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IoT based plant watering system using Arduino and Android mobile application

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Abstract*:* Modern agriculture mainly consists of automated techniques which lead to wastage of vital resources such as water. Water plays an important role in the growth of plants and is also regarded as a degrading resource on our planet. This paper presents a solution to this problem. A system in which the user is notified automatically of the reducing amount of water in the soil and can control the implementation of the sprinkler system via a user-friendly Android application, thereby reducing the loss of water, has been proposed. The data from the soil moisture sensor is first detected and if it is less than the threshold, then a notification will be sent to the user. On opening this notification, the user can switch on the sprinklers by pressing a button that is shown on the screen.
Keywords: IoT, soil moisture sensor, android application

I. INTRODUCTION

Water is very critical in the field of agriculture in nearly all aspects have a determining effect on the eventual yield. Without water, a plant will not grow at all and therefore is the essence of its growth. But the universal truth is that the water resource is degrading and it must be used precariously so that our future generation is not deprived of the same. Therefore, it is essential to utilize the available resource efficiently. Sensor A soil moisture has been used which will be inserted into the soil, in the field and it is programmed to monitor the moisture level, twice a day. If the moisture level is found to be less, then the user will receive a notification through an application (SURVEIL) in their mobile phone, when connected to the internet. The processed data is stored in the database and the communication between the crop field and the application will be done through a web server that is linked to this database. This solution uses only free versions of all software and hence cheap. The major advantage of this project proposals is that consumer need not be physically present to irrigate their crop field.

II. EXISTING SYSTEM

An IoT service-oriented systems for agriculture monitoring is the paper that has been chosen for the survey. From the mentioned paper, the concept of precision agriculture has been inspired. Precision agriculture is all about how easily a farmer can access all the related information from the field and control it, because of which production rate can also be enhanced. This literature survey will help only to display the data using IoT. The data is about how much water is used for irrigation and how much water is saved from irrigation, whereas in the following proposed system, farmers will be able to control the irrigation done for the field.

III. PROPOSED SYSTEM

A. Architecture

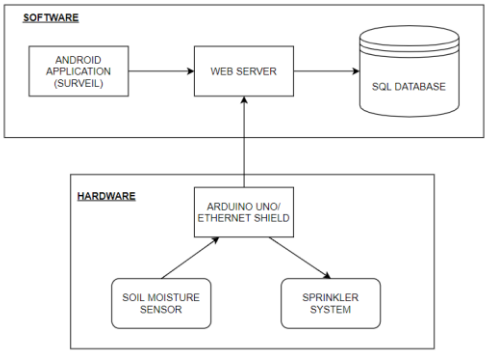

Fig. 1 Basic architecture of proposed system

The proposed system consists of both hardware as well as software. The software part includes the android application which must be installed on the user's Android phone. The web server acts as an intermediate between the android application and the SQL database. The button in the android application is constantly monitored if it's clicked or not. Once clicked, the website in the web service is invoked, and also the table in the database present in the SQL Server is updated to the current status of the sprinkler. The hardware part includes the Arduino UNO/ Ethernet Shield and soil moisture and sprinkler system. The Ethernet shield is integrated with the UNO board and is assigned an IP address once it is given an Ethernet connection. If the detected level is less than the threshold and after the notification is sent and the button is pressed, then the sprinklers are activated.

B. Components

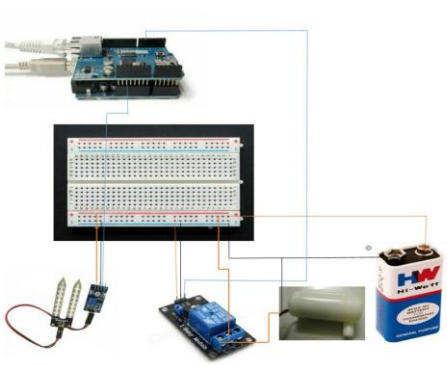

Fig. 2 Diagrammatic representation of the proposed system

1) Arduino UNO Board

Arduino UNO Board is a microcontroller which is based on Atmel's ATMEGA8 and ATMEGA168. It is designed to resolve problems from the simple issues to the high-end ones It is one of the best-integrated hardware and software components which is more user-friendly to use and handle. The board consists of 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The cost is almost inexpensive. It can work both on auxiliary power and on the USB ports. It is compatible with other modules and works with greater flexibility. On the software side, it has the ability to run on any OS such as Windows, Linux, etc. The Software is open source which runs on simple C program which has more predefined library functions with examples. It has a great flexible coordination with other components such as sensors, relays, etc. So we are using Arduino to implement the idea to accomplish the desired results.

