Water Irrigation and Flood Prevention using IOT

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***Abstract* — India is one of the largest producers of agricultural products. Main source of India's GDP is its vast agricultural produce that accounts to 16% of the total. About 58 percent of the India's workforce is involved in agriculture. But due to variable climatic condition of the country farmers are unprepared for these harsh and inevitable conditions. The farmers don't have any effective way to deal with natural disasters such as drought and flooding which results in damaging of the crop and steep loss to the farmers. This research paper proposes a system through which we can reduce the problems of the farmers by automated smart irrigation system in drought conditions and smart suction pump which will suck out the excess water during flooding conditions. A database will be maintained for thorough analysis of amount of water irrigated in the fields, measurement of amount of rainfall, amount of water sucked during flooding and humidity level of soil in timeline manner. This database will be used for prediction of such climatic conditions and informing the farmers to take appropriate measures so that they can reduce or nullify the losses under such conditions.**

***Keywords* — Sensors, Floods, Crops, Water Irrigation System, Water Suction Pump, IoT, Database, GSM.**

I. INTRODUCTION

India is one of the largest producers of agricultural products. Main source of India's GDP is its vast agricultural produce that accounts to 16% of the total. About 58 percent of the India's workforce is involved in agriculture. India is not only the great producer but also one of the largest exporters of the agricultural products which include rice, wheat, cotton, barley, maize, mustard etc. According to the research it is observed that the 10% of the total production is exported, which makes India 7th largest exporter. As per the recent data the agricultural output of India in 2017-2018 was estimated about 279.5 million of tones. Lots of government policies and schemes have been initiated in the favors of agriculture and farming like Pradhan Mantri Fasal Bimay Yojana (PMFBY). By looking at the stats above we come to know how many agricultural products hold an importance in India's growth and development. So we need to make judicious use of the resources involved in production of crops and other agricultural produce. If we go by the data it is observed that there is a decline in agricultural produce thereby increasing the prices which is fatal for both the producers and consumers. We have different kinds of crops being grown in India, which have different requirements for nutrients, water, sunlight etc. Lack of supply of optimum amount of water, water logging, flooding of the fields and inappropriate weather conditions are the main reasons for the declination of crop production. In vast country like India, climatic condition varies from place to place and time to time. Because of this, at some places crops are destroyed due to lack of optimum water where as at other places it is destroyed due to excessive water due to rainfall, floods etc. So there is a immediate need for India to produce its agricultural products in the most efficient and productive ways through the medium of smart technologies like Smart Irrigation System which will provide the crops with required amount of water. This will not only avoid water wastage but will also provide an effective way to avoid crop destruction. A Database can also be maintained to analyze the proper requirements of water regionally and according to the crop type proving to be a great source help for farmers. An arduino based water pump will automatically be switched on(with the help of sensors) if there is lack of water as per the crop requirements and a water suction pump will get activated(using sensors) if there is excessive water due to heavy rainfall or flooding conditions.

II. EXISTING SYSTEM

Taking the case of Drought, there are many situations where the system is not smart enough to detect the extent of drought leading to less/more supply of water as per the intensity of drought. Just because there is no way to store data of drought intensity which changes invariably overtime, the crops are getting destroyed even after using the technology. The current system is not capable for the water logging or flooding conditions. The sensors only detect the amount of water required by the crop thus providing them the same. They don't consider natural disaster like flooding and water logging. Even though they will stop irrigating the fields once they detect excessive water level, they won't be able to cure it. The excess water logged due to flooding cannot be pumped out which results in damaging of the crop and the water wastage [1]. Growth and development of plant roots are directly harmed by water logging. Maladjustment of water like excessive soil moisture can affect the physiological growth of plants and roots in a negative way. [2]There is a significant decrease in water and nutrients absorbing ability due to shortening and thickening of roots which results in the complete damage of the roots. We can also see a decline in the overall development of the plant and significant changes are observed as the root layer becomes shallow, its tip becomes brown and black, leaves color fade into the pale yellow color as the chlorophyll content in the leaves tend to decrease. When the plant continues to be under water logged stress for some period of time, its reproductive strength as well as the vegetative growth declines and it finds difficult to produce flower budding and the fruits on its branches for another few months. [3]According to the survey conducted by the Zhu et al [3], the cotton yield was reduced by 10.65%, 19.69% and 42.25% due to the 1 day, 3 days and 5 days of flooding, respectively.

