Irrigation Station with Supervised Learning Using AI

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***Abstract*—India is mainly an agricultural country. Irrigation is a vital component of agricultural production. Irrigation is a process of applying controlled amount of water to plants at regular interval. There are various technological improvements in irrigation including automated irrigation. Compared to manual irrigation, automated irrigation system can save water and maximize productivity. Automated irrigation system can be either closed/feedback control system or open/non-feedback control system. Feedback control systems monitor's environmental parameters to control irrigation. Closed loop control system can be either plant/crop-based system or soil-based system. Agriculture and farming are the key components and they contribute to the maximum in the income of any country. Farmers cannot depend on the rainfall for the crop's cultivation. So, watering and monitoring of the crops becomes a critical issue. Less watering or more watering to the plants can be a serious issue and it may lead to the less yield of the crop. Also, farmers cannot be at the irrigation land all the time. So, we are proposing a design for automatic monitoring of the crops so that the system automatically understands the need of water to the plants and acts respectively. We are also proposing to apply artificial intelligence to the irrigation system. By this the plants will be continuously monitored for any changes in the quality of the crops which will be immediately notified to the farmer.**

***Index Terms*—Smart Irrigation System, Soil Moisture Sensor, Arduino Uno, Internet of Things (IoT), Machine Learning, Precision Agriculture, Automated Irrigation, Wireless Sensor Network, Crop Monitoring, Water Management.**

I. INTRODUCTION

The main aim of this project was to provide water to the plants or gardening automatically using microcontroller (Arduino Uno). We can automatically water the plants when we are going on vacation or don't, we have to bother my neighbours, Sometimes the neighbours do too much of watering and the plants end up dying anyway. There are timer-based devices available in India which waters the soil on set interval. They do not sense the soil moisture and the ambient temperature to know if the soil actually needs watering or not. Assimilation is that the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. When a zone comes on, the water flows through the lateral lines and ultimately finally ends up at the irrigation electrode (drip) or mechanical device heads. Several sprinklers have pipe thread inlets on the lowest of them that permits a fitting and also the pipe to be connected to them. The sprinklers are usually used in the top of the head flush with the ground surface.

It has been well said that India is an agricultural country. According to 2014 the land share for agriculture is 60.4% and growing at an alarming rate of 0.03%. A country where there is a huge share to agriculture should be well acquainted with irrigation. Irrigation plays an important role in India, not only to artificially supply water to our crops but also to make our crops healthier. Due to global warming, there has been an unprecedented rise in temperature. across the globe and as a result there are irregular and uncertain monsoons in the country. Technologies are growing and so do humans grow with them, and so do the automated irrigation in our country, which is a major step ahead to a modern India.

Irrigation helps to water the crops in the event of unexpected rains. There are varieties of crops grown in India, of which some require water in excess while others in very less water. To meet these requirements irrigating the crops is vital. Jute and Paddy require excess amounts of water which cannot be fulfilled by rains and there is a need for watering them artificially. It also controls drought and other calamities faced by the country.

For a country like India where the population is solely dependent on crops for the food there is a necessity of further advancing our irrigation system so that our farmers do not toil all day.

Micro controllers like Arduino are being used to make the system to nearly complete automated. Arduino like any other device is an open-source platform which is capable of interacting with the objects by sensing them in the real world. The advantage of this little small electronic device is that it is very easy to learn and implement. Arduino can receive inputs from many sensors and in turn can control the motors,

Irrigation is the artificial application of water to the soil usually for assisting in growing crops. It is critical, yet a vital input of agriculture production process and pivotal to agricultural, social, and economic growth of nation. Civilizations have been dependent on development of irrigated agriculture to provide agrarian basis of a society and to enhance the security of people. Along with bless irrigation also brought the inherent attachments of several problems like salinity and water logging. Civilizations have risen and fallen with the growth and decline of their irrigation systems, while others have maintained sustainable irrigation for thousands of years. Understanding history of irrigation development helps in augmenting knowledge about the traditional systems many of which are equally relevant in today's context. Further, there are several lessons which we may learn from the past experience. Such lessons which enrich our design and management options must be explored.

