SMART IRRIGATION : IOT Based Irrigation Monitoring System

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***Abstract*—The project aims at autonomous monitoring of irrigation system in both large and small scale plantation estates with a view to eradicating the manual system which involves personal liability concerns and the ignorance of the field workers. Even sometimes the experienced people cannot assure how much fertilizers or water must be used for the maximum yield. Hence our system will monitor the temperature, humidity, moisture content of the soil and other physical factors like presence of major pollutants in air like PM2.5, PM10, CO,NOx etc. The factors and the crop yield are compared with dataset of past surveys and will try to predict is irrigation is necessary or not. With the help of this information, the rate of releasing water from pumps is decided and fed to a microcontroller system which supervises and controls the whole irrigation system. Besides, there is also provision to monitor plant growth both in longitudinally and horizontally.**

I. INTRODUCTION

Irrigation is the method in which amount of water is supplied to plants at regular intervals for agriculture is controlled by machines. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

Irrigation has other uses too. For example protecting plants from frost, suppressing the growth of weed in grain fields and preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rainfed or dryland farming.

Irrigation systems are also used for suppression of dust and sewage disposal, and in mining. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area.

Irrigation has been useful in agriculture for years and is the product of many cultures. Historically, it was the basis for economies and societies across the globe, from Asia to the Southwestern United States.

SMART Irrigation is Sustainably Managed, Accountable, Responsible and Trusted irrigation. SMART irrigation aims to minimise their environmental footprint through efficient water use, and to ensure a profitable business. This allows them to reinvest in new and improved technologies which ensure sustainable and responsible irrigation over time.

New irrigation technologies and support tools are regularly being innovated in New Zealand and globally. Water use efficiency and energy use efficiency are the main focuses of these innovations. Fortunately, efficiency is linked to better quality production and improved profitability. Over the last two decades there has been a major change in the irrigation technology used in New Zealand. There has been a move from manual flood irrigation to remotely controlled spray irrigation using techniques like centre pivots, dripline and micro sprinklers.

There are three components to SMART Irrigation –

The irrigation system can apply water efficiently

The use of water is justified

Irrigators can provide proof of the above and are held responsible for their actions

India is an agro-based country and now-a-days the small fields and farms are being merged with the large plantation farms.Due to the increase of 8% of foreign direct investment(FDI) in agricultural sphere,more and more farms are globalised.The multi-national companies cannot bear the loss due to the farmers(who are employed as field labourers) by means of excessive use of fertilizers and pesticides.The system will assist to implement optimal usage of man-power and endeavour to reduce the burgeoning expenditure.Since,the whole system will be integrated with a central server and will have mobile and web-app based user interfaces,the corporate supervisors can control the system from their own work-desk in offices.There will be just one-time investment for the purchase and installation of the system in the farm leading to a long term benefit.The increase in yield will also benefit the consumers as the price of basic food materials will decelerate with the supply hike as a consequence of which the inflation in field of daily commodities may decrease.

Keywords : Smart Irrigation, Agriculture, IOT, Sensor, Motor, Transmitter, Receiver.

II. RELATED WORK

Technology is improving every minute. Even though Irrigation ensures maximum crop yields overall, it might cause wastage of water resources overall. Let us introduce some of the systems proposed to improve irrigation process and their advantages and disadvantages.

In 1 focuses on optimization of water usage and shows that this technique requires 10% of the water needed. This system starts irrigation when soil moisture values below a certain value or when the soil temperature value exceeds a certain value. This system also provides fixed duration irrigation by switching manually and irrigation at a particular date and time exactly through a web application. Date and time details are downloaded to the end nodes sensing unit, whereas sensor values and irrigation results are uploaded to a web application using the GPRS. Irrigation also depends on lots of other parameters.That's one of the disadvantages of this system.

In 2 focuses on automated valve control and a manual valve control using wireless sensor networks. All the nodes send the soil moisture values to the base station for every 16 minutes. Based on the moisture value commands are sent to the node containing valve actuator to open and close the valves. The node containing valve actuator is equipped with boost regulator for the relay operation. All these operations are loaded to the web interface. Through the web interface, the user can get valve gets opened and closed. The advantages of this system include by means of web interface the user can see the irrigation details and manually do time based irrigation and schedule based irrigation irrespective of their location. The major issues with this system include not considering air humidity, wind speed and bright sunshine values truncates the irrigation efficiency .