III. PROPOSED SYTEM MODEL

A. Block Diagram

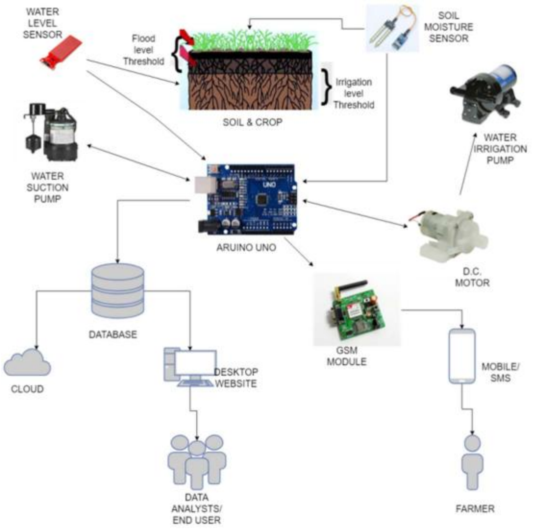


Fig. 1: Block Diagram of Proposed Methodology

B. Hardware and Sensors

1. Soil Moisture Sensor: It will detect the amount of water quantity present in the soil. The volumetric quantity of water present in the soil is measured indirectly by looking at the other properties such as neutron's interaction among themselves, dielectric constants and electrical resistance which when combined together contribute to soil moisture as a proxy. The two legged lead (immersed in the soil) and an amplifier are the two components used in it, which are connected to each other using two header pins. The amplifier which produces both analog and digital signals is connected to arduino. The output result of soil moisture content varies as it depends upon the some properties such as electrical conductivity and temperature.

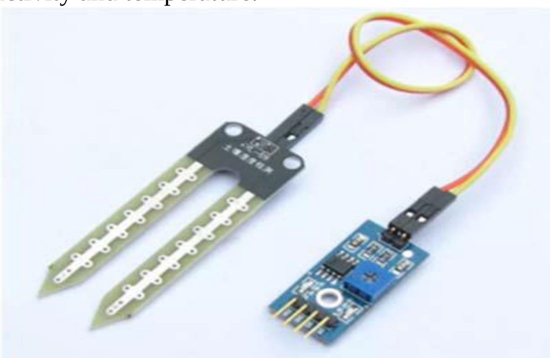


Fig. 2: Soil Moisture Sensor

2. DC Motor: DC Motor also known as direct current motor is used to convert electrical to mechanical energy [1]. We can control the speed of the motor by changing the current strength of windings or by bringing the variations in voltage supply. The motor is rotated using the positive and the negative heads which are linked to the battery. The direction of the rotation can be changed by reversing the heads.

Fig. 3: D.C. Motor

3. GSM module: GSM stands for global system for mobile communication which is used to send and receive information using mobile phones in open air [1]. This can help farmers to receive alerts even when they are far away from fields. It requires a SIM card for operation and has an antenna to receive and send SMS.

Fig. 4: GSM Module

4. ARDUINO UNO: It is the most widely used product of Arduino.cc. Electronic products are developed using Arduino.uno. It is a combination of both physical and easily programmed circuit board in addition to software (IDE). It will collect the data from all the sensors connected to it and display the data on the computer/mobile devices and that data will further be stored on cloud. It is easy to run the code and to collect data as it can be connected using USB cable and the IDE of Arduino is simpler version of C++.

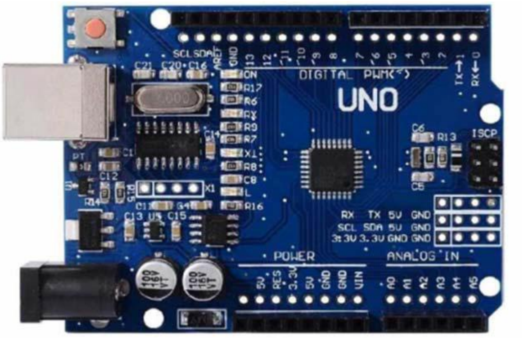


Fig. 5: Arduino Uno

5. Water Level Sensor: Water level sensors sense the rise and fall of water level. It can not only detect water level but can also detect level of fluids, and other liquids including powdered, slurry and granular fluids. Pressure can be one of the criterias to measure water level. We can set specific gravity (SG) of liquid to be used and measure the level of fluids such as urea. The properties it contains are super high quality materials, precision locking connector and automated calibration. The liquid level can also be measured using ultrasonic waves. There are 2 types of measurements. First is point which only indicates whether the water level is below or above the point and second is continuous which measures water level in a defined range and detects its presence precisely in a region.


