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Smart Drip Irrigation and Fertigation using IOT & WSN

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Abstract— In agriculture, despite large-scale funding and extension of irrigation services it is a serious concern that majority sectors are facing deficits in water management. Irrigation system is one of the major aspects to be enriched meeting the economic and sustainable challenges of the farmers. Recent trends in the area of Wireless Sensor Networks (WSN) have influenced a wide implementation of various applications in the area of precise agriculture. WSNs for environmental condition monitoring with defined knowledge are used for estimating crop growth and yield properties. The proposed system automates the irrigation and fertigation using WSN to make comparatively high yield than the traditional methods. Irrigation scheduling is estimated by use of WSNs real time monitoring of weather and soil properties. The exigent need for solving the constraints, Evapotranspiration (ET) system is integrated with irrigation module which uses Penman-Monteith FAO-56 model for calculating crop water need. The system overcomes limitations of traditional agricultural procedures by utilizing water resource efficiently and also reducing labour cost. As a result, the proposed system helps in water conservation to a great extent and also reduces soil erosion as only the required fertilizers are injected via the drip system. The paper also includes the implementation and results of surface drip irrigation and sub-surface drip irrigation are implemented in maize and sugarcane field respectively.

Keywords— *Irrigation System, WSN, Crop Selection.*

I. INTRODUCTION

Innovations are developing quickly with a blast in all areas. One such part is farming, where the mix of IOT gadgets, Image handling, Cloud processing and Google help gains a superior ground in a productive and powerful manner. The components of this joined innovation make things Possible by whenever anyplace in this world. With the consistent development in innovation today, the correspondences between individuals are decreasing while people are getting progressively associated with their gadgets. The Internet of Things is regularly eluded as Internet of Everything or the Internet of Intelligent Objects. A portion of the application spaces of IOT are in day by day life as advanced cells and control of home equipment's, and so on in transportation and portability, in workplace and furthermore in different areas, for example, social insurance, military, brilliant condition, observing and so forth. The significance of IOT is constantly expanding because of the development in fields like distributed computing, portable innovation and information examination. The couple of fundamental conventions utilized in the field of IOT are HTTP, MQTT, XMPP (Extensible Messaging and Preference Protocol), DDS, and AMQP (Advanced Messaging Queuing HTTP Stands for Hyper Text Transfer Protocol. Information must be moved in a tied down manner from versatile application to the cloud and HTTP will be utilized for this reason. At the point when Web administrations use REST (Representational State Transfer) engineering, they are eluded as RESTful APIs (Application Programming Interfaces). REST helps in decreasing vitality utilization and correspondence idleness. The REST web administration can be changed over to items to make it simple for control of web administration into synthesis. They use HTTP to convey the web server. Illustrative state move (Restful) frameworks more often than not convey over Hypertext Transfer Protocol (HTTP) utilizing GET, POST, and PUT, DELETE strategies which the internet browsers use to recover the website pages and send information to the remote servers. REST frameworks interface with web assets that can be identified by Uniform Resource Identifiers (URIs).

II. RELATED WORK

The results from paper [1] states that The controller exhibits the amount of hours it should work and different events it should water the field and the length between each cycle, ensuing to picking these parameters the status of the motor is to be picked. IOT based astute developing structure can finish up being incredibly useful for agriculturists since over and besides less water system isn't significant for creating. Edge respects for climatic conditions like stickiness,

temperature, soaked quality can be settled in light of the organic states of that specific area. This structure makes water system arrangement in light of the recognized consistent information from field and information from the air store. This structure can prescribe agriculturist whether, is there a need for water system.

[2]. The including highlights of this undertaking joins sharp GPS based remote controlled robot to perform tries like weeding, showering, sponginess recognizing, feathered creature and creature startling, keeping caution, and so forth. Moreover it wires marvellous water system with sharp control and insightful major organization in context on accurate nonstop field information. Thirdly, it is an astonishing dispersal center association which joins temperature support, stickiness upkeep and burglary territory in the stockroom. Controlling of these errands will be through any remote stunning gadget or PC related with Internet and the activities will be performed by interfacing sensors, Wi-Fi or ZigBee modules, camera and actuators with more diminutive scale controller and raspberry pi .