This process 3 is focuses on automatic irrigation based in greenhouses using wireless sensor and actuator networks. Based on the knowledge of the plant growth and environmental parameters, a decision will be made for irrigation. This system uses machine learning process to enhance plant state diagnosis. Machine learning totally depends on logging data and it is used to create rules for for irrigation threshold. To derive the irrigation rule, this system uses rule editor tool. This tool also provides the visualization of measured constraints and evaluated states. Quality indicators are used for handling the uncertainty of data. The advantages of this system includes fast configuration of sensor nodes with Tiny OS, integration of plant based method with soil-moisture sensor method increases the accuracy of irrigation on time and off time. The major contention with this system includes less coverage area of about 120 meters because of Xbee devices.

In 4 actually focuses on closed loop distant observing of precise irrigation by means of Citect configuration software. All the end nodes transmit soil temperature, humidity and soil moisture values to the sink node. Once the sink node received the data, it compares the received data with predefined value. Based on that, sink node sends command to open as well as to close the valve. Information like soil moisture value, soil temperature value, humidity and valve status at various time intervals are transmitted to the web server using GPRS module. The end user can remotely monitor via web interfaces. The advantages of this system include real time collection and transmission of data and conservation of water up to 25% when compared to normal irrigation systems. The major disadvantage include tapered irrigation efficiency by reason of not utilizing bright sunshine duration and wind speed values for reference evapotranspiration.

In 5 is based in dynamic automatic irrigation and pesticide avoidance using wireless sensor networks. As soon the wireless sensor nodes measures the soil moisture and soil fertility, the on stream camera compares the measured value with reference values. The valve keeps close when soil is wet and no pesticide found and gets open when soil is dry and pesticide found. When there is no need of irrigation the microcontroller will be put in sleep mode and when needed the microcontroller will turned into active mode for power consumption. The advantages of this system is improved energy efficiency using power saving modes, dynamic irrigation and pesticide avoidance. Reduced irrigation efficiency because of not considering bright sunshine duration, air temperature and wind speed values for reference evapo-transpiration are considered as the main issues with this system.

In 6 focuses on irrigation system using wireless sensor network and fuzzy logic to preserve the water resource and to improve the soil fertility. All the end node areas equipped with soil humidity sensor. The end node sends the measured soil moisture value and different crop growth information in different periods to the coordinator. All the data from the coordinator node will be transmitted to the monitoring station using RS232. The deviation of soil moisture value and the time at which the deviation occurs are fed as input to the fuzzy logic controller. From that, opening and closing of the irrigation valve will be computed.The main issue with this system includes fuzzy logic inconsistency and lesser bandwidth coverage forasmuch as Xbee is confined to 120 meters.

In 7 focuses on the automated irrigation system to ensure lower cost and higher power efficiency. The Wireless Sensing Unit (WSU) is built with humidity sensor and soil temperature sensor. Once the WSU reads the soil temperature and humidity, it forwards those values to Wireless Interface Unit (WIU). Then WIU actuates the solenoid valve for the irrigation process based on the threshold based algorithm. All the irrigation details will be intimated via Short Message Service (SMS) and also forwarded as an email to the farmer using General Packet Radio Service (GPRS) module. The advantage of this system includes lower cost and higher power efficiency. The main issues with this system are the signal quality of the wireless sensing unit differs time by time due to soil moisture dynamics and other environmental parameters like sunshine duration, wind speed have not been used for the irrigation decision which significantly affects the irrigation efficiency.

III. PROPOSED SYSTEM

The system can be operated in two modes-i)manual and ii)autonomous. The rate of irrigation, physical factors etc are continuously uploaded in the server. The manual mode gives option to select the rate of releasing water by pumps, duration of irrigation etc .In the first phase the autonomous mode decides the rate of irrigation according to the present physical parameters by the analysis of previous standard surveys uploaded initially in server. The next phase of automation will recognize the ideal rate of irrigation by using machine learning where the physical factors, rate of irrigation and the rate of growth in the first phase are used as training data. The pumps can also be controlled from a distant place via web based apps or mobile apps. The product will be like a thin slab having all the sensors embedded on it.

The product possesses a vertical track along which an ultrasonic sensor traverses to and from to measure the longitudinal plant growth. Another sonar moves in a horizontal track in to map the distance between the crops(in a particular plot or area) and the product itself to monitor the secondary growth.

When the implementation of fertilizers and pesticides is executed the system administrator will have the option to switch on to a special mode where the whole system becomes dedicated in supervising the change in moisture content ,acidity of the soil and the rate of photosynthesis and transpiration in a more precise way for studying how the plants react immediately to the fertilizers. It also observes how the Air Quality Index(AQI) is changing for the application of fertilizers.