Fig. 6: Water Level Sensor

6. Smart Water Pump: A water pump is connected to arduino using relay switch when the water level is below the required amount, it automatically switches on and turns of when the requirement is met.


Fig. 7: Water Irrigation Pump

7. Suction Pump: Sum pump are installed in the sump created in the lowest point in the ground. A threshold level is set, when the water rises above the threshold level the pump automatically activates and the excess water is pumped out until the water becomes or goes lower than the threshold value [5]. The problems of busted supply hoses and sensors that fail to stop the fill cycles are also handled by the sump pumps [5]. There are two types of sum pumps based on the structure and usage i.e. submersible, pedestal and backup pumps. These are mainly used in the areas where there are chances of excessive rainfall and flooding.

Fig. 8: Water Suction Pump

C. *Working of the System*

Looking at the drawbacks of the existing system, we need to introduce a new and refined automated irrigation system which will include the sensors and hardware such as arduino, water irrigation pump, water suction pump. The proposed system will help the farmers to not only irrigate the fields smartly with effective use of water but also it ill help to suck out excessive water which causes flooding, hence damaging the crop. The excess water will go through a purifying process and that the purified water obtained can be again used for other purposes such as household chores, industries etc. Once the water level will cross the predefined threshold limit the suction pump will automatically start sucking out the excess water and will turn off on its own when the water level will reach at a point ideal for the type of crop. This will avoid wastage of water to a great extent. A database will be maintained for the system that will keep record of all the activities such as how much water is irrigated, water required by the particular crop, times when the no water is irrigated and the amount of water sucked during the excessive rainfall or flood conditions. A data can be represented in the form of pie charts & tables. The stored data can be viewed on weekly, monthly or yearly basis on the website. And this data will be ubiquitously present to all the farmers and the agricultural data analysts across the country so that the farmers can be guided on the type of crop to be grown where and when and amount of water that need to be supplied to the crop. This whole data will be securely stored on the cloud storage like Amazon AWS, Microsoft Azure etc. Further segregation of the above parameters will be done crop's type wise.

D. Flowchart of the Model

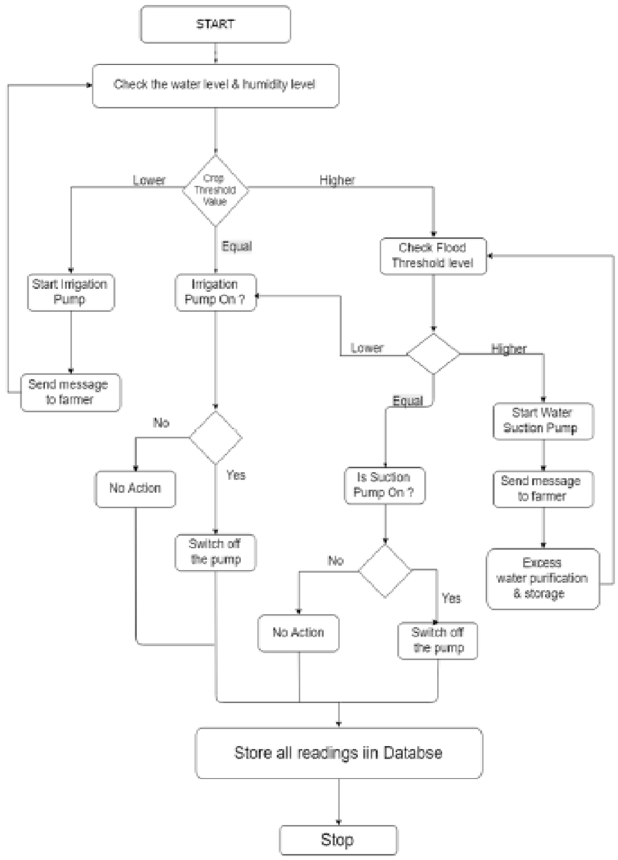


Fig. 9: Flowchart of the proposed model

IV. USER INTERFACE AND DATA ANALYTICS

The figures below depict the data collected from various fields and regions and their UI on the website from where Data Analysts can analyze data.

A. Moblie Interface

The Figure.10 below shows how the farmer will receive the alert message, when the irrigation or suction of excess water has started or stopped, through GSM module.

Fig. 10: Alert Message on phone through GSM module.

B. Web Interface

The below two figures shows the moisture level in the field during the day at various times. This figure shows the times when automatic irrigation and suction pump activates according to the preset threshold values.

