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Smart Irrigation System using Arduino

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Abstract: A variety of strategies must be used to address supply and demand issues in order to provide a growing and increasingly wealthy global population with inexpensive and wholesome food. In terms of supply, increasing irrigation is Future food production will depend on this, but the accompanying needs for storing water and the effects of doing so are uncertain. In this article, we calculate biophysical potentials for storage-fed sustainable irrigation, which does not degrade freshwater supplies or increase cropland but instead requires water to be stored before use. We also examine the consequences for infrastructure and food security. Because 460 km3/yr of sustainable blue water—enough to grow food for 1.15 billion people—can only be used for irrigation after being stored, we find that water storage is essential for future food systems. Even if they were all known Our findings point out the limitations of grey infrastructure for future irrigation and call for greater irrigation efficiency, a switch to less water-intensive farming methods, and the widespread use of alternate storage options.

Keywords: Smart Irrigation, Sustainable Irrigation, Water, Efficiency, Storage

I. INTRODUCTION

One of the more labour-intensive traditional practices in the agricultural industry is irrigation. Sensors and microcontrollers can detect when plants need watering in order to irrigate them autonomously. Automation entails accelerating production, cutting costs, and making efficient use of resources. The primary objective of this project is to create a microcontroller system that autonomously waters plants while relaying information to farmers. In order to place the water directly into the root zone and reduce evaporation, drip irrigation was used in this project, where the water was allowed to drip slowly to the plant roots from above the soil surface or buried into the surface.

It uses temperature sensor, soil humidity sensor to collect and monitor field information and also uses float switches to monitor ground water level through web page. When the field gets dry and ground water level falls down it will be notified through SMS. This provides a solution for the problems in developing a smart farming system. It uses node MCU, relay and water pump. Moreover, the automation of irrigation can help address issues related to water misuse. By implementing sensors and smart technologies, the irrigation systems can monitor soil moisture levels, weather conditions, and plant water requirements. This data-driven approach ensures that water is applied only when needed, preventing excessive usage and minimizing waste. It promotes efficient water management, especially in regions where water scarcity is a concern.

Expanding the automated irrigation systems to greenhouses presents unique advantages. Greenhouses require controlled environments for optimal plant growth, and automated systems can play a crucial role in maintaining the necessary conditions. These systems can regulate temperature, humidity, and light levels, in addition to providing automated irrigation. The combination of these features can improve crop quality and yield while reducing manual intervention. Furthermore, the ultimate goal of developing entirely automated farms and gardens holds immense promise for the future of agriculture. By integrating advanced technologies such as robotics, artificial intelligence, and Internet of Things (IoT), it becomes possible to create highly efficient and self-sustaining farming systems.

These systems can continuously monitor and manage all aspects of crop production, from irrigation and fertilization to pest control and harvesting. The potential benefits include increased productivity, reduced labor requirements, minimized resource waste, and enhanced crop quality. When combined with rainwater harvesting techniques, automated irrigation systems can contribute to significant water savings. By capturing and storing rainwater, farmers and gardeners can supplement or entirely replace their reliance on freshwater sources. The automated systems can then distribute this collected rainwater efficiently to the crops and plants, optimizing water usage and reducing the strain on local water supplies.

Agriculture is a major part of the economies of developing nations, but we don't always make the most use of the resources at our disposal. This is primarily due to the unforeseen irrigation water use. Even though there are numerous modern irrigation methods, including drip irrigation and sprinkler irrigation, farmers still need to go to the farms frequently to water the crops. It is therefore manually operated. All of these issues lead to the waste of time, agricultural, and human resources. Consequently, the creation of an automatic watering system is necessary.

II. LITERATURE SURVEY

Veena Divya,k, Ayush Akhouri "A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methodology" deal GSM based Irrigation Control System, which could give the facilities of maintaining uniform environmental conditions. For this, a software stack called Android is used for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. This system covered lower range of agriculture land and not economically.

Mansour "Impact The Automatic Control Of Closed Circuits Rain gun Irrigation System On Yellow Corn Growth And Yield" this research paper deals of automatic control of closed circuits drip irrigation system as a modified irrigation system on yellow corn crop vegetative and yield parameters under (KSA) Saudi Arabia conditions at Al-Hasa region. The field experiment carried out under automatic irrigation system for three irrigation lateral lines 40, 60, 80 m under the following three Drip Irrigation Circuits (DIC) of: a) one manifold for lateral lines or closed Circuits with one Manifold Of Drip Irrigation System (CM1DIS); b) closed circuits with two manifolds for lateral lines (CM2DIS), order to compensate for Etc. and salt leaching requirement. and take more power.