[3] This undertaking has attempted to demonstrate a profitable astute property framework. It has joined mechanization into different bits of the living arrangement. Another game plan for creature confine districts is advanced to overhaul the living states of subdued animals, and moreover decay physical work. It combines an automated light, temperature, wetness and sprinkler framework. The sponginess and wetness control parts ensure the creatures are satisfying in the fenced in domains they are kept in, by changing the settings as shown by fundamental. This will accomplish settlement, vitality feasibility, and quality and flourishing advantages.

[4] For future upgrades it might be refreshed by structure up this framework for colossal regions of spot where there is land. Besides the structure can be made to check the possibility of the earth and the headway of gather in soil. The sensors and microcontroller are suitably interfaced and remote correspondence is developed between different focuses. All observations and test tests show that this undertaking is an entire reaction for field exercises and water structure issues. Utilization of such a structure in the field can improve the yield of the harvests and general age.

[5] The framework joins a custom sensor plan for control productivity, cost plentifulness, shameful areas, and besides adaptability end settlement. In future there are a few assignments that ought to be done and would build up the framework to a more make state. The framework might be besides associated for outside use.

[6] 'Web of Things' is far and wide castoff in relating gadgets and get-together encounters. This development watching structure fills in as a solid and convincing framework and restorative move can be made. The made framework is dynamically ground-breaking and beneficial for agriculturists. It gives the data about the temperature, stickiness of the air in nation field through MMS to the rancher, on the off chance that it aftermath from immaculate range. The utilization of such structure in the field can prompt the accumulate of the harvests and by and large creation

[7] The computerized water structure framework has been outlined and executed in this paper. The structure made is significant and works in financially savvy way. It diminishes the water utilization to a continuously obvious degree. It needs insignificant upkeep. The power utilization has been diminished explicitly. The framework can be utilized as a bit of green houses. The System is incredibly helpful in locales where water need is a basic issue. The modify capability increments and the wastage of harvests is particularly lessened utilizing this water structure framework. The made structure is progressively useful and gives continuously utilitarian outcome

[8] The paper talked about the improvement of a structure that could address these issues. It is like way examined the course of action necessities and the system on the best way to deal with affiliation the structure with quickly accessible contraptions. The awe inspiring water structure controller was appeared to have the point of confinement of remote relationship of programming. This point of confinement will give a steady system to make updates to the structure without annoying the end client. Programming has been made and traded to the controller for manual use. The subsequent stage will be further building up the thing's accommodation and begin handling information putting away moreover, examination for robotization purposes. With the improvement of progression, agrarian field snatched importance in limiting the human power. In that manner IOT and Image managing progression has been utilized to see the plant diseases.

[9] In this Paper the general water system condition is engineered by expanded eagerness for higher plant benefit, poor execution and decreased accessibility of water for agribusiness. Regardless, our course of action will build the execution of plant field and keeping up the field keeping from infirmities.

[10] Things' is far and wide castoff in relating gadgets and get-together encounters. This development watching structure fills in as a solid and convincing framework and restorative move can be made. The made framework is dynamically ground-breaking and beneficial for agriculturists. It gives the data about the temperature, stickiness of the air in nation field through MMS to the

rancher, on the off chance that it aftermath from immaculate range. The utilization of such structure in the field can prompt the accumulate of the harvests and by and large creation.

III. METHODOLOGY

The block diagram of the Smart irrigation and fertigation system is as shown in the Fig.1 The meaning and functionality in short w.r.t. block diagram is as follows:

