IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Automated Irrigation System using IoT

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Abstract: The agriculture is one of the most fundamental resource of food production and also played a vital role in keeping the economy running of every nation, but there are several issues related to traditional methods of agriculture such as excessive wastage of water during irrigation of field, dependency on non-renewable power source, time, money, human efforts, etc. since the agriculture plays the significant role in improving the country's economy, an improvement should be applied in order to increase the productivity and expand the quality of crops.

This paper deals with innovative technology in considering the various to irrigate agricultural land using Internet of Things. So, this project signifies a smart auto irrigation system by using soil moisture sensor is connected to the Arduino-UNO which act as a controller and a global system for mobile communication which is used to transmit and receive the data between the controller and the user.

Index Terms **– Arduino UNO, Sensors, IoT, Irrigation.**

I Introduction

Irrigation is one of the most powerful sources in India but it is difficult for each individual to monitor it continuously and consistently. Smart irrigation system is integral to saving water and improving efficiency. It uses real-time sensors or historical data to inform irrigation methods and modify watering schedules to improve efficiency. This program is an IoT-based tool that can automate the irrigation process by analyzing soil moisture and climate. The main objective of this project to ease the work of farmers by introducing them with Smart Irrigation, IoT, etc.

To increase the efficiency of irrigation and preventing water wastage, a design of new system is needed, the system uses information from soil moisture sensors to irrigate the soil which helps to prevent over-irrigation or slow soil irrigation thus avoiding crop damage. The farm owner can monitor the process online. It can provide high accuracy water supply and avoid water wastage, it requires less man power. By using sensors, it can accurately determine the soil moisture level.

II Software and Hardware Requirement Specification

This section elaborates the proper methodology and the technical models that are used to build the system. The detailed technology used is as follows.

2.1 Technology

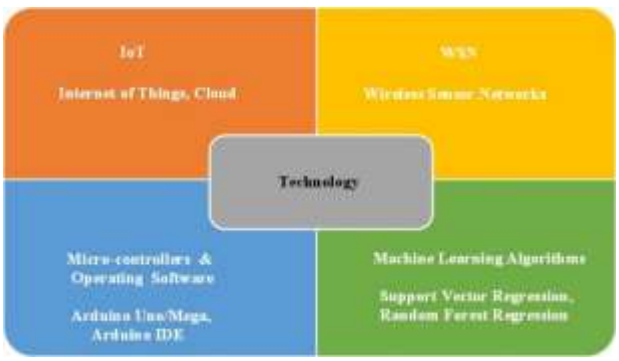


fig 1: technology

2.1.1 IoT

IoT (Internet of Things) technology has recognized smart wearables, connected devices, automated devices, etc. Now in agriculture, IoT has made a huge impact. With the introduction of the industrial IoT in agriculture, highly developed sensors are used. The sensors are now connected to the clouds via a mobile/satellite network. This allows us to identify real-time data from sensors, to make decisions.

Cloud-based data storage and end-to-end IoT Platform play an important role in an intelligent agricultural system. Data is analyzed and converted into critical information using analytics tools. The use of forecasting analysis helps farmers to predict future weather conditions and crop yields. IoT in the agricultural industry has helped farmers to maintain crop quality and soil fertility, thereby increasing productivity and product quality.

2.1.2 WSN

A wireless sensor network consists of a region with totally autonomous distributed devices having the sensors for measuring environmental or physical constants, such as pressure, temperature, carbon emissions and vibration. WSN is adapted to a variety of locations and situations, which extend the scope of their applications. WSN plays a major role in the environmental monitoring system and provides automated irrigation. The WSN contains moisture sensors, super capacitors as the storage device power harvesting systems and embedded controllers.

2.1.3 Micro-controllers & Operating Software

The proposed system relies on two types of micro-controllers namely Raspberry pi 3 and Arduino Mega, the choice of the micro-controller is based on their compact capabilities, cost and ease of access or availability. With the use of a variety of sensors, flexible parameters will be constantly monitored direct watering of the crops will be made.

Arduino is based on easy-to-use hardware and software as well as it is an open- source prototyping platform. Arduino boards can read input like light of a sensor, finger placed on a button, or message from Twitter and convert it into an output as driving the motor, switching LED on/off and publishing data online. Arduino IDE is the software used to operate the micro-controllers, which is a free software and it has inbuild programs for driving the motor, switching LED on/off and etc.

