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IOT BASED WATER CONSERVED SMART IRRIGATION SYSTEM

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ABSTRACT

The existing society is based on the traditional way of farming and needs man power for doing / conducting various activities related to the farming/agriculture. It is time consuming to give order to the worker and make them understand what they have to do at what time they have to do. people who becomes farmer due to some reason but don't know anything about farming .water drainage facility and climate change is major problem for the farmer because due to sudden change in the climate crops can be damaged and farmer has to suffer great loss , due to this kind of problems farmer has to suffer. Technology advancements have a rapid effect on every field of life, be it farming or any other field. Machine Learning has shown the promising results in irrigation through its decision making by analysing the data. Water scarcity has affected more than 100 countries in a matter of no time. People all over the world are vulnerable to its consequences in future. It is imperative to develop a control system that will detect the water wastage by analyzing necessity of, where is the need of water in farm can be the diagnosed with the help of various ML Algorithm.

so by using IOT based water conserved smart irrigation system it provides application which helps the farmer in conserving water and protecting crops from drowning in the water as climate change are keep on happening our application controls the water supply according to the weather, if there is access water in the one field or in one row of the field as sensors attached to the system helps in capturing the weather data like temperature and humidity in the air according to which water supply will be given to the farm , user can get more information regarding the farming through our application , overall , this application will be very beneficiary to all farmers as well as people who want information regarding farming.

Keywords

Automation, Microcontroller, Arduino Uno, IOT, NODE MCU , BLYNK, water conservation, Machine learning.

1. INTRODUCTION

In India , United States, China , Japan , Pakistan and many countries , outdoor water use averages more than 70 billion gallons of water each day, mainly for landscape irrigation. As much as 50% of this water is wasted due to overwatering caused by inefficiencies in traditional irrigation methods and systems. IOT based smart irrigation is the answer. Smart irrigation systems tailor watering schedules and run times automatically to meet specific landscape needs. These controllers significantly improve outdoor water use efficiencies .Unlike traditional irrigation controllers that operate on a preset programmed schedule and timers, smart irrigation controllers monitor weather, soil conditions, evaporation and plant water use to automatically adjust the watering schedule to actual conditions of the site. For example, as outdoor temperatures increase or rainfall decreases, smart irrigation controllers consider on site-specific variables, such as soil type, sprinklers' application rate, etc. to adjust the watering run times or schedules.

There are several options for smart irrigation controllers. Essentially there are two types of smart irrigation controllers:

[1] weather-based (ET) and on-site soil moisture sensors. The right solution depends on your geographic location and landscape environment. Weather-based controllers, also referred to as evapotranspiration (ET) controllers, use local weather data to adjust irrigation schedules. Evapotranspiration is the combination of evaporation from the soil surface and transpiration by plant materials. These controllers gather local weather information and make irrigation run-time adjustments so the landscape receives the appropriate amount of water.

[2] ET weather data uses four weather parameters: temperature, wind, solar radiation and humidity. It's the most accurate way to calculate landscape water needs. Soil moisture sensor-based smart irrigation controllers use one of several well-established technologies to measure soil moisture content. When buried in the root zone of turf, trees or shrubs, the sensors accurately determine the moisture level in the soil and transmit this reading to the controller. But we have tried to make our system capable of using both method for better conservation of water.

The solution is that proposed system will provide mobile application which is connected with the IOT device which collects data from the farm like moisture in the soil , temperature and humidity in the air . these factors helps in the understanding the weather and what amount of water should be supplied to the farm , if by chance access water supplied to the farm the water can be moved to the other farm or in the canal using solenoid valves which controls direction for water. Water motor gets on/off according to the moisture in the soil. The aim and objectives of our system is to digitize farming techniques upto some extend in farming . in which farmer can watch over the field that the field is getting enough water for the crops if excess water is given the system will notify the user which can help in conserving water and crop from damaging .it also helps in diverting the water flow .

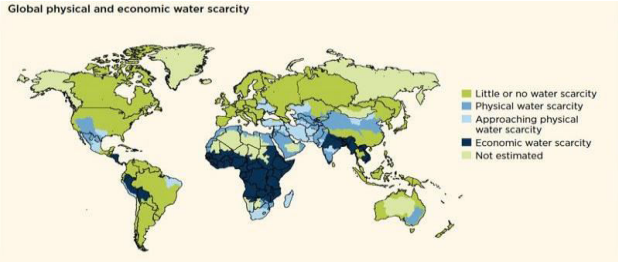

Fig1:- global physical and economic water scarcity [14]

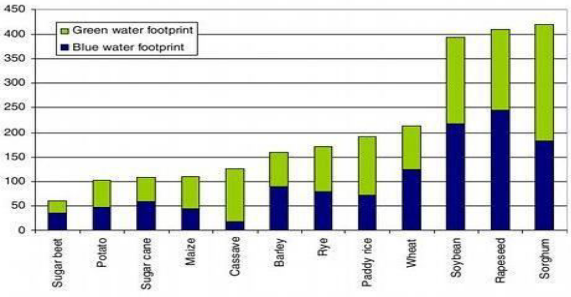

Fig2:- water usage in the world [15]

2. LITERATURE REVIEW

A comprehensive literature review has been done and some of the efficient possible technologies and algorithms based on the literature review and experiments are suggested in the paper for the development of the IOT based water conserved smart irrigation system. [1] Anneketh vij, Singh vijendra , Abhishek jain . proposes a system where the data of the soil is used for managing the water supply in the field according to the data gathered from the sensors . via microcontroller like raspberry pi or the arduino uno for the data collecting and sending via gprs module .