2) Arduino Ethernet Shield

The sole purpose of Arduino Ethernet Shield is to satisfy the internet demand. As per the paper, the real-time data from the premises is collected and sent via the internet to the destination(mobile). Arduino Ethernet Shield is compatible only with Arduino UNO. It can be stacked upon the UNO Board and it is ready to use. It will be powered via the UNO Board. It has an Ethernet port RJ-45 connectivity, which is needed to establish the internet Connection to the Ethernet Shield. An IP address is assigned to the Board a:b:c:d via the RJ-45 port. Since UNO has a tiny memory, it receives the real-time data from sensor and stores it in its memory and shares this information via the Ethernet Shield.

3) Soil Moisture Sensor LM393

This soil moisture sensor is used to assess the water content present in the land. Another type of sensor can measure the other property of moisture in the soil called water potential, which is the tendency to measure the movement of water from one area to another. There are two ways to measure moisture content. The first one is a direct gravimetric measurement of free soil which requires drying and weighing a sample. The second one is an indirect method, which uses properties such as electrical resistance, dielectric constant, interaction with neutrons. These may vary depending on various factors such as soil type, temperature or electrical conductivity. Assessing the soil moisture is important in agricultural applications, in order to help farmers to take care of their land more efficiently. It helps to use water more efficiently, to grow a crop and also increases the yield.

4) Water Sprinkler

It is a device that is used in irrigation systems for agricultural crops. It can also be used in lawns, golf courses, gardening and control of airborne dust. Sprinkler irrigation is same as natural rainfall, used for agriculture. Water is sent to the motor through a pipe, which is then sprayed into the land. It is designed to spray water as uniformly as possible. There are several types of sprinklers such as industrial, agricultural, residential and underground. In this paper, a new system has been introduced in which the web server controls the switching on and off of the sprinkler. This sprinkler is compatible with Arduino and is controlled through that.

5) SQL Management Studio

SQL Management Studio is a free database management system that was developed by Microsoft. It was initially released on April 24, 1989. The current version of SQL is SQL Server 2017. It uses simple language for coding. SQL can be used to manage databases, tables. Data can be retrieved from the created databases using query statements. The query specifies what is to be retrieved. This is processed by the query processor, which then determines the sequence of steps to be taken. This sequence is called a query plan. These databases and tables can be used to store, update and retrieve data in the table named "dbo".Status is used in order to update the status of the sprinkler and the data and time of updating into the server.The main statements used in the coding are

```
select *from dbo.Status
delete from dbo, Status
```

6) Visual Studio 2017

Visual studio is free integrated development environment(IDE). Websites, web applications and services can be developed easily. It was developed by Microsoft. The latest version is Visual Studio 2017 version 15.6.1. It includes code editor which makes it easier for the user to develops a code. It supports 36 different programming languages. It also allows support for a debugger. The Visual studio package, when installed with a Visual studio can provide three services namely, sVsshell, sVsUIshell, sVSolution. Visual Studio SDK also includes the Managed Packets Frameworks (MPF). Its main feature is that it includes code editor and debugger. the code editor supports code completion, which is done by IntelliSense for variables, loops, and functions. The suggestion appears and bookmarks can be set, which makes it, even more, user-friendly. Syntax and compilation errors are flagged with red underline which helps the user to identify and debug it immediately.

