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A Review and Proposed Automated Irrigation System using Soil Moisture Sensor and Android App

Laxmikant Jayprakash Goud[1,] Sneha Laxmikant Goud[2]Sharyu Kulkarni[3]
[1]*(Expatriate Lecturer, School of Computing Sciences, Information Technology Department, Wachemo University, Ethiopia (East Africa))*
[2]*(Master of Computer Application, INDIA)* [3]*(Redmi, INDIA)*

Abstract: The lack of proper rain and water supply turns the surroundings into water famine. The poor as well as farmer suffer most as they often depend directly on these water bodies for their needs.
In the field of agriculture, use of proper method of irrigation plays an important role for the economy and development of a country. After review of various papers it seems that the Automated Irrigation System was implemented by using Hardware Soil Moisture Sensor, Arduino Controller and other hardware.
So, in this paper I present the system which is a combination of hardware (sensor and GSM kit) and software such as Android application.
The Main objective of this Review is to propose a system which is used to save water supply in farm, as many times water supplied to the crop is more than it needs. So, it causes Wastage of water as well as it decreases the soil Quality too. This work makes the irrigation automated. It provides proper amount of irrigation to agricultural fields by observing the moisture content of soil.
First, the sensor will place in the field. It will detect the moisture present in the soil and produces a voltage level in terms of output. Now Controller decides if voltage is "HIGH" then "Less Moisture" in soil else "More Moisture" which decides that how much water supply is needed by the soil and controls the unnecessary water flow. Controller is connected to GSM in Android Application which allow farmer to handle the water Sources at the remote location.
It will save the unnecessary water flow in the field which also increases Soil Productivity. Farmer can access water startups on remote location and also get notified about the water consumption through GSM module.It can be used in farming, Construction area where water is mainly used in large amount.
Keywords: DBSCAN, Minpts, EpsilonSensor, GSM

I. INTRODUCTION

1. Introduction

In Ethiopia, agriculture is one of the sectors that give profit to the economy of our country. Based on their motto, "agriculture is life for more than 85%",the government has invested more money to develop the technology in order to increase the productivity ofagriculture. It is also an important element for the plants to survive. Therefore, the humidity of the soil that determines the amount of water in soil must be checked regularly to prevent the plant from wilting otherwise in the worst case it might die.

After Reviewing many papers, In this paper, I present the a system which monitors the humidity of the soil so that the end user such as farmer, gardener and so on can use it to automatic irrigate or water supply to sprinkle their plant. The System is integrated with GSM Module and Android application which allow users to select the area, select the crop and start sprinkle from remote location.

It also control the water flow which is usually gets wasted many times. In this, we are going to control the unnecessary water flow in the farm.

The aim of this review is to build an automatic plant irrigation system that sense soil moisture using microcontroller and control the flow of water as well as ON/OFF sprinkle from remote location using Android application.

Irrigation is an artificial application of watering the land for agricultural production. The requirement of water to the soil depends on soil properties such as soil moisture and soil temperature. Effective irrigation can influence the entire growth process and automation in irrigation system using modern technology can be used to provide better irrigation management. In general, most of the irrigation systems are manually operated. These traditional techniques can be replaced with automated techniques of irrigation in order to use the water efficiently and effectively. Conventionally, farmers will present in their fields to do irrigation process. Nevertheless, now a day's farmers need to manage their agricultural activity along with other occupations. A sensor based automated irrigation system provides promising solution to farmers where the presence of a farmer in field is not compulsory during irrigation process.

II. LITERATURE REVIEW

2.1: Introduction (Review)

The development of models and strategies to control the environment of plants started with the shoot environment, that is, with the climate. One important reason was that influencing variables such as temperature, humidity, and irradiation or CO2 concentration are easier to measure and to control." (Hans P. K, 2000).

From this research, we can see that there are a few factors that need to be control in the environment. The factor that is to be considered is soil moisture.

