor. Whenever I/O line is high, the motor will be ON through relay. It is operated on 5V and provides and with stands to the load current up to 40A. The advantage of SSR's is that they help to switch both ON and OFF the motor with much faster than mechanical relays.

Figure 5: Solid State Relay

3.3 Single Phase AC Motor

An AC motor is used in the smart water-saving irrigation system as discussed earlier for providing water in the field for crop. It is a single phase AC motor, interfacing with the relay output terminals. The motor works depending on the relay and it converts power from electrical power into mechanical power.

Figure 6: Single Phase AC Motor

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3.4 Particle Photon (Arm cortex with Wi-Fi Module)

In the present work, the Particle Photon is as shown in Figure 7 and it is used to process and control the data. Particle photon combines ARM cortex M3 microcontroller with a Broadcom Wi-Fi chip and a piece of software Web that runs on computer, used to write and upload computer code to the physical board which is shown in figure-7.

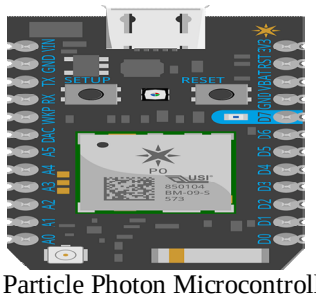

Figure 7: Particle Photon Microcontroller Board

The Photon has more capabilities in a small chip device with analog and digital communication interfaces and having the fowling features.

- Microcontroller with Wi-Fi module
- Arm Cortex M3 STM32F205
- Broadcom BCM43362 Wi-Fi chip
- 802.11b/g/n Wi-Fi
- On-board RGB (Red Green Blue) status LED
- Operating Voltage: 3.3V and 5V
- Flash Memory: 1MB
- Clock Speed: 120 MHz

3.5 Ubidots Cloud

In the present work Ubidots cloud server is used for to obtain the data from the microcontroller through Wi-Fi and to store and send the data to the display devices. It is one of the technology of IoT for analytics and visualization of information. Ubidots API keys accessed protocols are Very Simple Control Protocol (VSCP), Hyper Text Transfer Protocol (HTTP), Message Queuing Telemetry Transport Protocol (MQTT), Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). These protocols provide a simple and secure connection for transceving data to and from their cloud service in real-time. Ubidots time-series performance optimized for IoT data stored in the form of pdf files. The applications of this cloud server are interactive, real-time data visualization.

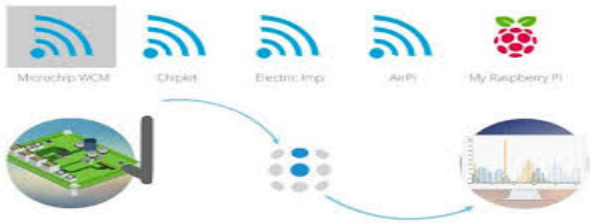

Figure 8: Ubidots Cloud

3.6 Android Mobile

Android is a mobile operating system, in this device any application is developed by using android studio software. The android studio is an open source software and includes android libraries. The layer consists of android libraries written in C, C++ and Java used by various systems and monitors the devices how to handle different kinds of data and are exposed to android developers via android application framework. The applications are written in java

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include a calendar, email client, sms program, maps, making phone calls, accessing the web browser, accessing contacts list and others.

IV. ALGORITHM AND FLOW CHART FOR ANDROID MOBILE BASED WATER-SAVING IRRIGATION SYSTEM

Algorithm and Flow chart for smart water saving irrigation system is as presented below