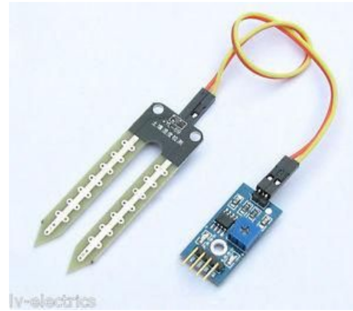
The project has four fields in technical sphere:-

1. Sensors:-

A. Temperature and humidity sensor DHT11 will measure the ambient atmospheric temperature and humidity. There is a control unit in DHT11. The output of the control unit is used to control the irrigation system by switching it on and off depending on the soil moisture contents. If the moisture value obtained is less than the pre set value then the motor will be automatically turned ON. The change in moisture is proportional to the amount of current flowing through the soil.

1. DHT11 Temperature Humidity Sensor

B. Hygrometer sensor measures the soil moisture content



2. Hygroometer sensor

C. PH meter sensor calculates the acidity of the soil

D. MQ135,MQ131,MQ2,MQ 9 sensors are used to measure the pollutants in air to evaluate AQI.

E. Ultrasonic sensors are used for pest control and also to monitor the plant growth.

F. Water level indicators are used to fill the field with water upto the required level.

2. MCUs and wireless communication modules:-

A. MCU plays the vital role in making judgements and taking vital decision and is the main apparatus for interfacing the sensors and connecting to network.

B. Wifi-module is used to upload the sensor data to web-cloud.

C. GSM module is used to control the pump.

3. Apps and dedicated web server and APIs:-These will be required to analyse the data and develop various GUIs.

4.Miscellaneous :- DC geared motors will be used to control the movement of ultrasonic sensors.Stepper motors are used to move the water level indicator sensor to the required height.

3. DC Geared Motor

The device is divided into two parts one the transmitter and other is the receiver. The transmitter part is attached with sensors is placed in the field to detect various parameters like temperature , humidity etc.The transmitter portion senses the parameters from the field through its sensors and sends it to the other part that is the receiver .The receiver portion in turn sends it to the server through the GSM Module that is attached with it.The server is where centrally all the data related to the various parameters that is sensed from the field is saved. Water pumps is placed at various portions of the field that supply water in a concerned area if required so as a result of analysis on the various data of various parameters that is saved in the central server at various time from the field conditions.Water pumps operate through the transmitter portion that sends commands for its operation.The data that is saved in the server is taken into consideration to analyze the field condition and predict if irrigation is necessary or not.

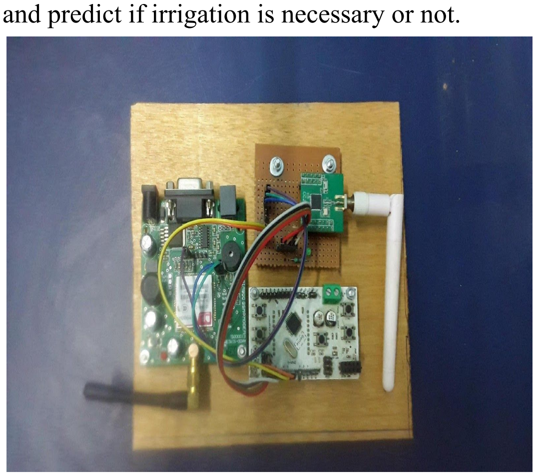


Fig 3 – Picture of the Receiver Module of the Smart Device

Fig 4 – Picture of the Transmitter Module of the Smart Device

Data Set Collected from the Central Server

Inputs from Your Hub:

logout

ID	DATA	Temperature	Humidity	Current Consumed
100	2017-03-24 10:56:18	409	206	0
99	2017-03-24 10:55:42	409	206	0
98	2017-03-24 10:55:06	409	206	0
97	2017-03-24 10:53:11	409	206	0
96	2017-03-24 10:52:05	409	206	0
95	2017-03-24 10:51:34	409	206	0

VI. CONCLUSION

Agriculture is a field that still lacks the mass innovation and aplications based o n modern techniques. Our proposal of smart irrgation will make optimized use of sousourses and solve the problem of water shortage. The data is stored in the server. Based on the conditions, data would be retrieved. So that, the system can adjust itself according to that.

VII. ACKNOWLEDGEMENT:

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