Khriji et al (2014) presented a complete irrigation solution for the farmers based on WSN. The automated irrigation system using low-cost sensor nodes having reduced power consumption can reduce the water waste and is cost effective. A node is deployed using Telos B mote and adequate sensors/actuators. Field nodes are used to detect the level of moisture and temperature in the soil. Weather nodes monitor the climatic changes, and the nodes connected to actuators are used to control the opening of the irrigation valve when needed.

Mahir et al (2014) proposed an efficient water usage system by pump power reduction using solar-powered drip irrigation system in an orchard. Soil moisture content is analyzed by Artificial Neural Networks (ANN) to provide even distribution of water for the required location. This will prevent the unnecessary irrigation and reduce the water demand. This system reduces the orchard's daily water usage and energy consumption by 38 percentages.

Farid et al (2013) presented a practical solution based on intelligent and effective system for a field of hyper aridity. The system consists of a feedback FLC that logs key field parameters through specific sensors and a Zigbee-GPRS remote monitoring and database platform. The system is deployed in existing drip irrigation systems without any physical modification. FLC acquires data from these sensors and fuzzy rules are applied to produce appropriate time and duration for irrigation.

Singh et al (2012) presents a solution for an irrigation controller for cultivation of vegetable plants based on the fuzzy logic methodology. In this system the amount of water given to the plants depends on its size, moisture control of soil, which is affected by temperature of environment, evaporation due to wind velocity and water budget. The system feed water to plants in a controlled and optimal way. Solar energy conversion technology is used to feed power to the pump controller.

Xin et al (2013) described an autonomous precision irrigation system through the integration of a center pivot irrigation system with wireless underground sensor networks. The wireless underground sensor aided center pivot system will provide autonomous irrigation management capabilities by monitoring the soil conditions in real time using wireless underground sensors. Experiments were conducted with a hydraulic drive and continuous-move center pivot irrigation system.

Robert (2013) promoted a commercial wireless sensing and control networks using valve control hardware and software. The valve actuation system included development of custom node firmware, actuator hardware and firmware, an internet gateway with control, and communication and web interface software. The system uses single hop radio range using a mesh network with 34 valve actuators for controlling the valves and water meters.

J.S. Awati and V.S. Patil, "Automatic Irrigation Control by Using Wireless Sensor Networks". The system was integrated with sensors into a wireless monitoring network to determine and evaluate calibration functions for the integrated sensors. The system compares the measuring range and the reaction time of both sensor types in a soil layer during drying. Data were transmitted over several kilometers and made available via Internet access.

Nolz et al (2007) integrated the sensors into a wireless monitoring network to determine and evaluate calibration functions for the integrated sensors, and compare the measuring range and the reaction time of both sensor types in a soil layer during drying. The integration of the sensors into the telemetry network worked well. Data were transmitted over several kilometers and made available via Internet access.

Christos et al (2014) described the design of an adaptable decision support system and its integration with a wireless sensor/actuator network to implement autonomous closed-loop zone-specific irrigation. Using ontology for defining the application logic emphasizes system flexibility and adaptability and supports the application of automatic inferential and validation mechanisms. A machine learning process is applied for inducing new rules by analyzing logged datasets for extracting new knowledge and extending the system ontology in order to cope.

2.2: Automated Irrigation System

At the previous works, considering to the automated watering techniques, it can be found that the Arduino based sensors have been utilized for the plant watering system (Devika et al., 2014) and automated irrigation systems (Agrawal&Singhal, 2015; Kumar Sahu&Behera, 2015; Singh &Saikia, 2017).

An Arduino Based Automatic Plant Watering System is proposed in (Devika et al., 2014) where the authors developed the Arduino microcontroller used to control two functional components which are the moisture sensors and the motor/water pump to automatically water the plant. The moisture sensor's function is to sense the level of moisture in the soil whereas the water pump supplies water to the plants.