1. Initialize the Particle Photon and with Suitable Libraries
2. Enable the Particle Photon device with SSID and Pass Word of the Wi-Fi Network
3. To create the account in the particle Web IDE (Integrated Development Environment) with email id and login to the Web IDE.
4. To create account in Ubidots Cloud with email id and login to the Ubidots cloud Server.
5. To select the Variable of dashboard of the Ubidots cloud server.
6. To enter the API key and Variable ID of the Ubidots cloud in to particle Web IDE.
7. Initialize the Soil Moisture sensor (EC-5).
8. To set the baud rate for UART (Universal Asynchronous Receiver and Transmitter) in the web IDE of Particle and connect to the Wi-Fi network.
9. Read the data through Analog (A0) I/O line of the Particle Photon device and data is stored in the variable
10. The soil moisture data send to the serial monitor through the baud rate 9600 bits/sec and this data send to the Ubidots Cloud server and also send to the Agri System App through the Ubidots Cloud Server.
11. If the soil moisture data is less than the 50%VWC (Volumetric water content) is the motor will be ON otherwise motor will be OFF. The status of the motor information shown in Android App.

The process of smart water – saving irrigation system is presented in figure 9.

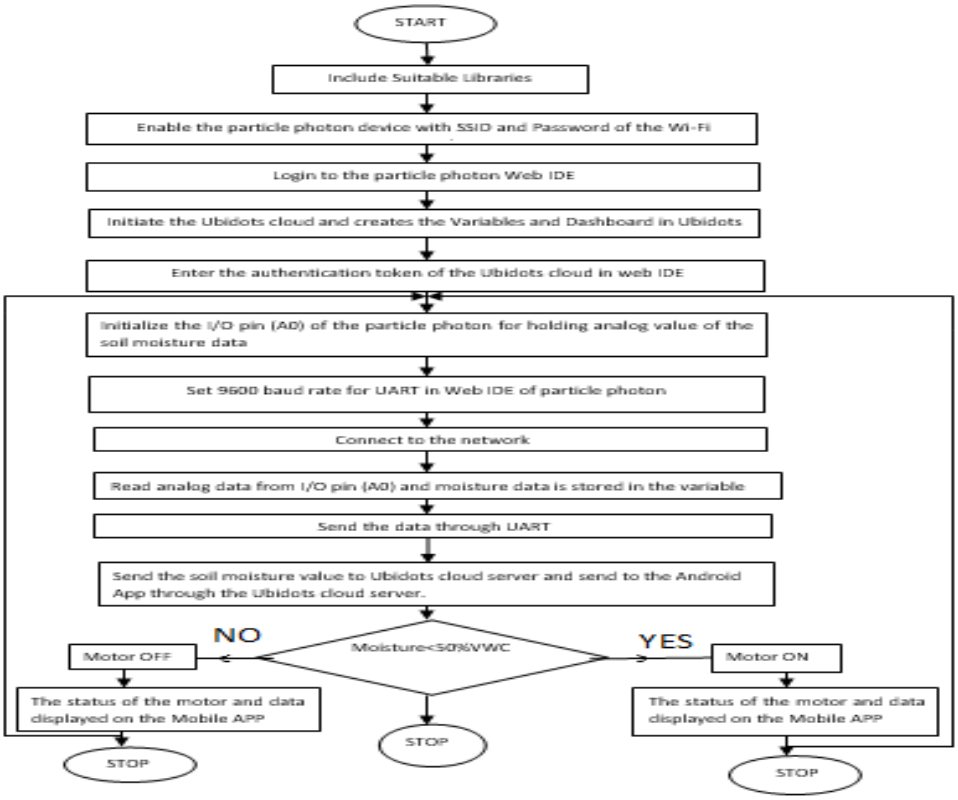

Figure 9: Flow chart for Android Mobile based Water – Saving Irrigation System

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V. RESULTS AND DISCUSSION

The proposed system is Android mobile based water saving irrigation system and has been developed and implemented successfully in our laboratory.