Irrigation is the artificial application of water to the soil usually for assisting in growing crops. In crop production it is mainly used to replace missing rainfall in periods of drought, but also to protect plants against frost. Irrigation has two primary objectives to supply essential moisture for plant growth, which includes transport of essential nutrients to leach or dilute salts in soil. Besides this irrigation provides number of side benefits, such as cooling the soil and atmosphere to create more favourable environment for crop growth, Irrigation supplements the supply of water received from precipitation and other types of atmospheric water, flood waters and ground water.

II. RELATED WORK

João Cardoso, André Glória [1] With the quick advance of technology and the appearance of low cost/high performance solutions, it became possible to develop new solutions in order to achieve sustainability. This paper proposes a scheme for monitor and control farming irrigation in order to measure and administrate the right amount of water needed to avoid overirrigation, preventing and alerting to risk situations, that require immediate intervention. This paper provides a methodology for an IoT system with a wireless sensor network installed on the ground and a main server, running machine learning algorithms, to process the collected data. Communications will be conducted using NB-IoT and LoRa. In order to give the owner, the capability of consult the collected data and control his property, an iOS application completes the methodology, allowing the system to be remote and to be used anywhere, only requiring an internet connection.

Rayner Alfred; Joe Henry Obit; Christie Pei-Yee Chin [2] Big Data (BD), Machine Learning (ML) and Internet of Things (IoT) are expected to have a large impact on Smart Farming and involve the whole supply chain, particularly for rice production. The increasing amount and variety of data captured and obtained by these emerging technologies in IoT offer the rice smart farming strategy new abilities to predict changes and identify opportunities. The quality of data collected from sensors greatly influences the performance of the modelling processes using ML algorithms. These three elements (e.g., BD, ML and IoT) have been used tremendously to improve all areas of rice production processes in agriculture, which transform traditional rice farming practices into a new era of rice smart farming or rice precision agriculture. In this paper, we perform a survey of the latest research on intelligent data processing technology applied in agriculture, particularly in rice production. We describe the data captured and elaborate role of machine learning algorithms in paddy rice smart agriculture, by analyzing the applications of machine learning in various scenarios, smart irrigation for paddy rice, predicting paddy rice yield estimation, monitoring paddy rice growth, monitoring paddy rice disease, assessing quality of paddy rice and paddy rice sample classification. This paper also presents a framework that maps the activities defined in rice smart farming, data used in data modelling and machine learning algorithms used for each activity defined in the production and post-production phases of paddy rice. Based on the proposed mapping framework, our conclusion is that an efficient and effective integration of all these three technologies is very crucial that transform traditional rice cultivation practices into a new perspective of intelligence in rice precision agriculture. Finally, this paper also summarizes all the challenges and technological trends towards the exploitation of multiple sources in the era of big data in agriculture

M. Rezwanul Mahmood; Mohammad Abdul Matin [3] The evolution of the wireless network systems over decades has been providing new services to the users with the help of innovative network and device technologies. In recent times, the 5G network systems are about to be deployed which creates the opportunity to realize massive connectivity with high throughput, low latency, high energy efficiency and security. It also focuses on providing massive Internet of Things (IoT) network connectivity as well as services for good health, large-scale agricultural and industrial production, intelligent traffic control and electricity generation, transmission and distribution systems. However, the ever-increasing number of user devices is directing the researchers towards beyond 5G systems to allocate these user devices with higher bandwidth. Researches on the 6G wireless network systems have already begun to provide higher bandwidth availability for densely connected larger network devices with QoS surety. Researchers are leveraging artificial intelligence (AI)/machine learning (ML) for enhancing future IoT network operations and services.

Pankaj Kumar Kashyap; Sushil Kumar; Ankita Jaiswal; Mukesh Prasad; AmirH.Gandomi[4] Recently, precision agriculture has gained substantial attention due to the ever-growing world population demands for food and water. Consequently, farmers will need water and arable land to meet this demand. Due to the limited availability of both resources, farmers need a solution that changes the way they operate. Precision irrigation is the solution to deliver bigger, better, and more profitable yields with fewer resources. Several machine learning-based irrigation models have been proposed to use water more efficiently. Due to the limited learning ability of these models, they are not well suited to unpredictable climates. In this context, this paper proposes a deep learning neural network-based Internet of Things (IoT)-enabled intelligent irrigation system for precision agriculture (DLiSA).

