Machine Learning and IoT: An Analytical Study for Agricultural Production by Controlling the Irrigation.

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Abstract

The purpose of this experiment was to test and learn how if the technology is being used in the agricultural society. The hard work, thought and practical experiments in the field has just changed the definition of method of cultivation and the result of production. This study says – there is no fixed figure to describe how much crops are getting waste or damage every year because of lack of knowledge of climatic conditions which is a major key to get success in the growth of a crop. Nobody can deny that, India is at the first position in terms of agriculture and cultivation. Millions of families in India are directly connected to this job. Agriculture is the only occupation in India which balances both the requirements of mankind and industries – all the raw materials are supplied to the industries. With time, the advancements done in this field and those farming techniques are enhancing the crop productions more profitable and hence reduce the irrigation wastages. The proposed project is a smart irrigation system which can predict the actual requirement of the crop depending upon the location and time, using Machine Learning and IoT the analysis for the soil and crop requirement can be easily done and the algorithm can predict the exact requirement what a crop need.

Humidity, temperature and moisture are three essential frameworks which determine how much water is required in any agriculture field. The project consists of sensors which are deployed in the field; they capture the information and data, send through a microprocessor (that can be Arduino or raspberry pi) and building an IoT device with the cloud.

Keyword: IoT, Machine learning, irrigation, field, crop yield.

1. Introduction:

In India, about 60-70 percent of the economy depends on agriculture, for the better productivity; there have a lot of techniques for the traditional agricultural practices. Rainfall in Bhilwara, Rajasthan is variably across the country and fluctuates by year. During summer season, the requirement of water into field gets increased. Over or either under irrigating the field can damage the field and crops and also can decrease the quality of soil, thus the condition of the field. Irrigation system is only efficient when the installation, design and field conditions are okay A substantial amount of water is lost to runoff as a consequence of improper watering methods like evaporation, wind and Reducing or eliminating this loss decreases utility bills and creates a more water efficient, healthy landscape.

As time pass, systems have been implemented towards Cognize the objective for which automated processes are the most famous as they allow information to be collected at high frequency with less labor demands. Bulk of the existing systems employ uses as Multi-processor based systems. These systems Provides a lot's of technological advantages but are bulky, unaffordable, difficult to preserve and less accepted by the technologically unartful workers in the rural scenario. The Internet of Things Devices is transforming the agriculture industry with a huge prospectus and enabling farmers to face challenge initially they faced before. First, the industry must overcome difficult to manage costs, increasing water shortages, limited availability of lands, difficult to manage In India, agriculture is the need of most of the Indians livelihood and it is one of the main sources while fulfillment the increasing expenditure & needs of a catholic population that is expected to grow up to 65% - 70% by 2050.India'scountry main supply of pecuniary gain is from agriculture Field and farmers of 2018-19's and most of the people believed in the agriculture.

In India, today agriculture is the needfulness of most of the Indians livelihood and is one of the main sources of livelihood. Agriculture also has a major influence on economy of the country. The consumption of water increases every day that may leads to the problem of water lack. Today, farmers are facing problems in the field of agriculture and the task of irrigating field is becoming quite difficult for the farmers due to lack of Rules & Regulation and negligence because sometimes they switch the motor ON and then forget to switch off which may lead to wastage of water.

Similarly, forget to operate the irrigation system, causing damage to crops. To overcome this problem, we have implemented a new technique by using raspberry pi. That way this plan is using soil moisture which is used to sensing moisture level whether the soil is dry or wet.

The moisture sensor is interface with Raspberry pi that will find the moisture level of soil and based on that it activates the water pump which compares the level of moisture content of the soil with the context value that will operate the pump through relay. Water is a very precious resource that must be properly utilized. Agriculture field is one of those areas which consume more water. Irrigation is an important process which should be done timely (means watering the crops on right time), it's a bit time-consuming process but it's the key to get good crop production.

The aim of the paper is to develop a smart irrigation system which measures the moisture of the soil and automatically turns on or off the water supply system. The amount of water irrigated to the field is crucial for the condition of a crop or field. To improve or enhance water frequency – proper schedule or strategy should be formed. So, our idea of this project puts a light on automation of irrigation system, using Raspberry Pi the system will automatically water the crops without manual intervention. A sensor to measure soil moisture was the basis for developing an irrigation system at a savings of 53% of water compared with irrigation by sprinklers in an area of 1000 m2.

2. Hardware used

2.1 Arduino Mega2560*:*

This microprocessor is designed for such projects which needs input/output lines. With larger RAM and I/O pins this microprocessor is best to such robotics projects.