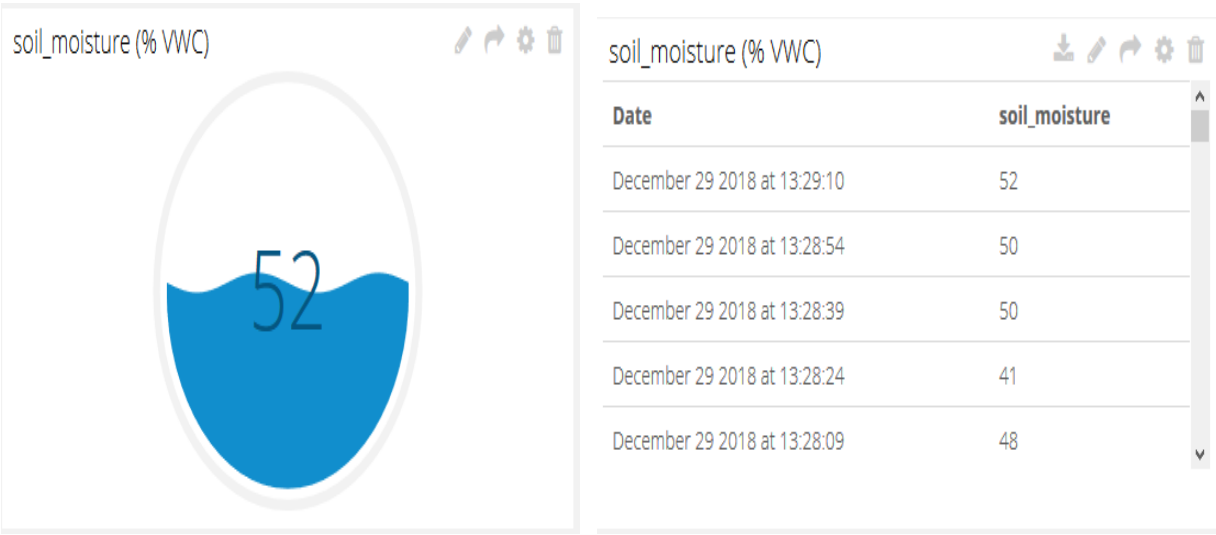

Figure 10: Display of screen shot for measured values of soil moisture data in cloud server.

Whenever opens the Agri System App in Android mobile, the user should select the language either English or Telugu. The App will display user selected language, if the selected language is English then the App will show in English only. The next step will be registration with details of name, address, adhar number, mobile number and land holding then submit the registration form through the submit button immediately login page will be displayed and login to the APP with user name and password. After login, it shows menu of agriculture Parameters such as SOIL MOISTURE and MOTOR is shown in Figure-12. A click on the SOIL MOISTURE button, the soil moisture data will be displayed. Similarly click on the MOTOR button, the status of the motor will The motor will operate depending on soil moisture data, if data of soil moisture is less than threshold value (50% VWC), motor will be ON automatically and MOTOR IS ON will be displayed in the Agri System APP like shown in Figure-13. Similarly if data of soil moisture is more than threshold value (50% VWC), motor will be OFF automatically and MOTOR IS OFF will be displayed like Figure-14 in the Agri System APP.