From the Review Analysis a proposed Automated Irrigation System using Soil Moisture Sensor system is a combination of hardware (sensor and GSM kit) and software (Android application). Automated Irrigation System using Soil Moisture Sensor is an Android based application which works with the help of Soil Moisture Sensors. The Motto behind this is to control the water flow which is usually gets wasted many times. In this, we are going to control the unnecessary water flow through Hardware such as Soil Moisture Sensors, and Controller which is going to control the hardware.

III. PROPOSED SYSTEM

3. Introduction

The system is a sustainable solution to enhance water use efficiency (WUE) in the agricultural fields. It provides water for plants according to the crop water requirement and operates according to the soil moisture condition of the root zone of plants. Thus it reduces excessive pressure on farmers to pay additional water tariff on water. In addition pump water irrigation also save additional cost for water pumping, further, automated irrigation system allows farmers to apply the right amount of water at the right time. Besides, human attention was reduced on irrigation significantly. Moreover, energy consumption on water pumps could be reduced by efficient water allocation based on the crop water requirement.

The aim of this review is to build an automatic plant irrigation system that sense soil moisture using microcontroller.

The following are objectives of the studies:

- To reduce human interference and ensure proper irrigation
- To minimize water loss and to maximize the efficiency of water used
- To prevent over labour of the pumping machine and prevent it from getting bad or burned

3.1 Block Diagram (Hardware)

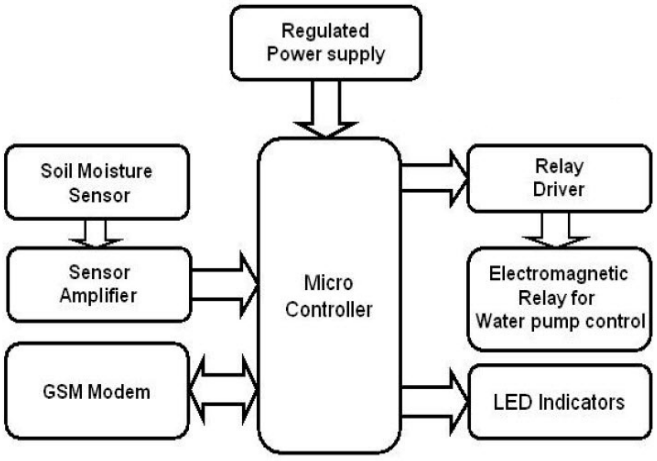

Figure 2.1 Block Diagram

3.1.1 Soil Moisture Sensor

[4] This is an Electrical resistance Sensor. The sensor is made up of two electrodes. This soil moisture sensor reads the moisture content around it. A current is passed across the electrodes through the soil and the resistance to the current in the soil determines the soil moisture. If the soil has more water resistance will be low and thus more current will pass through. On the other hand when the soil moisture is low the sensor module outputs a high level of resistance. This sensor has both digital and analogue outputs. Digital output is simple to use but is not as accurate as the analogue output.

The soil moisture sensor is often sensing devices embedded within some sort of insulation. The insulation may often be for electrical purposes - to isolate the sensor electrically. Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. In the proposed

system the moisture sensors used which can be inserted in the soil, in order to measure the moisture content of the soil.

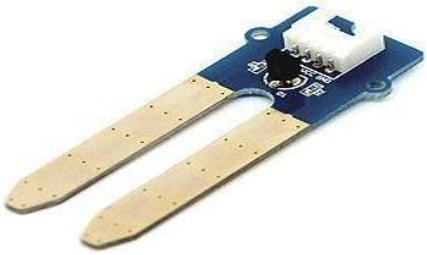

Figure 2.2 Sensor

Soil electrical conductivity is simply measured using two metal conductors spaced apart in the soil except that dissolved salts greatly alter the water conductivity and can confound the measurements.