2.2 RASPBERRY PI*:*

It is a low-cost microprocessor that can be plugged into the computer or a TV. It has extremely low power dissipation. It is bit comparable with both of networking options like Wired / Wireless. So, this is the best devices for the project.

2.3 Temperature And Humidity Sensor*:*

DHT22 is an inexpensive digital sensor that uses a capacitive humidity sensor – to measure the humidity and a thermistor sensor to measure the air in nearby regions.

2.4 Ph Sensor:

It an instrument or sensors which measure the pH level of the water. Finding the pH level is crucial because not all the crops are irrigated with the salty water or with the chemicals. While judging its pH level it can be clear whether it's right to use it or not. And if not, then the water can be purified.

2.4 Under Earth Moisture Sensor:

Under the earth, a Moisture Sensor is used to measure the water content (moisture) of soil. When the soil is having water shortage, the module output is at a high level; else the output is at a low level. This sensor reminds the user to water their plants and also monitors the moisture content of the soil. It has been widely used in agriculture, land irrigation, and botanical gardening.

3. Methodology

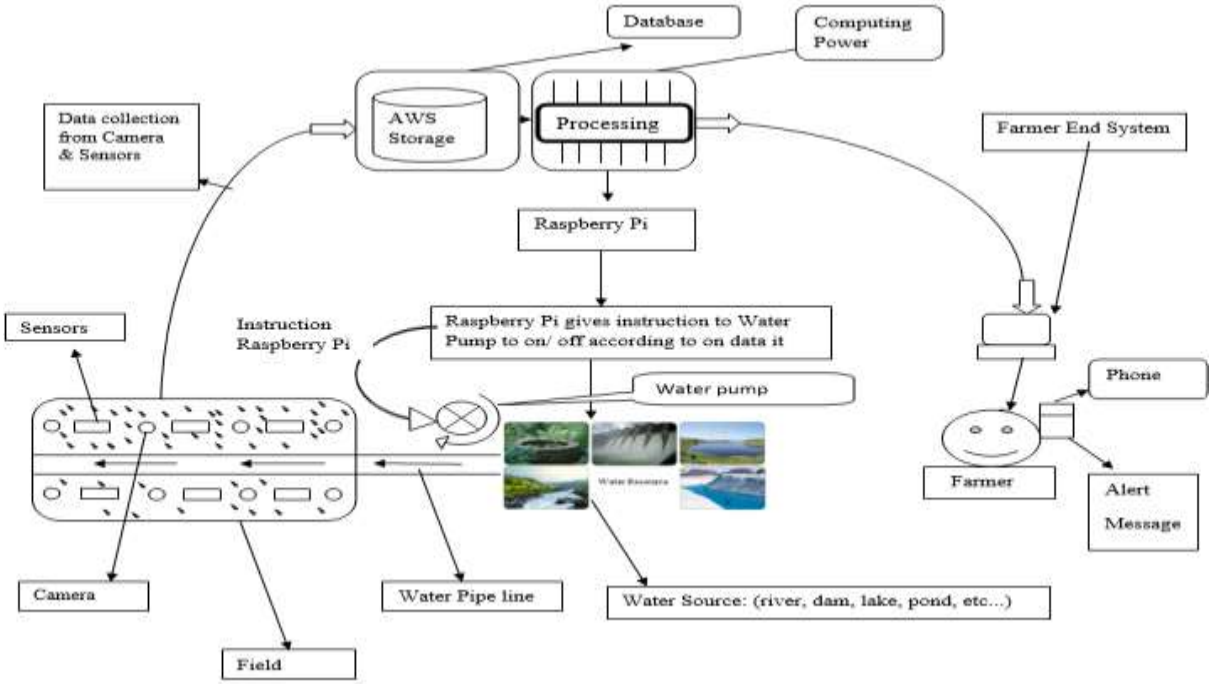

Figure 1: Working process of sensors and IoT device.

As shown in the architecture – there will be cameras and sensors placed inside the field equally covering all the areas with priority. The field is also getting covered with water pipelines and the sensors and cameras will be observing the whole day and night. The functioning of the camera is to view the condition of the crop, water level in the field, watching insects in the soil and on the crop and if anything, such is captured – the farmer will be getting the notification of it. The sensors will be capturing the activities happening in the soil and on the surface of the earth. Including the moisture of the soil, temperature of the earth, underwater happenings, soil formation and etc. The field data will be captured with the cameras and sensors present inside the field and all the data will be sent the database or to the server.