M. Guerbaoui, elafou, a.ed-dahhak "GSM based automated drip irrigation system" we proposed a system contribution to the development of greenhouse production in Morocco. The proposed solution involves the development of an integrated system for automate the drip fertilizing irrigation in green house. The solution adopted involves a data acquisition card PCL-812PG controlled by PC. The irrigation is provided by a hydraulic circuit based on an electric pump. Water needs are evaluated by measuring soil water status by soil humidity sensor.

Purnima, S.R.N Reddy, "Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth" ,proposed artificially supplying water to land where crops are cultivated. Traditionally hand pumps, canal water and rainfall were a major source of water supply for irrigation. This method has led to severe drawbacks like under irrigation, over-irrigation which in turn causes leaching and loss of nutrient content of soil. Changing environmental conditions and shortage of water have led to the need for a system which efficiently manages irrigation of fields. Automated irrigation system is a machine based system, which automates the irrigation of land by combining various software and hardware approaches together for field irrigation. This paper deals with a detailed survey of various GSM based automated farm irrigation systems. GSM serves as an important part since it is responsible for controlling the irrigation facility and sends them to receiver through coded signal. Our study is concentrated on comparison of various GSM approaches

Nicholas J. Car researched on the topic "Using decision models to enable better irrigation Decision Support Systems". Author step away from explicit DSS design and irrigation DSS relevant data management to review the state of the art of formalized systems for modelling decisions themselves. Author does this because we believe that many irrigation DSS that have been built, including some by this author, have not leveraged good knowledge of how decisions are actually made which is decision theory. These have met with limited success for many reasons, one of which is well known- that DSS encode decision rules are narrower in scope than the criteria, farmers really use to make decisions, thus their advice is of limited value or perhaps entirely irrelevant.

Rooholla Moradia, researched in the year of 2015on the topic "Energy use and economical analysis of seedy watermelon production for different irrigation systems in Iran". Author highlighted that about 85% of used water irrigation in agriculture was supplied from groundwater in Iran. Reduced irrigation system improved the IWEUE and energy use efficiency. Direct and renewable energies were higher under reduced than full irrigation system. Reduced irrigation could reduce water usage up to 95% than full irrigation. Reduced irrigation system leads to save the energy resources .Resource and energy use efficiency is one of the principal requirements of eco-efficient and sustainable agriculture.

Darouicha, researched on the topic "Drip vs. surface irrigation: A comparison focusing on water saving and economic returns using multi-criteria analysis applied to cotton Hanaa M." This study explores the use of drip and surface irrigation decision support systems to select among furrow, border and drip irrigation systems for cotton, considering water saving and economic priorities. Simulation of drip irrigation was performed with MIRRIG model for various alternatives: double and single row per lateral, emitter spacing of 0.5 and 0.7 m, six alternative pipe layouts and five self compensating and non-compensating emitters. Furrow and border irrigation alternatives were designed and ranked with the SADREG model, considering lasered and non-lasered land levelling, field lengths of 50 to 200 m and various inflow discharges.

III. PRINCIPLES AND WORKING

3.1 Objective of Project

- A method that simplifies and removes burdens from the farmer's side of the agricultural process is urgently needed.
- Use fewer people and use less water.
- Real-time monitoring and management.
- To obtain the soil water sensor's output and hydrate the crop.
- To keep an eye on additional factors to improve yield.
- The output of yearly crop production must now be increased due to recent technological advancements.
- One of the key goals of integrating such technology into the agricultural sector of the nation is the ability to save natural resources while also providing a fantastic boost to the production of crops.

3.2 Scope of The Project

- Day by day, the field of electronics is blooming and have caused great impact on human beings. The project which is to be implemented is an automated irrigation method and has a huge scope for future development.
- The project can be extended to greenhouses where manual supervision is far and few in between. The principle can be extended to create fully automated gardens and farmlands.
- Combined with the principle of rain water harvesting, it could lead to huge water savings if applied in the right manner. In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve great results with most types of soil.
- By developing a Smart Wireless Sensor and by using upcoming techniques a farmer can increase his profit by solving different problems that are faced by the farmer in his routine life. And also to involve Arduino – Controller with a video capturing by using an MMS facility about the crop position and at the same time sending video to the farmer
- It is more cost efficient, this claim is made on the fact that the proposed system does not need the heavy and expensive hardware for implementation.
- This type of automated irrigation system consumes 40-50% less water as compared to the traditional system.
- Ideal growth condition is been provided when small amount of water is been applied over large amount of time.
- This smart irrigation system extends watering time for plants, and provides ideal growth condition.
- It saves time and timer delay as per the environmental condition can be added for automatic watering.
- This smart irrigation system can be adjusted and modified according to the changing environment.
- It is simple to operate it starts by designing the map of your land and marking the location of planting.