Soil moisture sensor takes the data from the soil. It depends on the moisture level of the soil whether to send high or low voltage to the microcontroller to show that it is wet or dry. When the soil is wet, it will send the low output voltage, whereas when it is dry, it will send the high output voltage. This sensor is directly connected to Arduino microcontroller.

It gives a voltage output corresponding to the conductivity of the soil. The conductivity of soil varies depending upon the amount of moisture present in it. It increases with increase in the water content of the soil.

3.1.2 Arduino Uno Micro Controller

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Arduino Uno is the microcontroller which is the core hardware of the system. It receives the input from the soil moisture sensor and processes the input based on the requirement coded in the microcontroller.

3.1.3 Electromagnetic Relay

The automated function consists of two main controlling hardware, which is relay module and DC watering pump. The relay is an automatic electric switch that uses an electromagnet to move the switch from OFF to ON or vice versa. The switch controls the electric signal that pass through the water pump. When the moisture level is below the threshold level, Arduino sends a signal to the relay module to automatically open the path for the electric to pass through the water pump to water the plant. After the system detects the sufficient level of the water in the soil, the relay will close the path for electric and thus the water pump will be stop immediately pumping the water.

3.1.4 LED Indicators

It is connected to circuit for showing the status of motor like ON/OFF, soil moisture condition.

3.2 Understanding the Working

In this system i will be demonstrating Automatic Irrigation System with integrated temperature sensor which irrigates or waters your plants automatically.

A Moisture sensor is used to read the Moisture content of the soil. The LM35 Temperature Sensor reads the ambient temperature.

An LCD is provided to monitor the Soil Status, Ambient Temperature and Status of Water supply(Water Pump).

Arduino UNO is the brain of this system and all the sensors and display devices are controlled by it.

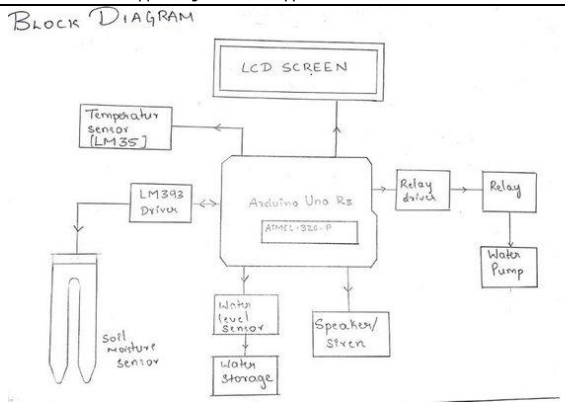

Figure 2.3 Working Design

The Soil Moisture Sensor value depends on the resistance of the soil. The value of this sensor varies from 0- 1023. 0 being most wet condition and 1023 being very dry condition.

The LM35 is a precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius temperature. The LM35 is operates at -55˚ to +120˚C.

The Water level Switch Contains a Reed-Magnetic Switch surrounded by a floating magnet. When water is available it conducts.

The Arduino reads the status of the soil using Soil Moisture Sensor. If the Soil is DRY it does the following Operations:

1) Checks for the availability of water using water level sensor.

2) If the water is available, the Pump is turned ON and is automatically turned OFF when sufficient amount of water is supplied. The Pump is driven by a Relay driver circuit.

3) If the Water is Unavailable, you will be notified with a sound.

The Status of soil (Dry, Moist, and Soggy), the temperature will be sent to GSM Module which will forwarded to user Android application. Android application will allow user to select the area, crop and start sprinkle.

3.3 An Automated Irrigation Hardware Implementation

At the previous works, considering to the automated watering techniques, it can be found that the Arduino based sensors have been utilized for the plant watering system (Devika et al., 2014) and automated irrigation systems (Agrawal&Singhal, 2015; Kumar Sahu&Behera, 2015; Singh &Saikia, 2017).

All the hardware will be assembled to Arduino, which is the microcontroller that uses to control all the hardware that attached to it and let it function.