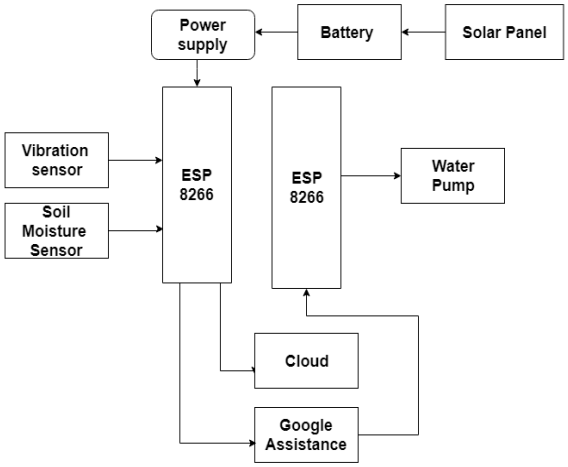

Fig.1. Proposed System

1) **Sensor for soil moisture**: The soil moisture sensor basically used to measure the water content present in the soil. According to that the water is supplied to the crop area. The sensor which is used here is made up of the two probes and variable resistors. The resistance between these two points is further represented as the electrical voltage.

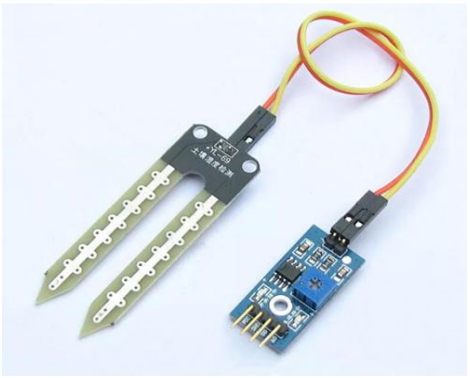

Fig.2. Sensor for soil moisture

2) **Vibration sensor**: It is type of sensor which uses the piezoelectric effect and measure the respective changes in terms of temperature, strain, or force, pressure, acceleration, after measuring it convert the terms into an electricalenergy.

Fig.3. Vibration Sensor

3**) Pumps:** By using 19 watt pump of submersible motor. Which is used to low the voltage fully submersible motor having no noise, it is of small size with no maintenance. The sensors are placed into the fields which is used collect the data from the atmosphere and collected data will send to the controller. After which the processing has been done, if the value is above the threshold value then the pump will be 0 and if it is below the threshold value then it will be started feeding the water to the area.

Fig.4. Pump

4) **Node3 MCU**: It provides ability to embed Wi-Fi capabilities within other systems, or to the function as a standalone application, with the lowest cost, with minimum space. And the biggest advantage is, it is responsible for monitoring the field. Individual soil moisture sensors are located for different plants to give the desire amount of water to the crops.

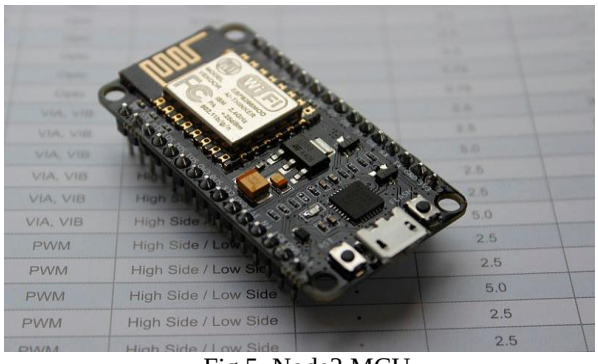

Fig.5. Node3 MCU

5) **WSN**: It's used for the controlling mechanism, it made up of sensors for monitoring as well as recording the physical conditions of the environment and it is used for organizing the collection of data at a central location. WSNs is specially measure the environmental changes like temperature, sound, pollution levels, humidity, wind, and so on.

6) **Email**: To start the irrigation system we are sending an email to a defined account. ThinkSpeak server is polling for emails in this defined email account. We are using Gmail account here with subject line PUMP ON or PUMP OFF to ON or OFF the pump respectively.

Required Software:

Cloud server: It is shared pools of configurable computer system resources and higher-level services that can be rapidly provisioned with minimum effort of management, often over the Internet. Cloud computing based on the principle of sharing of resources to achieve coherence and economies of scale, which is very similar to a public utility. Third-party clouds enable organizations to focus on their core businesses instead of expending resources on computer infrastructure and maintenance. It is note that cloud computing allows user to avoid or minimize IT infrastructure costs. It also claim that cloud computing allows the enterprises to get their applications up and running faster than before, with improved manageability and less maintenance, and that it enables IT teams to more rapidly adjust resources to meet functuating and unpredictable demand.