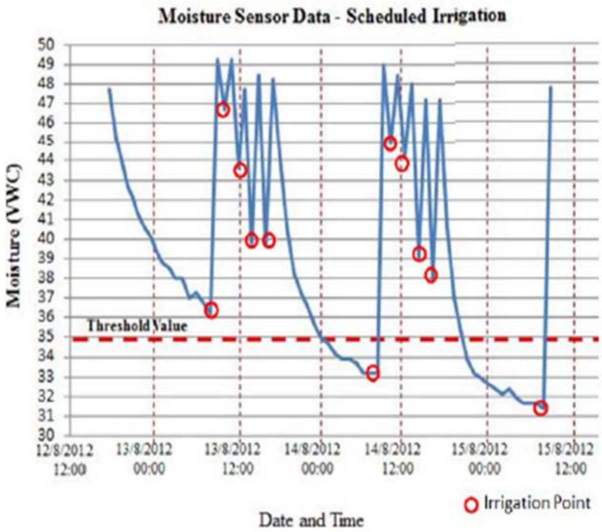


Fig. 11(a): Automatic Scheduled Irrigation Data.

The above Figure.11 (a) graphically represents at what time the moisture level sensor detected the level below threshold and started the irrigation.

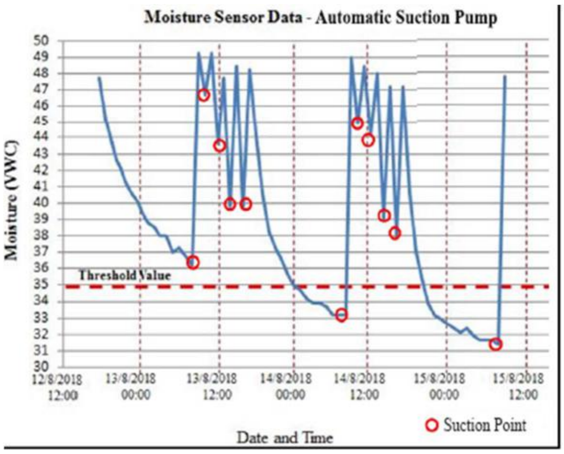
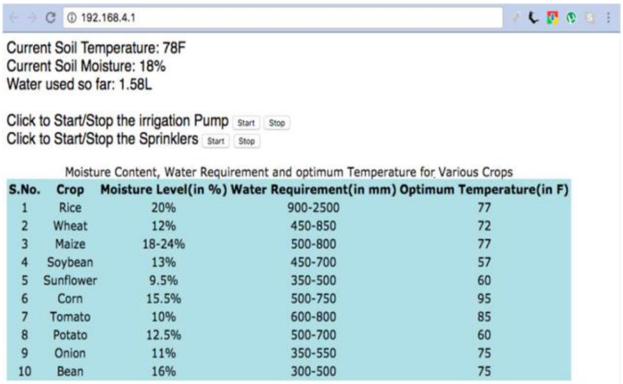


Fig. 11(b): Automatic Scheduled Suction Data.

The Figure.11 (b) graphically represents at what time the moisture level sensor detected the level above threshold flood value and started the suction.



192.168.4.1

Current Soil Temperature: 78F
Current Soil Moisture: 18%
Water used so far: 1.58L

Click to Start/Stop the irrigation Pump Start Stop
Click to Start/Stop the Sprinklers Start Stop

Moisture Content, Water Requirement and optimum Temperature for Various Crops

S.No.	Crop	Moisture Level(in %)	Water Requirement(in mm)	Optimum Temperature(in F)
1	Rice	20%	900-2500	77
2	Wheat	12%	450-850	72
3	Maize	18-24%	500-800	77
4	Soybean	13%	450-700	57
5	Sunflower	9.5%	350-500	60
6	Corn	15.5%	500-750	95
7	Tomato	10%	600-800	85
8	Potato	12.5%	500-700	60
9	Onion	11%	350-550	75
10	Bean	16%	300-500	75

Fig. 12: Crop requirements table as per different types.

The above figure contains screenshot of the table that categorizes moisture level, temperature and water requirements on the basis of type of crop and also the current details of the field conditions.

