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AN AMELIORATED METHODOLOGY FOR THE DESIGN AND IMPLEMENTATION OF SMART PLANT SYSTEM

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Abstract*-- In India Agriculture is the main profession. Majority of the farmers are dependent on the traditional approach of farming where they have to stay in their lands either for supplying the water to the crops or to monitor the moisture level in the soil and also the growth of plants. There is a possibility of excess water at some part of the land and there is a deficiency of water on the other side. This is one of the major problems to the farmer where he has to continuously monitor the flow of water. In this paper, we are proposing an automated smart plant system which supply the required quantity of water to the land, measures the moisture content in the soil using moisture sensor, and also measures the temperature and humidity in that area using temperature and humidity sensor. The proposed system is developed using hardware devices such as Arduino uno, Sensors, Relay board, Ethernet shield etc. In this system we are using a mobile phone to control all the equipments and devices which are connected in the system and we also send signals to start and stop the device through the mobile phone only.

Keywords: ***Arduino uno, Ethernet shield, Relay board, Moisture Sensors, Temperature and Humidity sensor.***

1. INTRODUCTION

In India agriculture is the main profession. Majority of the farmers are dependent on the traditional approach of farming where they have to stay in their lands either for supplying the water to the crops or to monitor the moisture level in the soil and also the growth of plants. There is a possibility of wastage of water as well as somewhere it is excess water and somewhere there is a deficiency. The Internet of Things (IoT) based smart plant system continuously monitors the health status of plants and crops. Monitoring the plants, that is observing and checking the progress of plants is one of the most important jobs for the farmers in any agriculture lands or farming fields. Traditionally farmers need to periodically visit their farming or agriculture fields to check the plants status like moisture level in the soil, temperature and humidity etc. Based on the necessity, the farmers pump the water by motor to irrigate their fields. The farmers have to stay in their fields and need to wait till the water flows sufficiently to plants and thereafter needs to turn off the motor. In this traditional approach of farming there is wastage of water as well as sometimes there is a excess water in some portion of the land and sometimes deficiency of water in the other parts of the land. Every time to start and stop the water pump the farmer needs to stay in the land itself. Sometimes there is a breakdown in the power supply, the farmer has to wait until he gets a power supply and can switch on motor. To overcome all these problems with the existing system we are proposing an automated system using the appropriate hardware devices such as Arduino uno, Ethernet shield, Relay board, and other sensors.

1.1 MOTIVATION

The most essential features for the quality and richness of plants growth are temperature, humidity, moisture level of the soil. Constantly monitoring of these three environmental features gives related information to the farmer to easily analyze that which parameters are affecting to get the maximum quality and richness of the plant growth. Controlling the climate and checking the status of plants health is one of the greatest tasks in the agriculture field or farming areas. The main motivation of the project is for the user to monitor the plants health status, cultivation or irrigation process to get sufficient water to plants based on the moisture level in the soil, without the users need to be present at the fields or cultivation areas. This paper also proposes that the system helps the farmers to give the required resources to the plants remotely without much more manual effort and also helps in richness and healthy growth of crops.

1.2 LITERATURE SURVEY

S.V.Devika et al [1] discussed automatic watering system to the plants using Arduino uno. The system allows water to flow if necessary or required for the agriculture fields and avoids the wastage of water. When the water level in the tank is empty, the system switches ON the motor. When the water level reaches the particular level, the system switches OFF the motor. This system is implemented in such a way that it will sense the soil moisture level and supply the water if necessary. In the existing system the supply of water is based on the moisture content in the soil but in our proposed paper we are also testing for the temperature and humidity in addition to the moisture level in the soil. SangmeshMalge et al[2] developed a embedded system that handles the overall irrigation process. The farmer receives the SMS by the system which is received by GSM module and forwards the SMS command to microcontroller to take further actions. The farmer first checks the parameters like water level, temperature etc by sending SMS to embedded system. The embedded system reply with the related information about the above parameters, then the necessary actions will be taken by the farmers by sending commands via SMS to the system. In the existing system the user can control the system by sending SMS but in our proposed paper the user can control the system using mobile application through internet and can also access the data related to plant status which is stored in the cloud through internet. And also the existing system monitors the temperature but in our proposed paper we are also testing for the moisture level in the soil. BenahmedKhelifa et al[3] discussed the smart irrigation system techniques based on internet of things. In this smart irrigating system sensors are placed in the farming or agriculture lands. The soil moisture value, water level in tank, well water level values are sent to web server to mobile data communication network. The existing system monitors the soil moisture level but in our proposed paper we are also testing for the temperature and humidity measures in that area in addition to the moisture level in the soil and also we pump the water to plants based on the soil moisture.