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3.3 Equipment Required

A. Arduino UNO board

Arduino is a single card microcontroller designed to make the application more appreciable, that is interactive objects and the surrounding environment. The UNO board of Arduino is a microcontroller based onATmega328. It has 14 digital input and output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power connector and a reset button. Contains all the necessary support controller required (Baraka etal., 2013). It is presented by ATmega16U2 (Atmega8U2 up to R2 version) programmed as USB serial converter. It is a simple USB interface system. This allows the interface. This allows the USB interface since it is like a series. The chips on the card connect directly to the USB port and are compatible with the computer as a virtual serial port. The advantage of this configuration is that serial communication is an extremely simple protocol that has been proven over time and that USB connects to modern computers and makes it comfortable (Sahu and Behera, 2015). It is easy to find the microcontroller brain that is the Atmega328 chip. It is an open source project and there is an advantage to beopen source, since it has a large community of people who use it and solve it. This facilitates the help in debugging projects. It is very convenient to manage the energy inside and has an integrated voltage regulation function. This can also be powered directly from a USB port without an external power supply. It is connected to an external power supply up to 12 V and adjusts the digital pins of the 5v and 3.3v.13 and 6 analog pins. This type of pin allows you to connect the hardware to the UNO board of Arduino externally (Senpinar, 2018).Simply connect the electronic devices and sensors to the plugs that correspond to each of these pins and areready to work.

B. Moisture Sensor

The humidity sensor is used to measure the water content (moisture) of the soil. This sensor reminds the user to irrigate their plants and also controls the moisture content of the soil. It has been widely used in agriculture, irrigation and the land botanical garden (Shahidul Islam et al., 2015). The ground moisture operating voltage is 5 V, the current required is less than 20 mA, the interface is analog type sensors and operate between 10 and 20□. The soil moisture sensor uses capacitance to measure the dielectric permittivity of the surrounding soil. In the soil, dielectric permittivity is a function of water content. The sensor creates a voltage proportional to the dielectric permittivity and, therefore, to the water content of the soil. The sensor calculates the average water content over the entire length of the sensor. The soil moisture sensor is used to measure the loss of moisture over time due to evaporation and plants. Monitor soil moisture content to control irrigation in greenhouses and improve bottle biology experiments. The hardware and software needed for the soil moisture sensor is ArduinoIDE (Senpinar 2018) humidity sensor software, and the Arduino Uno board. The soil moisture brings connected to the VCC% v of Arduino UNO, GND soil moisture and interconnected sensor Arduino UNO and the last door of the A0 sensor connected to the 0Arduino analogue board (Baraka et al., 2013). The program will generate the sensor value as output. Take different types of terrain and insert the sensor into the ground. As a result, you will get the value of moisture present in the soil. For demonstration purposes, the user can keep the sensor on the ground. On the serial monitor. Note that the sensor will read the moisture on the floor and show the output.

```
int sensorpin = A0; // select the item
pin for the potentiometer
sensor value int = 0; // variable to store the value
 coming from the sensor
void setup ()
{
Serial begin (9600);
}
void loop () {
Sensor value = analogue read (sensorpin); //
Read the sensor value:
delay (1000);
serial.print ("sensor =");
serial.printin
```

(sensor value);
}
To connect the FC-28 humidity tester in digital mode, connect the digital output of the Arduino digital pinsensor.The LM393 comparator compares the sensor output value and the threshold value and then exits through the digital pin which will give 5V and the display in the sensor will turn on when the sensor value is lower than this threshold value, the digital pin will it will give 0V and the light will go down.

C. Relay

A relay is an electrical main voltage switch. This means that it can be turned on or off, letting the current flow or not. Controlling a relay with Arduino is as simple as controlling an output like a motor (Senpinar, 2018). There are many types of modules, such as single channels, double channels, four channels and eight channels (Souza et al., 2017). A type of relay able to handle the high power required to directly control an electric motor or other loads called contractors. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overloads or failures. In relation to the mains voltage, the relays have 3 possible connections. There is a common pin (COM), usually a pin (NO) and a normally closed pin (NC). There is no contact between the common pin and the normally open (NO) pin. We activate the relay to connect the COM pin and the power supply is supplied to a load. There is a contact between the COM pin and the NC pin. A connection between the COM and NC pins is always required, even when the relay is switched off. When we activate the relay, the circuit opens and there is no power supply for a load (Reche et al., 2015). All the pins of the forwarding. The connection between the relay module and the arduino is really simple. The GND of the relay goes to ground. IN1 relay port connected to the Arduino digital pin. Check the first channel of the relay.