The proposed system includes the Arduino board and all the necessary attached hardware. The Arduino is the center of this system which connects all the required hardware.

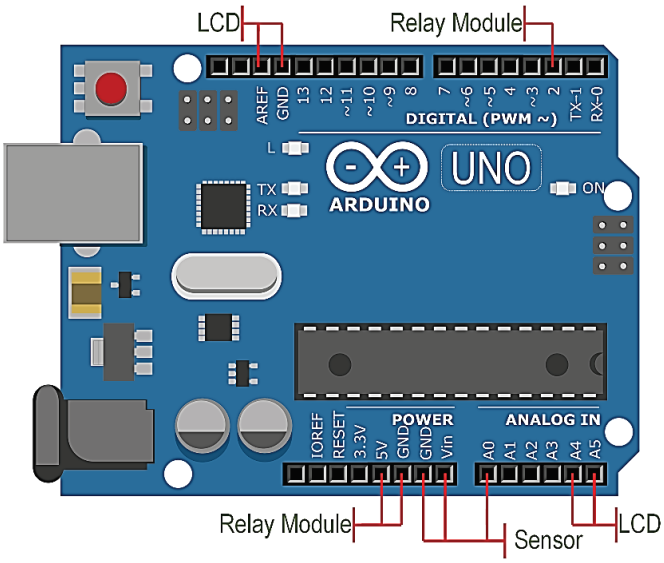

Figure 2.4 Details of Arduino Pin for Hardware Connection

The soil moisture sensor measures the level of moisture from the soil, and it is transferred to the Arduino board to process and make decision.

The LCD display shows the value that the Arduino received from the moisture sensor. At the same time, the data acquired is sent to relay module to determine whether to switch on or off the water pump. If the condition is met for the water pump to be switched on, the water pipe attached to the pump will begin to draw up the water from the water source, and push the water to the other side of water pipe to complete the watering process for the soil.

IV. WORKING PRINCIPLE OF THE PROPOSED SYSTEM

4.1 Work Flow Diagram

This Application will work with the help of Hardware. Hardware which required is Sensors, Controller, GSM Kit.

First, the sensor will place in the field. As per its name it will detect the moisture present in the soil. This produces a voltage level in terms of output.

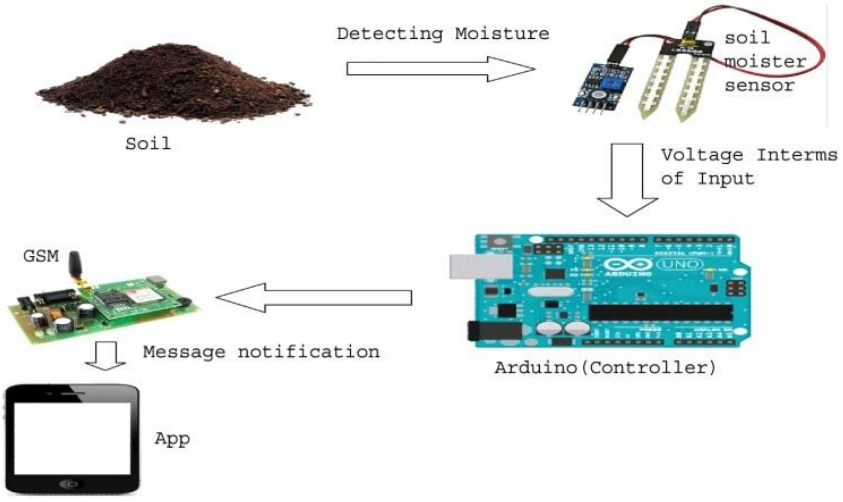

Figure 4.1 Work Flow Diagram

As Machine will only understand the language of voltage, this voltage will be acquired by the controller and it will produce output as:

```
If (Voltage level = high)
{
        Less Moisture;
}
Else
{
More Moisture;
}
```

Hence In this way sensor and controller will work together to produce the moisture level. After getting the voltage levels, it decides how much water supply needed by the soil.