ChandanKumarSahu et al[4] proposed a low cost smart irrigation control system. This system includes the sensor nodes and control nodes. In this system the agriculture field is partitioned into small squares and soil moisture sensor is placed in each square. The sensor sends the moisture level of the soil to the Arduino uno board through wireless sensor network. The control node is used to start or stop the irrigation process based on values. The existing system monitors the moisture level in the soil but in our proposed paper we are also testing for the temperature, humidity and water level in tank in addition to the moisture level in the soil. Ayman M.Hussain et al[5] in his paper presents irrigation management system(IMS) for open canals using the wireless sensor network and water pumps. In this system they used two main sensors that is water level sensor and flow sensor. The water level sensor is connected to the main irrigation canal and water flow sensor is connected to the water pumps. Both these sensors are connected to the wireless gateway. This gateway sends data continuously to web server. The database will be connected to the webserver which checks the level of water at all canals. The web based IMS compares the data stored in database with specified values and then it sends SMS to the farmer. The existing system is used to pump the water to lands through canals but in our proposed paper we pump the water to crops based on the moisture level of the soil and we also monitor the temperature and humidity measure in that area. A.Kumar et al[6] proposed a low cost moisture sensor which uses xbeebased data acquisition system that is used for automatic irrigation process. The authors have implemented an impedance based moisture sensor. These sensors task is to work on the change of impedance between two electrodes that are placed in the soil; its moisture level changes can be measured in a relative manner. In this paper they have tested only moisture level. In the existing system they have tested only the moisture level in the soil but in our proposed paper we also monitor the water level in the tank and temperature and humidity values in that area in addition to the soil moisture and we pump the water to plants basedon moisture level in the soil. Y.Kimet et al[7] proposes a system for crops growth or production over a vast area with the use of wireless sensor network and decision making software for effective cultivation or irrigation process. The system consists of different sites such as sensing and a weather site. They have used five sensing sites. Every sensing site consists of a processor with two soil water reflectometers, and also consists of soil temperature sensor and Bluetooth communications. Each sensing site senses the soil moisture value and soil temperature value and then stores the data in the database. Then the irrigation process is started by the decision making software that makes use of the information taken from the information network and location of irrigation machine. In the existing system they have tested for soil moisture and temperature but in our proposed paper we also monitor the water level in the tank and humidity in addition to the temperature and moisture level in the soil. Mancuso et al[8] has done a research work in tomato greenhouse which is situated in the south of Italy. They have used the sensicast devices for the air temperature, humidity and soil temperature monitoring and measuring with wireless sensor network. They have implemented a web based plant monitoring application. Greenhouse grower can check the measurements over the internet. The alarm will be set and is sent to the user mobile phone by SMS or GPRS if there is any rapid change in the measurement variables. The existing system monitors soil moisture and temperature but in our proposed paper we also monitor the humidity and water level in the tank and pump the water to plants based on moisture level in the soil. Teemu Ahonenet al[9] has done the research in martens greenhouse research centre's which is situated in the narpio town in western finland. They have integrated three commercial sensors with sensinode's sensor platform. It measures the four environmental key parameters in greenhouse control. They have used SHT75 sensor to check the temperature and humidity value, TSL262R sensor to check the light irradiance and Figaro's TGS4161 sensor to sense the CO2.

The system feasibility was verified in a star topology setup in a tomato greenhouse. In the existing system they have tested for the temperature and humidity but in our proposed paper we also monitor the moisture level in the soil and water level in the tank in addition to the temperature and humidity measures.

1.3 TERMINOLOGY

Arduino uno: Arduino uno is a hardware device consisting of 14 pins out of which 6 pins are used as input and 6 pins are used as output and can be connected to the system using USB cable.
Ethernet Shield: The Ethernet shield is used to connect the Arduino board to the internet in a very few minutes and this Ethernet shield should be plugged on the Arduino board.
Relay board: A relay is used to operate the switch electrically and also provides electric isolation to prevents damage between electric circuits.
Internet of Things: The internet of things is the inter-connection of many physical devices that is used to send and receive data.