D. Water Pump (DC, 12V)

For this study a water pump is required, which must be DC, 12V. The DC motor is the commonly used motor and has DC power distribution systems (Sethumathavan et al., 2016). Some rotors carry magnets and the stator grabs the conductors. The supports are used to allow the rotor to rotate continuously towards its axis (Reshma and Babu, 2016).

E. Jump Wire

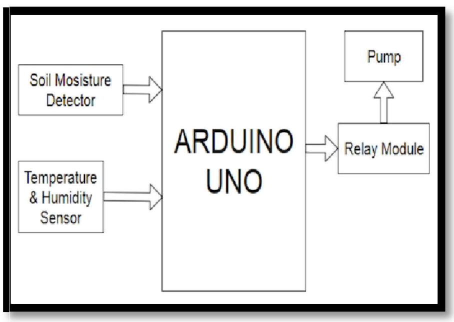
A jump cable is used to connect the test plate, the prototype or the internal circuit with other non-joined instruments.

F. Arduino IDE Software

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, MacOS, Linux) written in the Java programming language. It is used to write in the java programming language. It is used to write and load programs on the Arduino board. The source code for the IDE is published under the GNU General Public License, version 2. The Arduino IDE supports the C and C ++ language using special code
structuring rules (Souza et al., 2017). The Arduino IDE provides a software library of the wiring project, which provides many input and output procedures.

IV. PROPOSED SYSTEM

4.1 Block Diagram



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The Model works as follows:

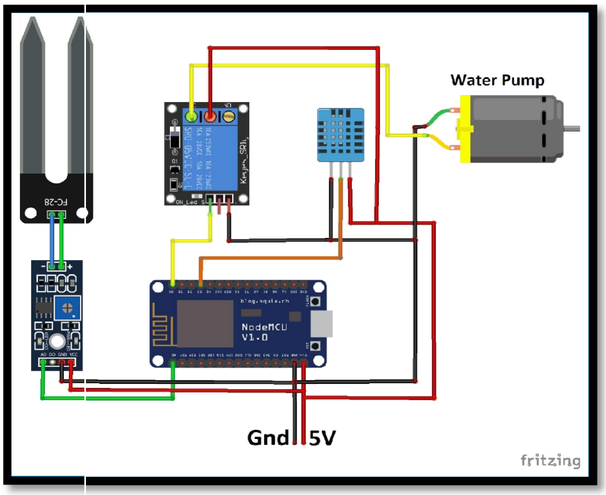
The results of the moisture, temperature and threshold level can be calculated through the sensors used in the project.

Analysis of soil parameters can be done and the needed nutrients can be calculated for the soil.

The need of water supply of the soil can be calculated and hence appropriate irrigation is done through smart techniques.

4.2 Circuit Diagram

Since we are making a prototype of this project, we will make connections on the breadboard and avoid soldering the components. We will use male to male, male to female and female to female jumper wires.



V. RESULT AND DISCUSSION

All Sensors determined the soil moisture level, Humidity, Temperature, at the root zone. Arduino Micro controller should get sensor data in per minute. Micro controller should record & analyse all the data and take correct action. Soil moisture sensor takes an important role in an agricultural system controller. Soil moisture level set as per based on plant specification, soil type, seasonal rainfall. Arduino microcontroller should upload that observed data in every hour and supply water flow as per requirements.

Efficient results have been obtained from the following project. Table 1 shows the recorded data at field in several days. The hardware implementations have been successful and they are reliable and the sensors that we are using are giving good results and performing to the expectations.

VI. CONCLUSION

The concept of automated irrigation systems holds great potential for the agricultural industry, benefiting not only time-strapped farmers and gardeners but also addressing water misuse and promoting water conservation. By expanding the idea to include greenhouses, where manual oversight is limited, and eventually developing entirely automated farms and gardens, the efficiency and productivity of agricultural practices can be significantly enhanced. Automated irrigation systems offer several advantages. They can be programmed to provide water at optimal times and in precise amounts, ensuring that crops and plants receive the necessary hydration for healthy growth. This eliminates the need for manual labor and constant monitoring, freeing up farmers' time and reducing their workload.

Moreover, the suitability of this technique for various soil types and regions with significant rainfall shortages makes it highly adaptable. By leveraging automated irrigation systems, even areas with limited access to water resources can achieve sustainable agriculture. The ability to customize irrigation schedules and precise water delivery based on specific soil and crop requirements enhances agricultural productivity in such challenging environments.

In conclusion, the expansion and implementation of automated irrigation systems have the potential to revolutionize agriculture, benefiting farmers, gardeners, and the environment. By saving time, reducing water misuse, and promoting water conservation, these systems can enhance productivity, improve crop quality, and contribute to sustainable farming practices. The integration of rainwater harvesting techniques and the development of entirely automated farms and gardens further amplify the positive impact of this approach.

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