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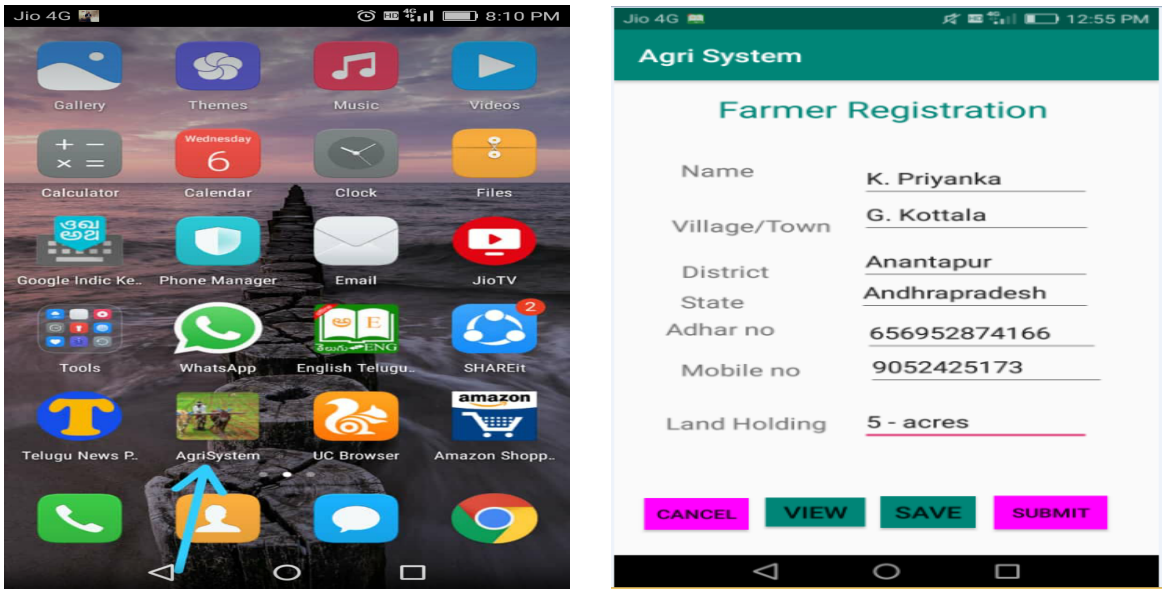

Figure 11. App Icon of the Agri System and Registration form of Agri System in Mobile.

Figure 12. Menu software of soil moisture and motor buttons in Android mobile.

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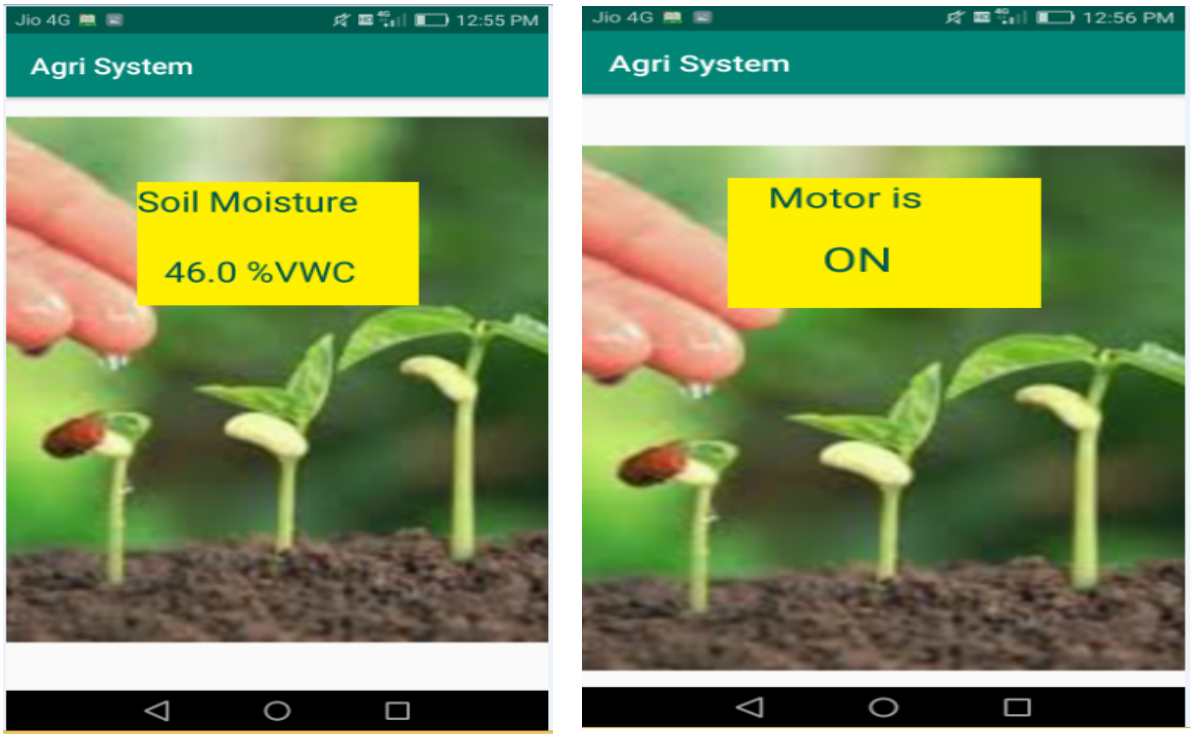