III. ARCHITECTURE DESIGN

The purpose of the design is to plan a solution of the problem specified by the requirement document. This phase is the first step in moving from the problem domain to the solution domain. The design of the system is perhaps the most critical factor affecting the quality of the software and the hardware. Here we build a system block diagram that will be helpful to understand the behavior of the system. Here we divide problem into modules. Data flow Diagrams show flow of data between/among modules.

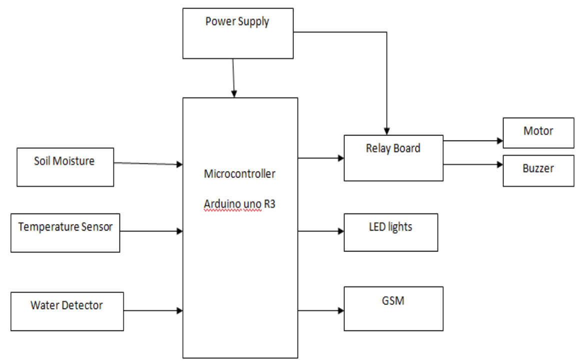

Fig. 1. System Overview

The purpose of the design is to plan the solution of specified by the requirements document. This phase is the first step in moving from problem to the solution domain. In other words, starting with what is required: design takes us to work towards how to satisfy those needs. The design of the system is perhaps the most critical factor affecting the quality of the software and has a major impact on the later phases, particularly testing and maintenance.

System design aims to identify the modules that should be in the system, the specifications of these modules and to interact with each other to produce the desired results. At the end of the system design all major data structures, file formats, as well as the major modules in the system and their specifications are decided.

Motor:

A Motor is a device which converts electrical power into mechanical rotation using the principle of electromagnetism. Electro-magnetism: A wire wound on a ferrite core carrying electric current generates a magnetic field; this principle is called Electro-magnetism

DC motor:
DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy.

Soil moisture Sensor:
Soil moisture sensor includes comparator (LM393) which converts analog data to discrete. Two soil probes consist of two thin copper wires each of 5 cm length which can be immersed into the soil under test. The circuit gives a voltage output corresponding to the conductivity of soil. The soil between the probes acts as a variable resistance whose value depends upon moisture content in soil. The resistance across soil probes can vary from infinity (for completely dry soil) to a very little resistance (for 100% moisture in soil). It consists of different types of sensing units such as Soil moisture sensor to measure water content of soil, temperature sensor to detect the temperature. DC motor-based vehicle is designed for Irrigation purpose. If the growth of plant is proper, the soil moisture electrode is inserted in soil.
The set point for soil moisture sensor is 200. If the soil moisture value is less than 200, water will be supplied for few (16) seconds. If the soil moisture value is greater than 200, no water supply takes place. The Raspberry Pi will send all the Information to the server using Wi-Fi. We are designing an Android App based server. The android app has a GUI which will show all the data to user.

IV. METHODOLGY

The system can be represented using algorithms and algorithms are designed using flowcharts.
The logics of the algorithm help to identify whether there is need of water to plant. Further, logics and decision-making conditions help soil moisture condition of the soil and it always maintain moisture and also the user gets the status of the motor on the mobile. First the moisture sensor senses the soil. The output of the moisture is in the analog form. The ADC of the Arduino converts the output of the moisture sensor into digital form

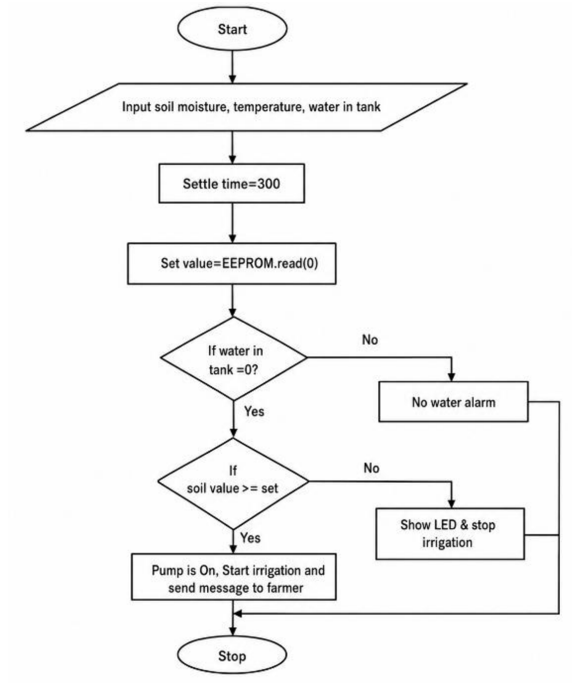

Fig 2: Flow chart of the system

The digital value is then sent to the Arduino decides whether to soil is wet or dry and according to that water the plant. If the soil is dry, Arduino actuates the relay and water pump starts which leads to water to flow. If the soil is wet, Arduino turns the relay of as a result water pump is off and water flow stop.