Now database is highly requisite because weather, temperature, soil, moisture is such a thing which is natural and cannot be same all the day, all the month or for the entire year or even keeps same on the same date of next year. Things got changed because the story of the nature, so when the system is getting the different data then it can actually learn live and can implement best of its predictions on future data. With all possible combinations of these natural factors within an year or few can teach a lot to the system and in few years it can be so predictive and best that it will start alerting you as prior as it can looking to the conditions.

The data will be saved in the database which can be even used as a input for other locations, because by location things are not working but by natural happening things are working. So, might be the nature combination Rajasthan had sometime – is now happening in Gujarat then what to do? No worries because the system will be learned to react and predict in different nature combinations.

After the data got saved in the server it will be accessible to all other system in the entire India. The system or the engine will be receiving live data from the server and the machine learning algorithm will be working on it. The algorithm will be having several aspects to compare the weather combinations to the field environment and will predicting what to do in such case – looking to the data happened by the farmer previously in past years when the same condition or near close condition has happened.

After the functioning of the algorithm alert messages will be sent to the farmers number – mentioning what actions to be taken or what is going to happen so farmers can be prepare priorly. Also, within this idea the

planning of irrigation can be set. When the data is getting from the field and the entire processing will be same – if the field and the crops feel empty and needs water to be full. Then the smart sensors connected to the motors will be started automatically. The fields are covered with the water pipelines which are obviously coming from a water body (now it can be a river, lake, pond, tank or etc.); so, looking to the condition of the soil and crop the motor will be started. It can be manual also; an alert message will be generated to the farmer which says – field needs water, pour it. The farmer has two options either to keep it smart so whenever water is required the motor will automatically start and stop as well or farmer can manually keep an eye on switching ON or OFF the motor. This way the fields will be watered on time and with the sufficient quantity of water – which a crop needs in a particular weather condition.

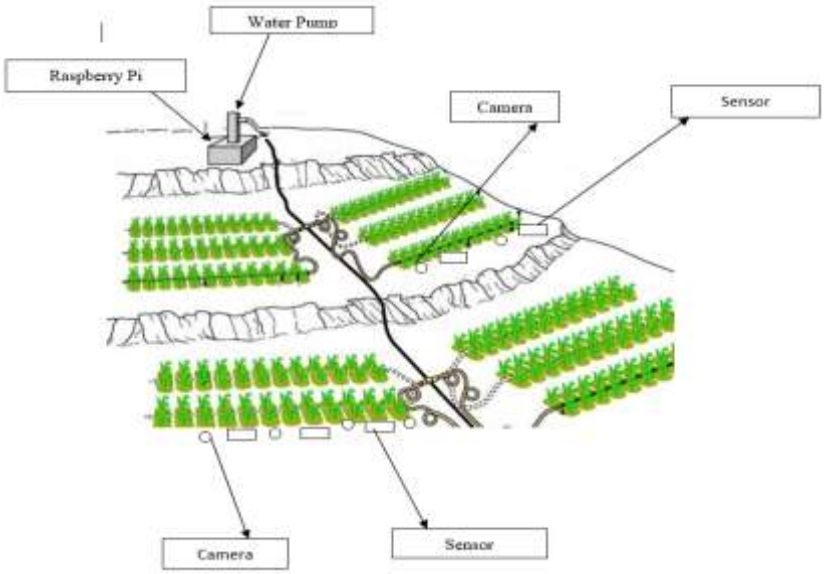

Figure 2: Irrigation process and monitoring using IoT devices

The above diagram shows the working structure of the system inside the field. The picture has been zoomed to understand how the things will work inside the field. The field is embracing with the cameras and sensors, each one of them keep a strict eye on the surface of the earth, soil, crops and water especially. An irrigation canal has been formed from the water tank or any of the present water body to the entire field. As described the above, the cameras and sensors will be sharing the raw data which will be processed by the machine learning algorithm and thus the prediction will decide what to do next? If the algorithm reaches to the decision and concludes that irrigation is requirement then there two cases which will happen. Firstly, the message will be sent to the farmer through the mobile application or via SMS; now farmer can do two things – whether he manually switch on the pump for the irrigation process or he leaves everything on the system. The system will automate the pump and thus the irrigation inside the field will be started. Pouring right amount of water to the specific crop will help farmers to get high production and save crops from getting waste.