C. System Design

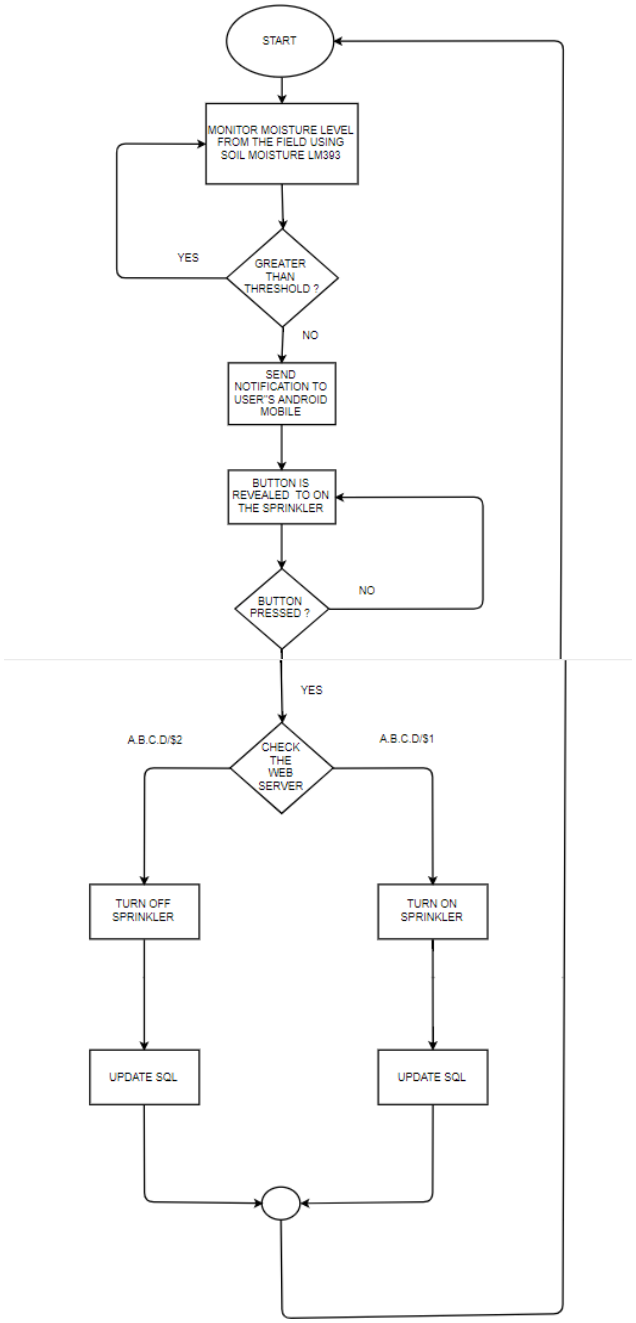

Fig. 3 Flowchart of the proposed system

First, the moisture level is monitored from the farmer's field by using LM393 soil moisture sensor. When the sensor detects the value, which is greater than the threshold, no further action will take place. It starts to monitor again. If it is not greater than the threshold, then the notification is sent to user's android mobile. After that, the user has to authenticate the further steps. When the button is pressed by the user, then check the web server, whether it is A.B.C/$1 or A.B.C/$2. If the detected website is $1, then the sprinkler will turn on and if it is $2, the sprinkler is turned off. Irrespective of the website invoked, the SQL database will be updated. The above process will repeat periodically.

D. Result

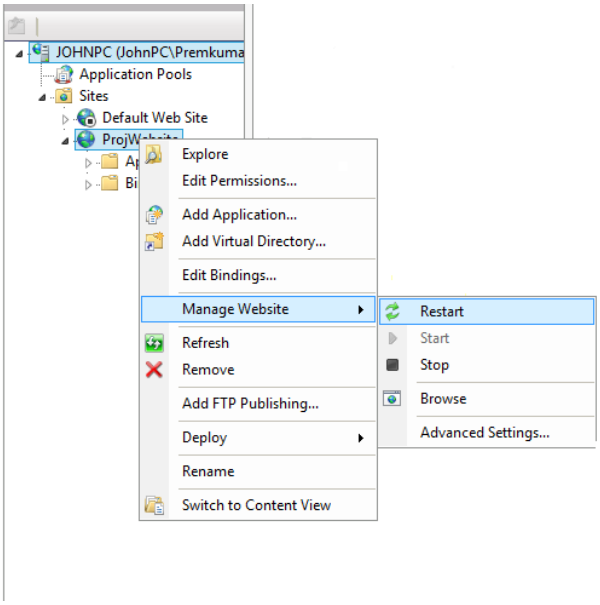

Fig. 4 Steps to refresh the local network

The local network that includes the web server being used is restarted in order to refresh the website. This local network is the network that the PC is connected with.