Figure 13: Display of screen shot of soil moisture data and status of motor in Android mobile.

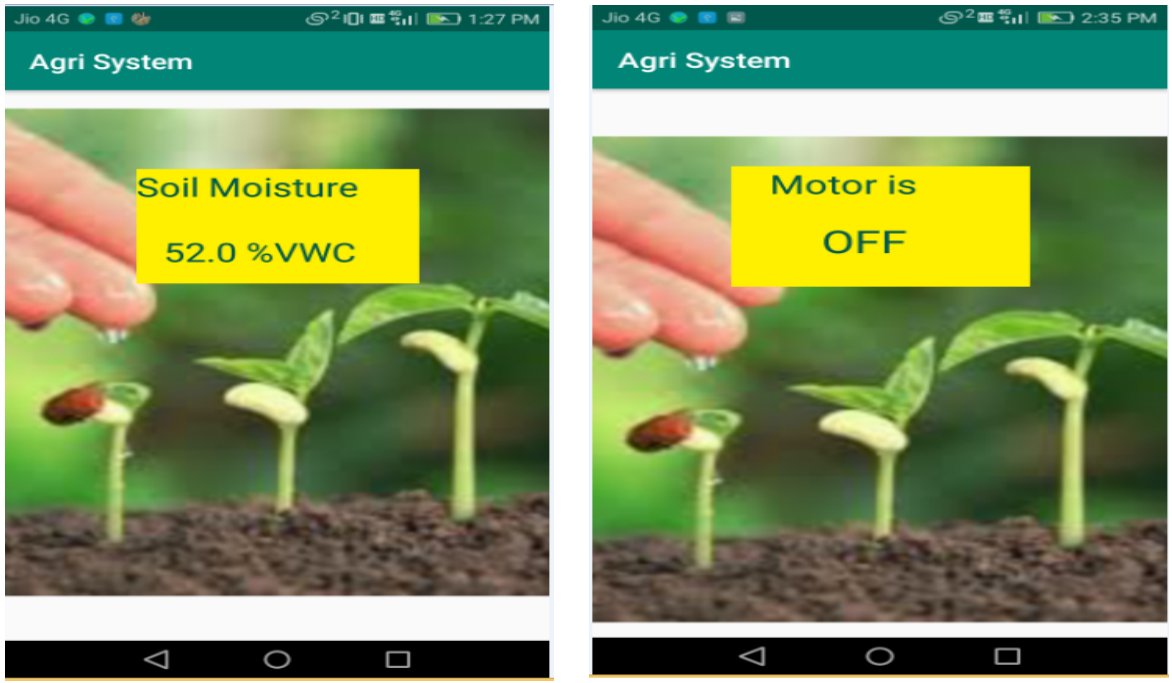

Figure 14: Display of screen shot of soil moisture data and status of motor in Android mobile.

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VI. CONCLUSION

The developed system is tested and implemented successfully in laboratory and also in Greenhouse field as a smart Agriculture System and we found the systems working precisely and accurately. The system providing the advanced features like easy portable, low cost and standalone system. The System can be installed in urban and remote places as well, prevents from wastage of water and thus reducing the manual labour, which is very useful for the farmers and also agriculture research scientists in increasing yield of crops. The scope of future work is planned to add more number of devices/sensors for proper monitoring and installation of communication systems to the help the user by providing real time conditions of the field in the form of MMS facility with video capturing of the field.

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