

Next Gen Farming: IoT in Smart Irrigation System

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Abstract - Day by day population is growing and hence resource demand. Agricultural sector will play vital role in resource management. To fulfill the water need for agriculture effective water management will be most important and crucial parameter. In today's environment evolution in technology is continuously happening in agriculture sector too. Internet of Things (IoT) is most promising technique that can be used to make irrigation system smart. IoT is shifting agriculture sector from factual to quantitative approach. IoT sensors are capable to provide all necessary information related to farm, soil, crop etc. IoT has number of benefits in agriculture like monitoring, analysis and crop management. These sensors provides real time data which helps to get proper analysis and hence efficient water management can be done. This paper describes how IoT plays important role in making traditional irrigation system smart. It explains how data can be collected, analyzed and how this real time data is used to make smart irrigation system. The proposed system will help to manage water effectively, increase productivity.

Key Words: Internet of Things (IoT), Sensor, Cloud computing, Arduino, Soil Moisture, Capacitance

1. INTRODUCTION

What is Internet of Things (IoT)? Connecting daily routine things embedded with electronics hardware, sensors, and software to internet enabling them to collect and exchange data. The device communicates over the internet without needing a person to initiate the communication. IoT is fast developing technology in sectors like Agriculture, Health care, Manufacturing, Supply chain, Smart cities etc. Electronics hardware is continuously developing day by day [2, 3] due to this IoT becomes more popular. To get real time data in physical world sensors are playing most important role [5].

In recent years with increase in agriculture production new technologies and introduced in the sector. This advances in agricultural technology leads to concept smart farming. In 21st century farmers are able to access internet, GPS, sensors etc. In order to create the smart irrigation system lots of work done has been done on IoT. The IoT significantly transformed the agricultural environment. IoT is giving answers on water crisis, yield issue, productivity. This cutting edge technology has solutions to improve the productivity, water management etc.

The intelligent system will monitor the crop growth as per the environmental conditions. [14, 15], the collected raw data is used to analyse the exact water requirement [4]. This raw data collection is done by using sensors. This collected data is stored on cloud and has to compare with the standard crop data to generate exact need of water requirement for particular crop at particular day and time. The proposed concept focus on capacitive approach for soil moisture measurement. Use of IoT allows well planned irrigation scheduling by keeping mind the limited resources.

2. IOT TECHNOLOGIES RELATED TO AGRICULTURE

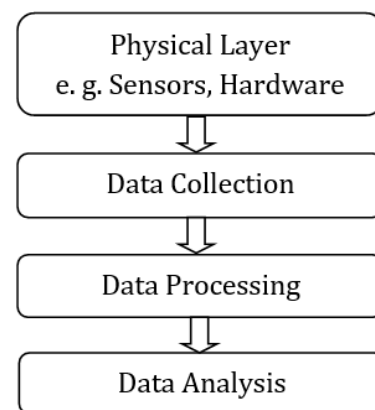


Fig -1: IoT enabled system flow

IoT enabled smart irrigation system has major components like physical structure of sensors and electronics hardware, collection of data, processing of gathered data, and last most important is analysis of data. The IoT enabled system must meet the sensor control while measuring the soil moisture, capacitance (Relevant approach), sensor node identification, hardware controlled devices. This action can be done by software or mobile application linked to internet. The system should focus on primary aspects like monitoring and managing functions. IoT gives rise to lots of solutions in agriculture sector. Among these few need to be highlighted.

2.1 Cloud Computing

It is the most important and crucial term while fulfilment of smart irrigation system. The software or mobile application based on cloud [6, 10] are used for accurate data processing.

2.2 Big data

Sensor produces huge amount of data. From this data optimum is to be processed by big data analytics [7, 8].

2.3 Agricultural Robots

Agricultural robots are developed for various functions like pesticide spraying, planting crops etc.

3. TYPICAL ARCHITECTURE OF SMART IRRIGATION SYSTEM

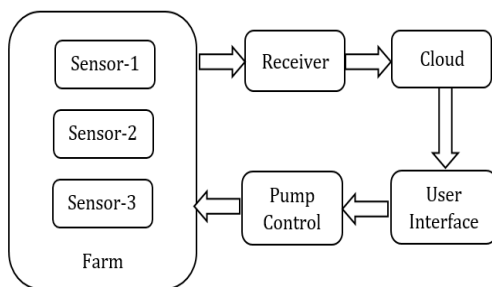


Fig -2: Smart Irrigation System Framework

The figure shows the framework of smart irrigation system. Sensors are installed in the farm. The installed soil moisture sensors measure the real time moisture contents from the soil. All soil moisture sensors will share moisture contents to the central receiver by wireless communication. Receiver is used to collect the data from all installed sensors. Receiver shares all received data continuously to the cloud with internet from GSM module or Wi-Fi. At backend data is analyzed and after comparison with the standard exact water requirement is calculated. As per the water required pump operation will be done that too using mobile application, call or by sending the SMS.

4. SOIL MOISTURE SENSORS

Soil moisture control is a critical factor in crop growth. Measurement and accurate monitoring of soil moisture will give better crops, increase in profitability and bring efficient control on nutrients and other inputs. Soil moisture sensors help farmers to understand what exactly is happening in the root zone of the crop. There are multiple approaches to measure the soil moisture contents, among these two of them are briefed below.

4.1 Resistive sensors

In this type of sensors change in resistance is measured to get moisture contents. The measured output voltage will have the inverse relation with moisture content. These sensors are cost effective with high surface to volume ratio; but not optimal for measurement below 5% pH [1].

4.2 Capacitive sensors

Soil moisture measurement relies on the capacitance. This sensor is composed of two metal plates separated by a thin layer of non-conductive film. This thin layer of film attracts moisture and when moisture makes contact with metal plates it creates the voltage change. These sensors are considered as more accurate and stable to produce results [12].

5. PROPOSES HARDWARE

5.1 Arduino

Arduino Nano is a small board based on ATmega328p. It offers similar connectivity like Uno board. It is the easiest and cheapest to create new devices or to enhance existing devices as a part of the IoT applications. The main benefit of using Arduino for IoT is that the board can be programmed a number of times. It makes possible to make various projects by changing the code. The main difference between Nano and Uno is the size. Uno size is double than the Nano. For programming micro USB is needed for Nano while for Uno USB is required. We prefer Nano for smart Irrigation application.

5.2 NodeMCU

It is the cheapest IoT platform. Firmware is included which runs on the ESP8266. The NodeMCU is the combination of node and microcontroller unit. It is having built Wi-Fi functionality. This is the main part of receiver section. Main benefit is it can also be programmed by Arduino IDE.

5.3 HC-12

It is the wireless serial port communication module. It is multichannel embedded wireless data transmission module with wireless working frequency band is 433.4-473.0MHz. This module sends the moisture content data from sensor to receiver continuously.

6. USER INTERFACE

Farmers can visualize, analyze and take control action with desktop based software, mobile application. As per today's scenario mobile application is the best option to use as interface. In mobile app user can monitor plant growth, soil moisture content level, real time water requirement for particular crop. Also farmer will be able to turn On/Off the pump using feature in application. The pump can also operate by making call or sending SMS. The multilingual mobile application will add more advantage to user interface.

6. CONCLUSION

IoT plays major role in making agriculture industry smart. It is going to revolute the irrigation system. The proposed system will effectively manage the water requirement for crop. The effective water management will improve productivity, crop yield. The use of Arduino, NodeMCU will make system calibration much more flexible and easy. This all is going to make Smart Irrigation System as a main part of next generation farming.

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