Fig. 5 Image of the button in the virtual device using an emulator

This is the screenshot of the application through the emulator. Here, the button displayed has been clicked three times, which turns on, then off and then on the sprinklers only if the water level below the threshold has been sensed through the water sensor connected to the Arduino.

```
LocalIP address of the arduino:192.168.1.4
Server Started !!!
ON
OFF
ON
```

Fig. 6 IP address allocation as shown in the serial monitor of the Arduino

The IP address allocated to the Arduino the Ethernet shield is 192.168.1.4. The Arduino serial monitor displays this information along with the switching on and off of the button in the application.

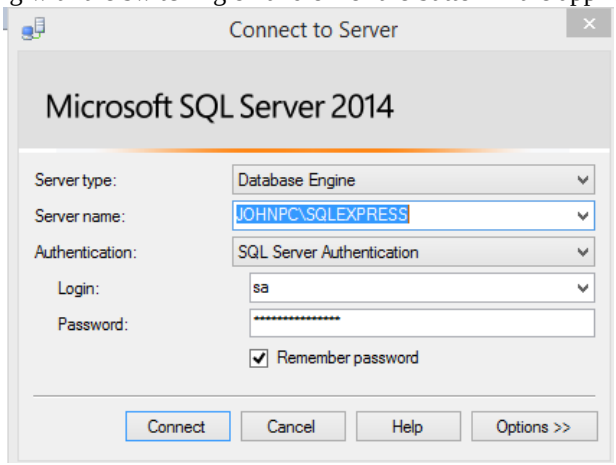

Fig.7 Connection to the SQL server by entering details

SQL Management studio 2014 is initiated to display the login details as shown above. Login details such as server type, server name, login, and password are entered and the server is connected.

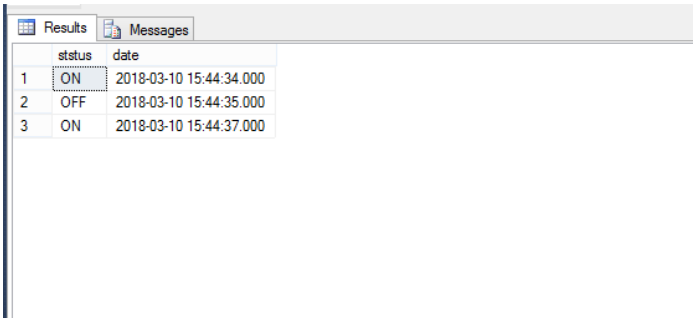

Fig. 8 The status of the sprinkler updated in the SQL database

Whenever the button is pressed in the application, the database will be updated for both 'ON' and 'OFF', along with an accurate time of clicking. The database can be opened in the SQL server by finding the table under the database on the left side. This table is updated three times and is as shown above.

IV. CONCLUSION

Irrigation is the application of controlled amounts of water to plants at needed intervals. Irrigation helps grow agricultural crops, maintain landscapes, and re-vegetate disturbed soils in dry areas and for periods of time, even when there is no rainfall. This project is also related to this. When the land gets dry, the farmer will receive a message that the land is dry and then by using this method it will fill water in the land. This method helps the farmer to save the plants as well as water.

Agriculture is the cultivation and breeding of animals, plants, and humans but a recent survey says that Between 2001 and 2010, over 2,600 farmers committed suicide in the state due to no water in the land. Our project will surely help the farming lands and agriculture

V. FUTURE SCOPE

In the upcoming generations, the cloud can also be used instead of the database for faster communication. Furthermore, many sensors, such as NPK sensor, auto crop chopper, pesticide level sensor can be integrated using Arduino Mega. NPK sensor can be used to detect the degrading levels of nutrients like Nitrogen, potassium, and phosphorous and when it decreases below a pre-defined threshold, a notification and a workflow function can be triggered in order to balance the nutrients level of the plant. Other levels such as herbicides, insecticides, pesticides which help to improve the environment for plant growth and to destroy plants. Those level are measured and are made to indicate in the application as a warning.

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