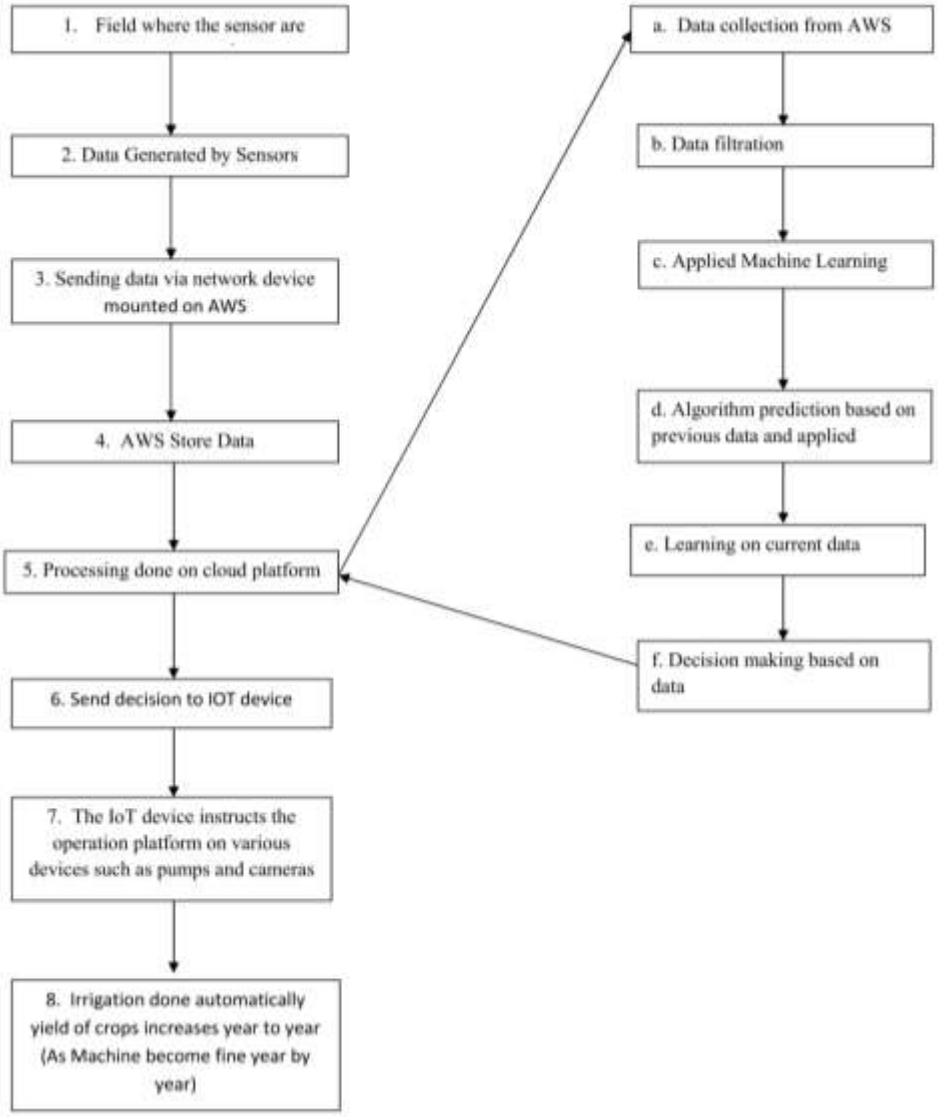

Figure 3: Data flow between the devices

The flow chart clearly explains the flow of data and flow of working in this project. This flow chart is as simple to understand by just a first view because it describes the entire project and the soul of the thought. Let's understand the meaning and importance of each step in this flow chart.

1. The very first requirement for implementing this project is obviously a field or a land. The aim of the project is to help the farmers in saving crops from natural disasters and earn a good annual income with a good production. So, the fields or the lands will be the major priority for implementing the first step of this project. Looking to the area covered by the field will be embraced with the cameras and sensors.
2. The cameras and the sensors will be collecting the data of the field from every corner of it. The sensors will be collecting the information regarding soil, moisture, weather, water level and etc. and the camera will be keenly observing the crops which will find out whether it's getting caught by any insect, animal or bird. Will also look at the lifestyle and lifecycle of a crop. When a farmer puts a seed inside the soil and pour water and embraces with sunrays, with some time it grows which is natural. Now within this project it's not necessary or mandatory for a farmer to stay every time in the field and check each crop personally by taking time. Because the camera will keep eye on each and every crop. Every step of growing the crop

will be captured and intimated to farmers till the harvest time come. Cameras will also intimate the farmers about best time to harvest looking to the weather conditions and will also tell when to save crops if the weather report says for a heavy rainfall, thunder, storm and etc.