II. PROPOSED METHODOLOGY

This paper presents a smart plant system which is based on Internet of things that uses different hardware components such as Arduino uno board, Ethernet shield that makes the internet connection to the Arduino board in few minutes and Relay board which supplies power between circuits. In this plant system we have used different sensors like soil moisture sensor which checks the moisture level in the soil, Temperature and humidity sensor that is DHT11 sensor which gives the temperature and humidity values, and Ultrasonic sensor which is used to check the water level in the tank. The proposed system allows the user to constantly check the water level in the tank remotely on a mobile application through internet. The user can switch ON or OFF the motor depending on the level of water in the tank irrespective of physical location of the user. The smart plant system can be installed in the farming or agriculture lands to continuously monitor the soil moisture and pump the water to plants based on the moisture level. The user can check the temperature and humidity via mobile through internet. These environmental parameters values are stored in cloud, so that the user can access those values through internet whenever required at anytime.

2.1ALGORITHM

Input: Soil moisture sensor, DHT11 sensor, Ultrasonic sensor
Output: soil moisture values, Temperature and humidity measures, water level

NOTATIONS:

m →Soil moisture
t →Temperature
h →Humidity
w →Water level
th1, th2 →Threshold values
The following steps are followed in automatic irrigation system.
Step 1: Begin the process.
Step 2: Check the Humidity and Temperature.
Step 3: Check the moisture level of the soil.
Step 4: If m>th1, then there is no need to pump water to plants
Step 5: If m<th1, then pump the water to plants.
Step 6: Check the water level in tank.
Step 7: If w<th2, then pump the water till it reaches the normal value.
Step 8: If w>th2, then there is no need to pump water to the tank.
Step 9: user can operate the system remotely through a mobile.

2.2 WORKING OF PROPOSED SYSTEM

The block diagram of the smart plant system is shown in the fig 1.1. In this paper we proposed the smart plant system which is based on Internet of things that uses Arduino Uno and Ethernet shield. This Ethernet shield connects the Arduino Uno to the internet in a few seconds which helps in the communication between the user and the smart plant system. This smart plant system uses different sensors such as soil moisture sensor, temperature and humidity sensor, water level sensor etc. Here we have used a relay board that electrically operate switch and provides electrical isolation between two circuits. The user can monitor the plant health status and can take any necessary action using wireless sensor network through internet irrespective of his physical location. The moisture sensor will be placed in the soil that sense the moisture level and sends the related information to the user. If the moisture level is less than the predefined value then the user can pump the water to the plants through internet using mobile. If the moisture level is more than the predefined value then there is no need to take the further actions. The moisture level of the soil will be stored in the cloud; the user can access the values anytime using internet. This smart plant system uses the ultrasonic sensor that checks the level of water in the tank.

The water level status in the tank will be sent to the user. If the level of water in the tank is less than the predefined value, then the user can switch ON the motor through internet using mobile. Once the water reaches the predefined value then the user can switch OFF the motor through internet. The motor status will be sent to the user mobile. The temperature and humidity values can be checked by the user in his mobile through internet and can pump the water to the plants depending on the climate and moisture level in the soil. The temperature and humidity values, soil moisture values and level of water in the tank will be stored in the cloud, so that the user can access anytime through internet.

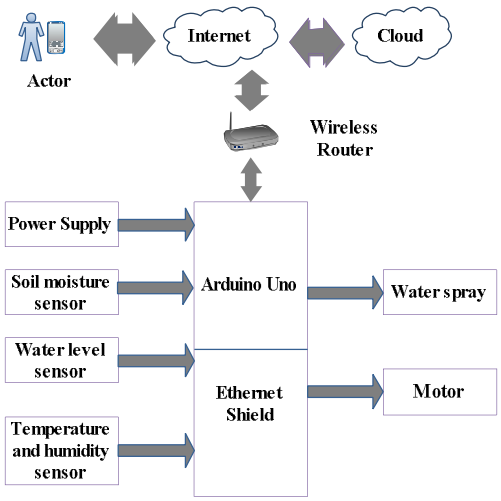

Figure 1.1 Block Diagram of Smart Plant System

III. CONCLUSION

In this paper, we have proposed an automated system to monitor the temperature, humidity and moisture content in the soil and supply the required quantity of water to the crops and plants. The system is tested for correctness and completeness by executing the system with all possible input values

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