ThinkSpeak server is an open data platform and API for the Internet of Things that enables us to collect the data later on save it and analyze it too with visualize, and act on data from sensors.

Arduino: It is an integrated development environment **(IDE)** is a cross- application platform (for Windows, macOS, Linux) that is written in the programming language called Java. It is used for writing along with uploading the desired programs to Arduino boards which is very compatible, also with the help of 3rd party cores, other vendor development boards. The source code which is used for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C along with C++ using special rules for coding structure. It also supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, which are for starting the sketch and the very important main program loop, that are compiled and linked with a program stub *main()* into the executable cyclic program which will be excitable with the GNU tool chain, also included with the IDE distribution.

Complete setup of proposed system:

The proposed architecture is built with WSN's comprising of several sensor network nodes, Google assistance and Solar panel. Each node has sensing unit processing unit, communication unit and power unit.

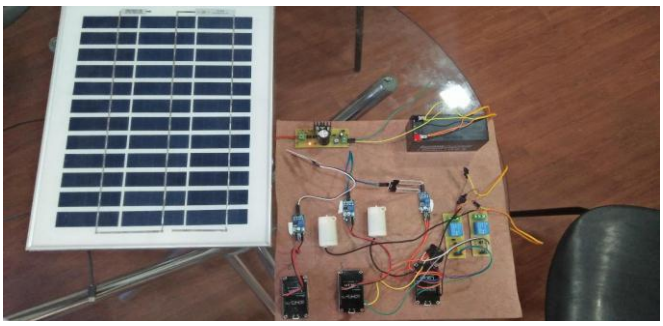

Fig.6. Hardware Model

Flow Chart:

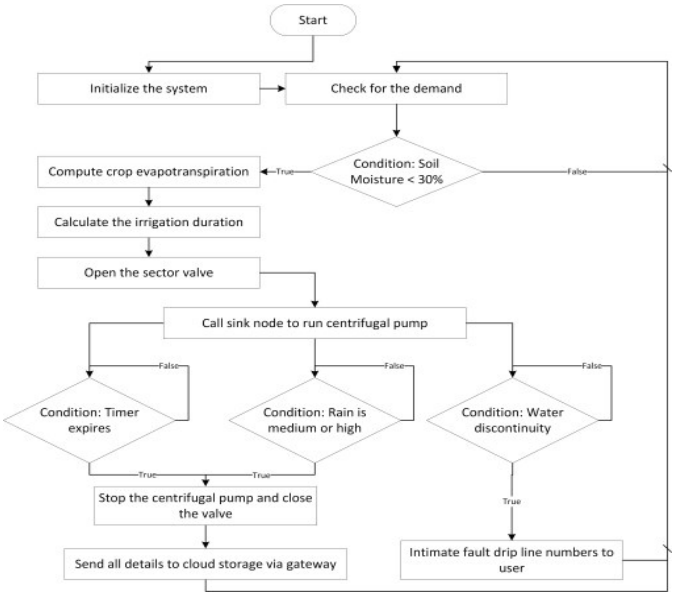

Fig.7. Flow Chart

There are four major functionalists which has been carried out by end nodes, the functionality include estimation of needed water for the crop, calculation of irrigation period, detection of water discontinuity and monitoring the residual energy of the battery. Five dc motor are used in the end sink nodes for the control of irrigation valve, centrifugal pump. Global gateway valve and fertilizer injector valve. It calculates the following things:

Estimation of water crop need:

Water continuity detection and intimation system:

Battery charge determination and intimation system:

Solar panels can be used as an alternative source for power management. But, Solar panels have its own demerits. Hence the entire scheduled irrigation and fertigation system will fail to work. To avoid this situation, the proposed system uses a 12V DC voltage sensor to read the residual energy of the

battery. The proposed system uses an alert message to notify and intimate the farmer to charge or change the battery when it detects 50.

IV. RESULTS AND DISCUSSION

Fertigation scheduling for sugarcane and Maize:
For sugarcane and maize, the quantity of nitrogen, phosphorus pentoxide and potassium in grams, total fertilizers in grams, and quantity of fertilizers with water in litters, duration of fertigation injector valve in minutes during the corresponding phases.