2.1.4 Machine Learning Algorithms

Machine learning technology plays an important role in SIS. It uses a calculation method to study agricultural data. The focus of the learning process in training data is to make specific data defined by a set of features. That feature can be a name, binary or number. The irrigation system uses a machine to learn water control, crop growth, and soil management. Also, in agriculture it is used for crop management, crop forecast, weed detection, disease detection, species recognition and crop quality.

The smart irrigation system model is based on the Decision Tree (DT) algorithm, which is a machine learning algorithm that trains the system in the data segment to create a model that will be used to test and predict residual data.

Machine learning is a branch of decision-making tool based on the application of intelligent and continuous intelligence that allows computers to learn without explicit programming. ML models have emerged as an effective tool to support prudent decisions based on the rational and sustainable use of clean water resources in the context of precise irrigation management.

Support Vector Regression

Benefits of a support vector regression to avoid the hassle of using line function in the space of large input samples and the efficiency of complex problems converted to simple line function preparation. Support Vector Machine (SVM) is an algorithm for machine learning (ML) that can be helpful for finding solutions for better crop management.

Random Forest

Random forest algorithms are used for retrieval and partitioning. It is an integrated learning environment, made up of many trees to cut down. By measuring the impact of a few decision trees, informal forests often improve forecasting.

Decision Tree:

Decision Tree is used to build a model in the form of a tree which is used for retreat problems or partition. It is widely used to create a training model that is used to predict a class or to separate data given a set of coding rules. Firstly, the decision tree identifies the root node from a set of attributes, at each step the root node can be identified based on the qualification selection factor. The leaves of the decision tree are used to represent the class labels, the combination of elements is represented by branches that lead to those class labels and the attributes are represented by inner nodes.

2.2 Components

2.2.1 Soil Moisture Sensor

Soil moisture sensor is used to detect excess water in the soil which means it collects information about moisture in the soil. It converts the physical parameters to the electrical analog signals and transmits them to the Arduino. The soil moisture depends on a variety of factors such as the type of soil whether it is clay, sandy, salts and loam present in the soil such as Calcium, Sulphur, Phosphorus, iron, etc.

fig 2: soil moisture sensor pin configuration

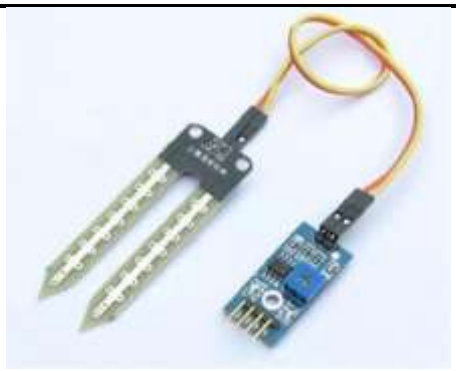


fig 3: soil moisture sensor

2.2.2 DHT 11 Sensor

A simple temperature sensor relies on the metallic expansion principles of thermodynamics. As the temperature changes, the metal bends until contact is made or removed from a switching mechanism. This would imply the desired temperature has been reached. More complex temperature sensors, especially for electronic circuits, rely on the voltage drop across a transistor to determine the current temperature. Since the voltage delta of transistor devices is well known as a factor of temperature, it is very easy to determine what the temperature is by measuring base to emitter voltage.

The DHT 11 sensors stands for the *Digital Humidity Temperature* sensor, which can detect the humidity as well as temperature from the environment. It passes the output data in the form of digital signals.

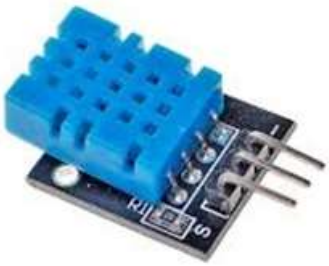


fig 4: digital humidity temperature sensor

2.2.3 Arduino

Arduino is a prototype platform that is open source which is based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed and a readymade software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. The Arduino boards are able to read analog and digital input signals from different sensors and turn it into an output such as activating motor, turning LED on/off, connect to the cloud and many more actions. You can control board functions by sending a set of instructions to the micro-controller on the board via Arduino IDE. Arduino does not need an extra piece of hardware in order to load a new code onto the board, it simply uses a USB cable. Additionally, the Arduino IDE uses a simplified version of C++. Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package.

