ILANJI-Automated Irrigation System

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Abstract

The automated system enables to find an efficient way of irrigation control mechanism for a large farm based on the crop variety and other primary factors. While each crop variety requires a different amount of irrigation at a regular interval of time, to make it still more efficient, additional factors are put under the consideration for irrigation to take place. These factors are moisture content of the soil, area of each plot and weather forecast. These data sets are processed using machine learning model, which provides a processed prioritized list of plots with their keys for irrigation. While these data inputs are used to process the irrigation requirement, the farmers are eased with an interactive UI in their android mobile. The UI provides a clear view of the plots and the irrigation level with additional data under the hands of the farmer. On the other hand, on the farm, the automated irrigation is accessed by controlled solenoid valves which work on the basis of a pre-defined operation.

Keywords: Agriculture, Irrigation, Water, Moisture

1 INTRODUCTION

Being one of the key natural elements, water has been used on the extreme potential and now we are under the circumstance to have a control on its usage and about the usage of water in farming, we introduce the concept of irrigation, farming is not in the state of how it was used to be. Manpower has been under crisis for several years specifically for farming. Hence, automation has been a mandatory requirement for the sustainability of agriculture for the future. In agriculture and irrigation, the primary drawbacks we would be facing are water availability and manpower. Considering these circumstances drip irrigation would be the optimal solution.

Current proposals should save these essential water resources for the future generations, by using drip irrigation optimal utilisation of them can be ensured and the automated system is trained to suit the needs of the soil with the support of the sensor inputs(weather API, moisture, pressure sensor) prevent waterlogging and desertification keeping the texture of the soil intact to allow consequent good yields.

Automation allows flexible labour since there is no need for constant monitoring, supporting the farmers, escape from the expensive labour, which can always be prone to errors. Agriculture is the backbone of Indian Economy has lost its worth among youth due to irksome nature of it and lack of technical research on the subject. Our project targets to eradicate constant monitoring of the plot all through the productive season reducing the labour demands and cost of labour.

Drip irrigation

In recent times, the most common form of irrigation used in the agricultural sector is drip irrigation. Being one of the most efficient ways, it delivers the water directly near the roots of the crop which reduces the water consumption and also provides a way to control the water regulation with the use of gate valves. [1]

1.1 NECESSITY OF AUTOMATED IRRIGATION

A call for automated irrigation has arrived with the decline of the rural population which has resulted in scarcity of manpower. The lower gains in farming are outweighed by the cost of labour which has seen a major rise as jobs have been seasonal and the payoffs are not ample for them to make the ends meet. Automated irrigation systems are designed to work under high precision which would drastically reduce the water wastage and pacify the crop growth. Human minds tend to perform errors irrespective of the experience they have in a field, which paves way for automation.

1.2 SOFTWARE AND HARDWARE PLATFORM USED

1.2.1 Hardware used

Wireless moisture sensor, Wi-fi Wireless Transceiver Module, Repeater, Arduino, PIC controller, Water pump, Solenoid valve, Pressure sensor.

1.2.2 Software used

Java script platform, TensorFlow, AWS S3(Cloud platform), Android Visual Studio.

1.3 MAJOR SCALE USAGE

The proposed model is not limited to confined spaces [like a greenhouse, rooftop irrigation], but can be implemented on farmlands that vary in shape and area. This concept is fulfilled by the use of map creation feature under google maps, which enables us to create a customizable map plot for each farmland. Apart from separating each farmland, we need to separate each and every plot on the farm based on the way each gate valve irrigates the individual plots. Map customization can be done to any shaped plot which can be a major advantage for the farmers that can be used in a large scale covering every corner.

2 BASIC CONCEPTS/ TECHNOLOGY USED

2.1 Moisture sensor

The moisture content present in the soil will be a major affecting factor for the growth of crops. A wireless moisture sensor will be installed in each plot that would be providing a raw data form of the moisture content of respective plots for a regular time period. Individual wireless moisture sensors will be connected to a common router using repeaters placed at necessary ranges. The collected data sets will be stored in the cloud platform which will be used by the main controlling unit (MCU).[4]

2.2 Pressure sensor

Pressure sensors are required to monitor the pressure of the water flow inside the pipes, as, in case of direct blockage of the gate valve from the primary source through the water pump, it could lead to the bursting of pipes at any random place and lad to a cumbersome process. When we use these sensors, the abrupt change in the pressure could be monitored at any point of the system. To avoid the damage to the pipe system, the MCU will look after that at least one of the gate valves is left open at any cost when the pump is switched on.