The work of GSM is to allow user to handle the water Sources at the remote location. As well as it will notify user at the time whether actually water supply is started or not.

In this way user can handle water supply if he is not physically present there.

4.2 Android Application Module

The work of GSM is to allow user to handle the water Sources at the remote location. As well as it will notify user at the time whether actually water supply is started or not.

Android application allows user to handle water supply if he is not physically present there.

1. Android Application Home Screen

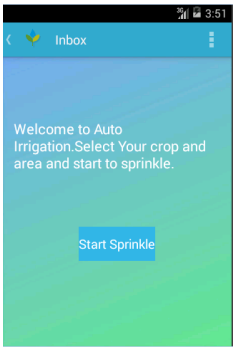

Figure 4.2 Android App Home Screen

Home activity will allow user to select the area, select the crop.Then together whole data will be accessed by another activity.

2. Crop Selection

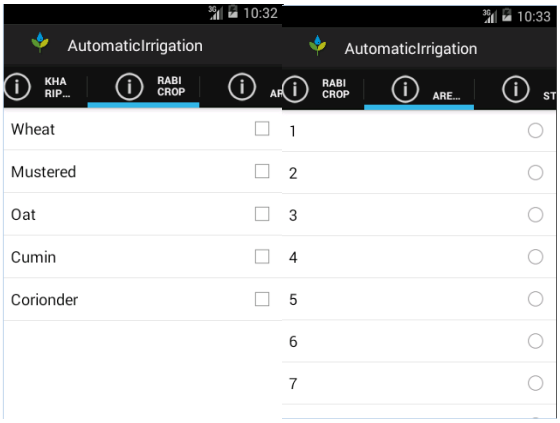

Figure 4.3 Android App Crop Selection Screen

It allows users to select the Crop and the Area of the crop where he wants to irrigate.

The Selected area of the Crop is send to Hardware Module. Where the sensor will detect the moisture of the soil and send it to the Arduino controller and it send result to Android application through GSM.

This Expected output is shown below.

3. Expected Output

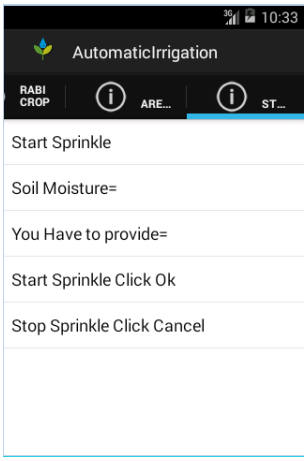

Figure 4.4 Android App Output Screen

Android Application will receive data from GSM Module and it will display here.

Here user will see Soil Moisture and he will START as well as STOP Sprinkle from any Remote Location.

V. ANALYSIS

After review of various papers the Automated Irrigation System was implemented by using Hardware Soil Moisture Sensor, Arduino Controller and other hardware.

In this paper I present the system which is a combination of hardware (sensor and GSM kit) and software (Android application).

Automated Irrigation System using Soil Moisture Sensor is an Android based application which works with the help of Soil Moisture Sensors.

In my proposed system Arduino Controller is connected to GSM Module. The Controller send message to GSM module about the moisture of the soil. GSM kit will receive the message and forward to the Android application.

Android application will receive the soil moisture level and will show the expected output to the user as shown in figure 4.4. It allows user to START as well as STOP Sprinkle.

VI. CONCLUSION

In this work, I successfully reviewed a system that can help in an automated irrigation system by analyzing the moisture level of the ground. The grounded sensors all around the farming land will give notification about the need of water and accordingly it will be supplied.

Simultaneously I present the proposed the system which is combination of hardware (sensor and GSM kit) and software (Android application).

In this paper I configured an automated approach for the sprinkle to be start and stop through Soil Moisture Sensors, Arduino Controller and Android Application by user from any remote location.

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