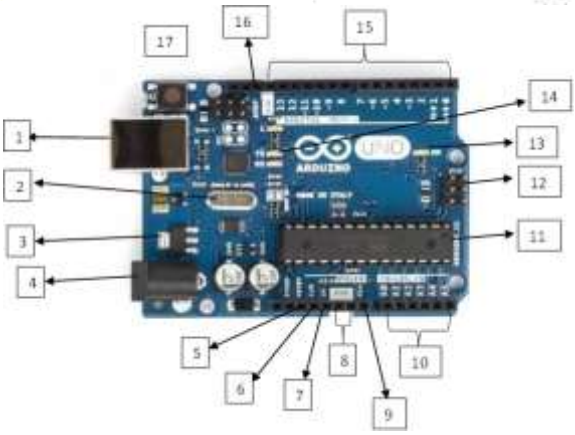
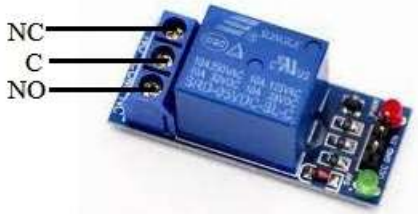


fig 5: arduino uno

1: Power USB: Used to power the Arduino board using USB.
2: Crystal oscillator: Helps Arduino in dealing with the time issue.
3: Voltage regulator: Controls the voltage and stabilize the DC voltages used by the processor and other elements.
4: Power (barrel jack): Used to power the board directly from the AC mains power supply.
5,17: Arduino reset: Resets the Arduino board, i.e., starts the program from beginning.
6,7,8,9: Pins (3.3V, 5V, GND, Vin)
10: Analog pins: Read the signals from analog sensors and convert it into digital value.
11: Main microcontroller: It is the brain of the Arduino. Mainly the micro controllers are of the ATMEL compony. The main IC on Arduino is slightly different from board to board.
12: ICSP pin: It is a tiny programming header for the Arduino consisting of MISO, SCK, RESET, VCC and GND.
13: Power LED indicator: For indicating the board is connected to power supply.
14: TX and RX LEDs: Flashes while sending and receiving process data respectively.
15: Digital I/O: The Arduino UNO board has 14 digital I/O pins out of which 6 provide PWM (Pulse Width Modulation) output.
16: AREF: AREF stands for Analog Reference. It used to set an external reference voltage between 0 to 5 volts.

2.2.4 Relay Module

The relay is an electrically operated device, used to control the operations of the water pump. It acts as a logical operating switch as it transmits the incoming signals from one circuit to another circuit. It is used to drive the DC motor; hence it is also known as motor driver.



NC: normally closed ; C: common ; NO: normally open

fig 6: relay module

2.2.5 ESP8266 Wi-Fi Module

Node MCU-ESP8266 is an affordable open source IoT platform. The name node MCU combines ‘node’ and ‘MCU’ i.e., micro-controller hence it has same features as Arduino with a beneficial feature that it can transfer data over Wi-Fi protocol. It is used to communicate between the user’s PC/android and the system over a Wi-Fi network.

fig 7: esp8266 wifi module

2.2.6 DC Motor

The main purpose of the DC motor is to pump and supply the water, which will be in control of the motor driver i.e., relay module. When the arduino pass the signals to the relay module, it will turn on/off the DC motor pump.

fig 8: dc motor pump

2.2.7 LCD Display

The LCD Display device is used to display the data collected by the input sensors like soil moisture sensor and DHT11 sensor. It also displays the state of the motor pump that is it shows whether the pump is on or off.