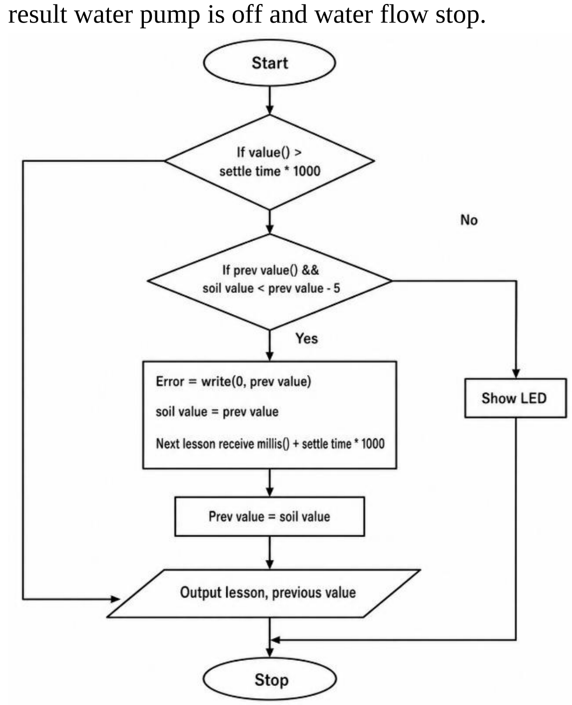

Fig 3: Learning Phase

V. RESULT ANALYSIS

The result analysis is the automatic irrigation system by applying the concepts of supervised machine learning so that the entire irrigation system will become self-learning and act upon it randomly. We have decided to use like soil moisture sensor and temperature sensor, near the plants. Using the values from these sensors and applying machine learning on these values we can get the status of the plants and the crops. Depending on this information necessary water can be supplied on the plants to stop drying of the crops. The moisture content in the soil will be read by the moisture sensor deployed in the soil and will be sent to the Arduino micro controller. Depending on the moisture content Arduino will control the motor which will water the plants till the moisture content reaches the required threshold. We have also used the ESP 8266 Wi-Fi module to send the readings of the different sensors read by the Arduino micro controller to the android application used by the farmer anywhere in the world so that the he can water the plants remotely. Android Application is used by the farmers to control the entire system.

The sample of soil the moisture is tested by changing the amount of water content and the values are recorded. Three zones of conductivity are defined which are indicated by the three LED'S. If the red LED glows, then it indicates that the soil is dry also referred as the dry zone. If the green LED glows on the PCB, it indicates that the moisture content is up to the level and does not require any more water. The third zone is the one in which the soil has more water content than the normal. The second method deals with the same sample of soil taken in a bottle of certain height and the moisture at different levels of the soil is being tested, three sensors are being inserted at three different depths.

The output of the three sensors is given as an analog input A0, A1, A2 to the Arduino board. The LED's can be used as an indicator of the warning if the water level is too low or too high. The pros are-low cost, efficient. The calculation of the moisture at different levels helps to understand that when and how much water is required for the root of the crop.

VI. CONCLUSION

Agricultural monitoring is very much needed to reduce much of human labour and at the same time minimise on water usage. Lot of system been developed employing Wireless Sensor in monitoring and predicting the soil condition for irrigating the field. In addition, machine learning techniques been employed towards crop yield. The system here receives the input from soil moisture sensor and temperature sensor and transmit to microcontroller. The sensor input is transmitted serially, machine learning algorithm (neural) employed for predicting the soil condition based on trained data set. Devices communicate among themselves in predicting the soil condition for watering the field. This proves that the use of water can be diminished and hence water will not be wasted as compared to the present records. It reduces the human resources. This irrigation system was found to be feasible and cost effective for optimizing water resources for agricultural production. The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance.

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