2.3 Solenoid valve

We prefer solenoid valves over other types because a direct electric input is enough to create an electromagnetic field which opens the valve and facilitates the irrigation. The absence of the electric current retains the valve to its closed state.

2.4 Machine learning

Apart from the hardware technologies, the software part plays a key role in the system. The raw data sets obtained from the above-mentioned sensors are fed into the MCU and using the concept of machine learning, we would train our model to process the data given to it and provide an output data of a prioritized list of the plots with their identity numbers.[2] This output data is used by the MCU to regulate the irrigation system of the entire farm by controlling the gate valves. The model would be trained in such a way that, not all the factors would be controlling the output data in the same weighted manner. Like, when we consider a case in which, we could expect rain in 3 days, but the moisture content is really bad in the soil, the weather data would not be a major factor affecting the output, since the moisture content has to be regained since the crop could not withstand days without water and thus irrigation would be facilitated at the very first cause.[3]

2.5 Cloud storage

The data feed on the moisture sensors placed in the plots is directly fed into the cloud using the Wi-Fi module which is connected to the MCU. These data sets are then used by the ML model, along with the other input data sets to produce the priority list. Additionally, the database of the moisture content data of each plot can be accessed by the user at any time to get an overview of the irrigation status.[6]

2.6 Gate valve control mechanism

When compared to previously existing technologies of the automated irrigation system, this stands a place apart from all other in the gate valve controlling mechanism. To support this mechanism the processes of the MCU along with the data from the pressure sensors are used. The gate valves are controlled in a way that the pressure inside the pipes is maintained to the near stable condition the entire time. To achieve this, a pattern is used to be followed, so that, the valve to the plot that has to be irrigated in the next moment is opened, this will result in a drop of the pressure tremendously, but when the previous plot valve is closed, the pressure will be regained. When the distance between the plots is really huge, the intermediate valves are also considered in the process. But when we visualize this in the built UI, its represented in a simpler way, like, a gate valve for each plot alone, the intermediate valves are hidden to the user.[8]

3 STUDY OF SIMILAR PROJECTS OR REVIEWS

Based on the study of other similar papers and projects, the ILANJI system stands apart from then is a distinct way in several cases. Automation for huge farms with respect to each plot and pre-existing gate valves along with some self-learning machine learning technology which would learn on its own as years pass by and get more efficient with usage. While other similar projects also exist to provide similar mechanism, they tend to shorten their vision to shorter areas like pre-defined area plots of greenhouse or terrace farming with very few data inputs to process. As the data inputs are increased the efficiency and the accuracy of the model increases simultaneously. Based on all these factors we could provide several advantages like:

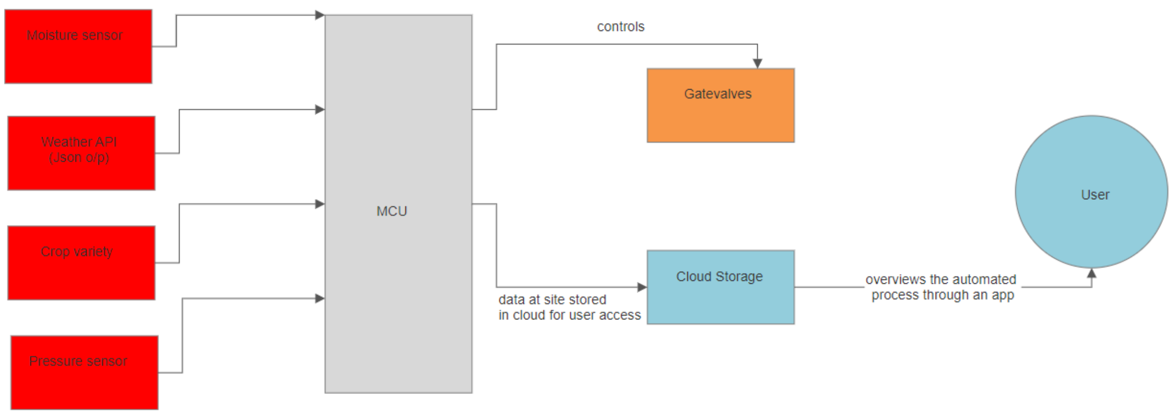
- More reliable
- Quicker adaptability
- Can be used for any sized farm
- More water is conserved
- Energy efficient
- Reduces fungal growth in the plot
- Reduces growth of weeds in the plot
- Scheduling based on moisture content
- Easy data retrieval as it is stored in the cloud
- Better Data security