fig 9: i2c 16*2 lcd display

III System Architecture and Designing

3.1 Work Flow Diagram

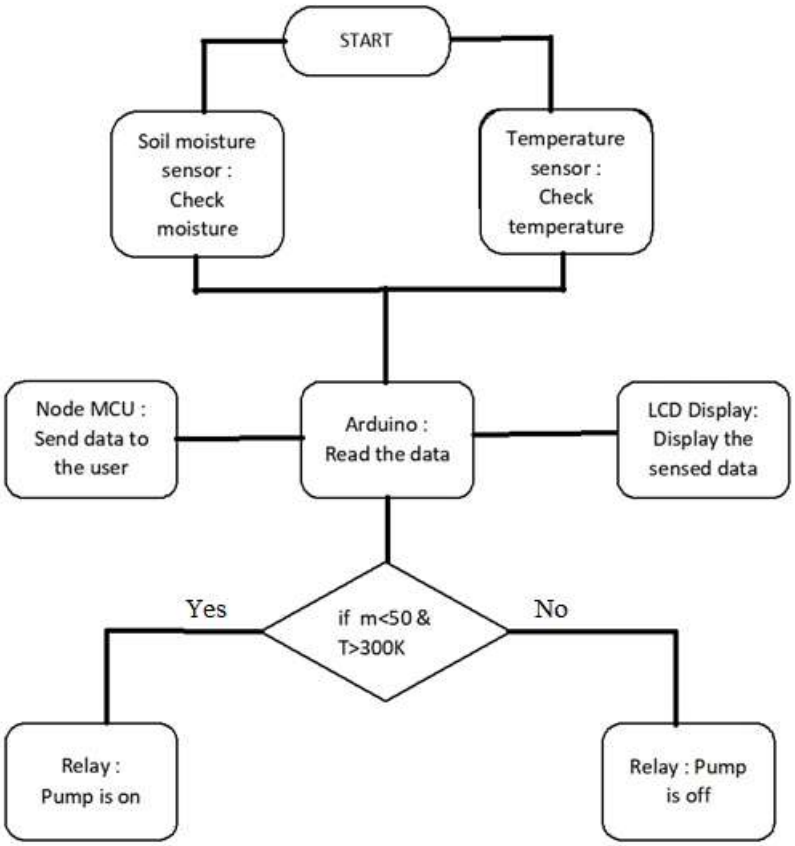


fig 10: work flow diagram

3.2 System Block Diagram

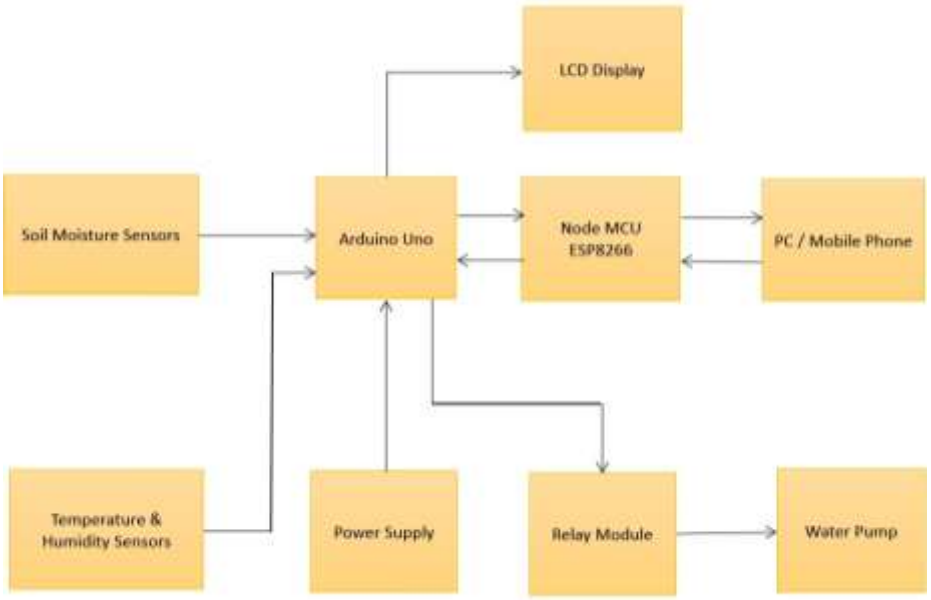


fig 11: system block diagram

IV Conclusion

The automated irrigation system has been designed and implemented in this paper. The system developed is beneficial and works in cost effective manner. It reduces the water consumption to a greater extent. It needs minimal maintenance The power consumption has been reduced very much. The system can be used in green houses. The System is very useful in areas where water scarcity is major problem .The crop productivity increases and the wastage of crops is very much reduced using this irrigation system. The developed system is more helpful and gives more feasible results

V Reference

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