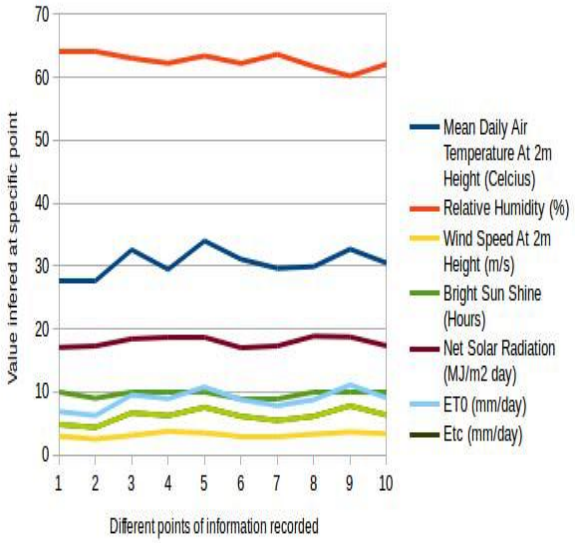

Fig.8. Fertigation Schedule for Sugarcane, Maize

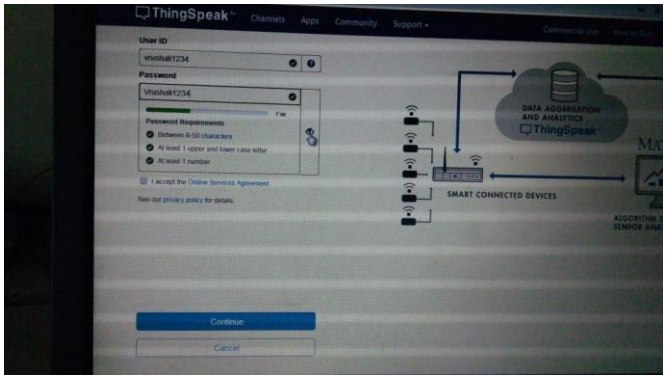

Fig.9. Account initialization on ThingSpeak

After examine the sensors values from nodes the notifications send with the form of graphical method by using Thingspeak as shown in fig.
After every 15min a new data has been send to ThingSpeak.

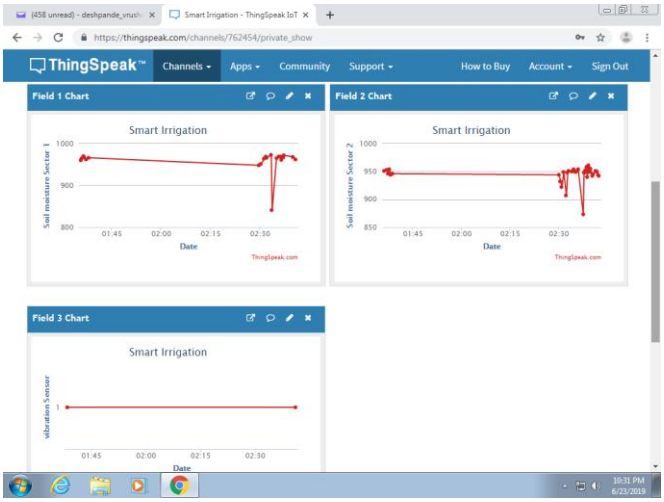

Fig.10. Graphical representation of fertigation field

V. CONCLUSION AND FUTURE SCOPE

An attractive user interface with the most efficient way of controlling the irrigation system. It gives the idea to monitor the soil moisture content and temperature in a farming area and the user can control watering system using Android device provided with Wi-Fi facility. So, the overall implementation cost is cheap and it is affordable for a common person. Considering the present situation, we have chosen Android platform so that most of the people can get benefits. The design consists of Android App by which user can interact and send a control signal to the output of the valve which will control sensors and also monitor the environment. This system of irrigation is also helpful in the region where there is a scarcity of water and improves their sustainability. It is also adjusted according to the need of varieties of the crop to be irrigated. This work can be extended to develop a complete real-time irrigation monitoring system through Fuzzy and Neural network techniques along with buzzer system.

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