Even with so much of working and insight knowledge used in the project, still a few things could not be simplified to a more efficient way, thus, a few future enhancements that can be brought to the system are:

- Depends on the range, connectivity and accuracy of the sensors
- Repeaters might be required as the field size increases

4 PROPOSED MODEL

The scenario requires the action of these blocks to implement efficient irrigating automation. The sensors (Moisture Sensor, Weather API, Crop Variety , Pressure Sensor) will be given to the Main Control Unit present on field which can control the gate valves based on the trained model and give the status to the cloud storage from where the farmer(user) can get the details of the status of the form using an application.



5 IMPLEMENTATION AND RESULTS

The proposed model can be divided into two parts, one-hardware and second – software. The hardware portion consists of devices placed in the farm such as moisture sensor, PIC, Wi-Fi Module, Repeater, and solenoid valve. The PIC controller is used to switch the motor on and off automatically according to the signal received from the Main Controlling Unit [MCU]. The controller helps prevent the dry run of the motor which could damage the motor permanently and might require a change of the entire unit especially the coil of the motor [7][8].

The MCU controls the data sent and received by the sensors and various components like valves and PIC controller. The MCU is also responsible for sending data to the user which can be accessed through the app on mobile. The MCU receives weather forecast from "www.openweathermap.org/api" on a daily basis as Jason file and decides if it has to irrigate the field or not, based on the training done through Machine Learning. This also decides if it has to water the field based on the input/data received from the moisture sensors placed around the field which sends data to MCU every 30 minutes**.** The data is analysed by the MCU and comparing it with the optimal moisture level for each plot schedules the order in which plots have to be irrigated. The MCU schedules the irrigation process based on high priority i.e. if a plot with lower priority is being irrigated presently and a plot has a higher priority, then the irrigation for the plot is stopped by closing the valve and the valve of the plot having higher priority is opened till the optimal moisture level is reached.

The valves open on receiving a signal from the MCU when the moisture content is low in any one plot and closes the valve when the moisture level is at the desired level. The MCU sees to that not more than one valve is open at a time and gives higher priority to the plot that has very low moisture content compared to other plots, thus redirecting water flow to the plot having a low moisture level.

Repeaters are placed in regular intervals in the field from the Wi-Fi module so that sensors can upload the data to the cloud which is later used by the MCU to make decisions. The MCU is connected to the Wi-Fi module with the help of which it takes decisions and sends the processed data to the user via the app. The pressure sensor placed in the main pipe regulates the pressure in the pipe. The MCU automatically switches off the motor if there is a pressure build-up in the pipes. Thus, making sure that the pipe doesn't break under the excess pressure and water is not wasted.

The software part of the model plays a major role, as it is where the main interaction between the user and the MCU takes place. The app should be installed in the mobile of the user/farmer for the above to take place. The app gets the shape of the plots in the field from the user with the help of "Google Maps" and labels each plot with a unique number and shows the present moisture level in the app corresponding to the plot number. The user has to choose the type of soil of the plot from the given options and the plant that is growing in that particular plot. Based on the given input the optimal moisture level required for each plot is set automatically and the system is activated to maintain the optimal moisture level in the different plots one plot at a time starting from the plot having very low moisture content. The app shows the user the present plot being irrigated, the status of the motor, water pressure, moisture level in each plot and the status of the system in a simple user interface. The user is alerted if there is any failure of the component through the app. The user is constantly notified about the changes the MCU is making in the field. The app keeps track of the events happening so that the user can look back if needed. The app also keeps track of the time and duration of the individual plots that had been irrigated and shows the data to the user when required.

5 CONCLUSION

The significance of Water has increased exponentially that it would be no surprise even if World War 3 arises for its sake. In this scenario conservation of water is of high importance. The farmer can just overview the sensor outputs and the machine-learned models' action on the irrigation gate valves and can intervene if some action is necessary. The actions of the model must be trained based on the sensor inputs for a season until the model is worthy enough to act on its own. The given plot is segregated into smaller units and irrigated based on a good scheduling system which prioritizes based on which plot to be irrigated is maintained and the gate valves are thereby closed or opened based on the sensor inputs of moisture etc. In future this model can be implemented on a global basis that can help in the distribution of water from the rivers to different locations situated along its bank. This Machine Learning model we produce is not aware of the availability of water and can have a future encasement of controlling the water output on every single part of the plot having the constraint of water availability.

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