3. The data and information collected by the collected by the sensors and cameras will be sent to the database via network devices. AWS database is being used in this project. The reason for sending the data to database is because we know that the weather condition and the condition of the crop is not going to be same every year on the same day. But yes, it can happen that the same condition may occur at some other place or it happens at the same place again. The database will be having the data of such situations and the result too – so, the engine or machine learning system can predict the right output and inform the concern farmer priorly. So, a major action can be taken before any mess happens.
4. All the data will be stored at AWS for a life time so that the data can be used by the engines at different locations of India and with millions of data the engine will perform well and the confidence of the system in result will be higher and thus, the situations can be handled from the farmers' side. Not every time the nature condition is same – for an example {the temperature of Punjab is cold, sunrays is quite heavy, weather is getting child + windy} now what to do in such case? This is what the engine will be learning from different nature and weather conditions and will predict the result with high confidence.

5. The data received at the database centre will be processed by the machine learning algorithm to find the result.

    a. For prediction algorithm data taken from AWS server which was collected by different sensors (Sensor mounted in the field).
    b. After that, collected data was filtered by used various filtration techniques. (Data filtration is a major task for Machine Learning because accuracy of the model will depend on the data.)
    c. Different Machine Learning algorithm is used for training of the model but while the compression with respect to accuracy predication algorithm better accuracy.
    d. Previous data are used for training and testing of the model after getting batter accuracy (Up to 97%).
    e. This trained model is used for taking motor decision (water recourse pump on / off).
    f. If moisture up to mark then motor pump stops by the Raspberry Pi and vice-versa (Python code is return for this purpose on Raspberry Pi).
6. Now whatever result or prediction done by the system will be sent to the device.
7. The results received to the IoT devices will be sent to the machines which are connected to the systems so that actions could be taken. As the project initiates for saving water and providing enough and sufficient amount of water to the fields, the motors or pumps are connected to the systems and they will automatically switch ON or OFF according the requirement or the instruction given the engine.
8. Irrigation task will be handled by the system and will automatically work when the field needs water and when it's not. The cameras and sensors will observe it very minutely just to check that the field shouldn't

be overloaded with the water – as it will damage the crop and soil as well and also it will destroy the field. So, both the cameras and sensors will be working together just to ensure that each part of the crops gets wet, get enough and sufficient water and even soil get the best it needs.

4. DECISION TREE ALGORITHM*:*

It is a type of supervised machine learning algorithm, where the data got split according to some certain parameters. The two main types of decision tree are – classification tree and regression tree. It basically works on level; each level has possible two outputs or more. After receiving the data from the database, there will be two nodes for the decision if the level satisfies – it will be moving to another level where again it will be having two nodes from where the correct node will be chosen. The process will go on until it reaches to the final decision with high confidence.

5. MOBILE APPLICATION*:*

The infrastructure of the application can vary looking to the comfort zone for the farmers and a basic need will be to provide a clear, clean and short data to the farmers; so, they could get the conclusion faster without getting confused. This application will serve full connectivity to all the farmers by providing data for their farms. Along with the alert messages farmers will also be getting a data graph which is basically the summary of all the details and information, with which farmers will be aware about all the climatic changes, crop requirements, irrigation details, soil and insect information and etc. A unique account will be created for each farmer in which his field information, longitude, latitude, area, and crop type will be clearly mentioned. Login id's and password will be generated for each one them. The farmers will be getting direct messages from the microprocessor and apart from automatic machine – farmers can also regulate the machines manually.

6. Results

Smart Irrigation System using IoT is very cost-effective by enhancing the techniques to intercede water resources and to Change it for good Production in the field of agriculture. This system helps the farmer by working automatically and smartly, it reduces the Working Style & Customize the Labor Cost & Time Consuming.

7. Conclusion and Future Work

Agriculture in villages plays vital role in Improving &developing the country. Agriculture depends on the Weather that's Play a very important Role for Productivity in the form of Hot, Cold & in Rainy Seasons or can say monsoons, which is not enough water source. To overcome this problem, the irrigation system is employed in the field of agriculture.

Most of the time farmers do not understand to complete all the needs of crop (like Providing Actual water during irrigation, fertilizer) or may be provided in the large amount water/ fertilizer. Impact of that, the Crop has not produce as much as it can.

This paper proposed that with the help of this process (mean with the help of IoT Devices) one could understand all the activity so that, he can save a lot of water, Lot of Fertilizer and Produced Good productivity in the field.

In future, this system would be implemented by different IoT devices to betterment result. May be the results will varies with respect implementation cost and, sensor are going to be refined with respect to noise values. By that, result will be become better.

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