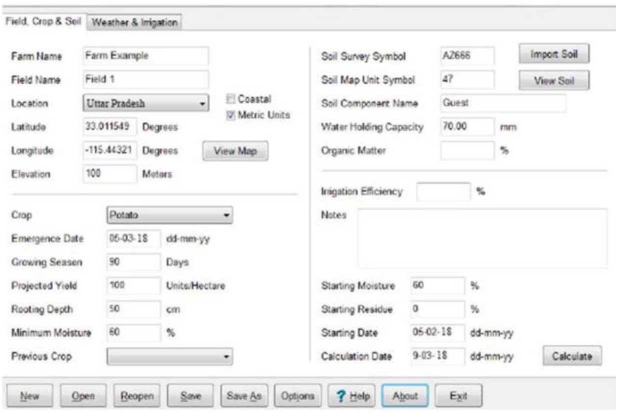


Fig. 13: Automatic Scheduled Suction Data.

The page above describes the moisture level requirements, date of emergency, soil type and components for a specific location.

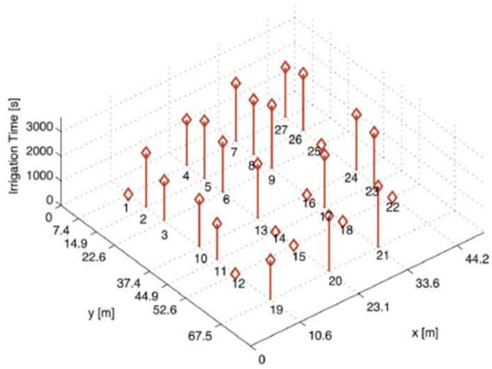


Fig. 14 (a): Water Irrigation and Suction during summers.

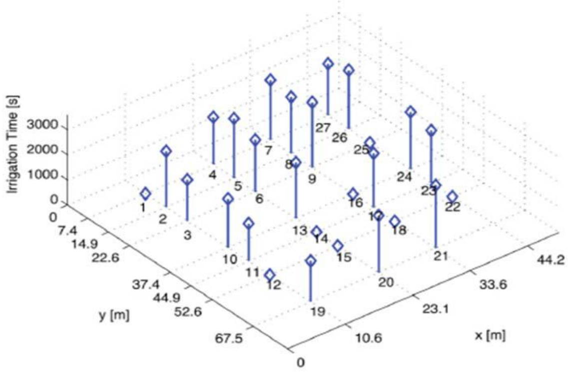


Fig. 14 (b): Water Irrigation and Suction during winters.

The two graphs above show various times of irrigation and suction times during summers and winters.

C. Data Analytics

Here analysis on the data is performed based on the irrigation and suction operations in different regions of the country and at different times.

TABLE.1: MONTHLY RAINFALL PRECIPITATION CALCULATION.

Precipitation (mm)	Mar	Aprl	Jun	Jul	Aug	Sept
50.1 -100	0.26	0.51	0.81	0.53	0.61	0.26
100.1 - 150	0	0	0.21	0.26	0.14	0.05
150.1 - 200	0	0.02	0.07	0.11	0.09	0.05
200.1 - 250	0	0	0.02	0.02	0.02	0
250.1 - 300	0	0	0.04	0.02	0	0
>300	0	0	0	0.04	0	0

The table above shows the amount of rainfall precipitated each month of rainy season i.e. from March to September.

TABLE.2: REGIONAL RAINFALL PRECIPITATION CALCULATION.

Interval (day)	Haryana	Punjab	UP
(1-3)	3.45	15.52	3.45
(4-7)	10.34	24.14	10.34
(8-10)	1.72	10.34	8.62
(11-15)	1.72	12.07	15.52
(16-20)	1.72	12.07	8.62
>=21	5.17	24.14	1.72

The table above displays the regional rainfall data in percentage according to the areas and intervals.

V. FUTURE SCOPE

This flood avoidance technique and maintenance of database will help farmers to large extent in saving their crops from flooding and water logging a natural disaster and also help them to gain knowledge on what type crop to grow where and when. But problem will arise when there will be an intervention in the database which will mislead data analysts in analyzing data, in turn the farmers won't get the accurate data. So to avoid this data in the database will be secured by introducing the concept of BLOCKCHAIN. This technology will secure the data and no one will be able to tamper with it, so accurate and correct information will reach the farmers to grow healthy crops. Further farmers can also control the irrigation pump and suction pump by just sending predefined text messages to the GSM module through which they can override the normal execution of the sensor driven pumps.

V. CONCLUSION

This flood avoidance technique and maintenance of database will help farmers to large extent in saving their crops from flooding and water logging a natural disaster and also help them to gain knowledge on what type crop to grow, where to grow and when to grow.

The main advantage that the farmers will get through the implementation of this technique is that they can prevent the damage of large amount of crops and now they won't have to worry about excessive rainfall or any other source of flooding.

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