[2] Dr. Sanjay N. Patil , Madhuri B.Jadhav . it proposes a system where sensors are used for monitoring the field using sensors like moisture sensor , temperature sensors , light sensors, raindrop sensor, which can be used for monitoring purposes in the field .

[3] K.N.Sivabalan , V.Anandkumar , S.Balakrishnan proposed system helps in understanding the effective utilization of water and energy via IOT for controlling the water usage and crop irrigation for saving the wastage of water.

[4] Laura Garcia , Lorena parra , Jose M Jimenez, proposed the system where the sensors are connected with the microcontrollers like arduino ,which helps in capturing the data from the sensors connected in microcontroller and sends data to the user for the further process like whether the field needs water or other purpose.

[5] Wanod kumar , Wajiha shah , Dilip kumar , this system is setup under a closed chamber where irrigation can be done by controlling the soil moisture and surrounded temperature by using collected data from the sensors like moisture sensor and temperature sensors which helps in maintaining the temperature and moisture level I soil by turning on the fan and starting the sprinklers which are helpful achieving the desired temperature which is essential for the crop.

Some of the system comparison with our proposed system.

[1] "IOT Based Smart Farming for Effective Utilization of Water and Energy"

This project is based on conserving water, uses raspberry p to interact with the sensors and water pump for conserving water and electrical energy.

[2] "IOT BASED SMART IRRIGATION SYSTEM"

As this project helps in monitoring the field as well as controls the water supply by interacting with the sensors for the controlling the motor .

[3] "IOT BASED REMOTE MONITORING AND CONTROL OF AN AGRICULTURE CHAMBER"

This project helps in making an artificial weather using fans , water sprays and heater under a chamber which makes faster growth of crops and make essential condition for crops to grow.

[4] "IOT BASED SMART FARMING STICK"

This system is based on collecting every data related to the cultivation of crops like moisture in the soil , weather , water , ph values soil fertility which helps in faster growth of the crops.

[5] "IOT BASED SMART FARM MONITORING SYSTEM"

This system efficient implementation helps agriculture, a self-discipline as nicely as reducing human work and increasing crop cultivations. This system endorses sensible IOT based Agriculture Stick as farmer's aid by obtaining Live knowledge (Temperature, Soil Moisture) of farm data. These live readings help the farmers to try clever farming and to increase their average crop yields, also the quality of plants. The Smart Agriculture with Arduino Technology supports the farmers to control the live farm data and get the desired crop cultivation results.

features	Smart agriculture monitoring System using iot[1]	Iot based smart farming For effective utilization of water and energy.[2]	Iot based smart irrigation system[3]	Iot based remote monitor- ing and control of an agriculture [4]	Iot based smart farming stick[5]	Iot based smart farm monitoring system[6]	IOT BASED WATER CONSRVED SMART IRRIGATI- ON SYSTEM (proposed system)
Login notification	No	No	No	No	No	No	Yes
Sensors notification	No	Yes	No	Yes	No	Yes	Yes
Different Sensors	Yes	Yes	Yes	Yes	No	No	Yes
Controlling of water supply.	No	Yes	Yes	No	Yes	No	Yes
Solenoid valve	No	No	No	No	No	No	Yes
Machine learning for weather predict	No	No	No	No	Yes	No	Yes
Suggestion	No	No	No	No	No	No	Yes
Automation	No	No	No	No	No	No	Yes

Tab1:- system comparison table.

3. RELATED WORK

In this system how it is work are as follows:

(1) The newly developed software, available for Android , has the simple user interface which is usable by every age of person, it has the simple authentication procession it takes details like user name , email address , password for the login.

(2) It use BLYNK platform which is great for IOT platforms .it allows user to access different types of IOT sensors via Arduino and node MCU from anywhere in the world . BLYNK also provide authentication service by send mail to the new user for login into the app.

(3) once the user get login on to the application he/she can have access to the motors solenoid valve and other sensors necessary for the starts analysing moisture in the soil , temp and humidity in the atmosphere, the method to conserve more water for wasting in the process irrigation in the field.

(4) as machine learning helps the system to manage the water usage in the crop irrigation process by calculating the soil moisture and temperature and humidity in the air. Using various sensors attached to the system like DHT11 , moisture sensor and other sensors. Which helps better decision making for which crop should be yield in the farm .

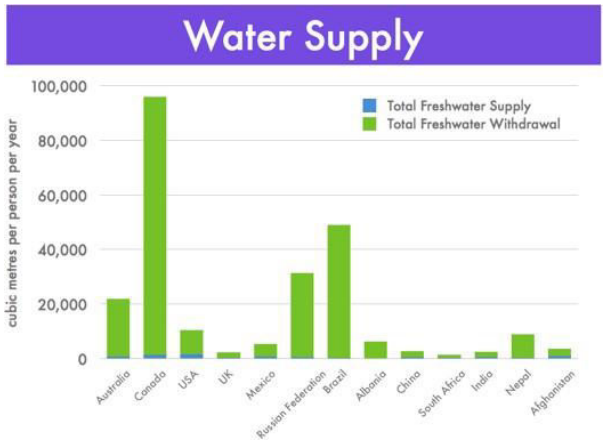

Fig3:- water supply in the world. [16]

Select Water Footprint Per Capita Data, 1996- 2005*

Nation	Population	Rain Water	Surface and Ground water usage	Freshwater Pollution	Total
	(thousands)	(Cubic meters per person per year)			
Australia	19,320.00	1,853.30	216.30	245.00	2,314.60
Bolivia	8,408.00	3,359.90	62.70	45.30	3,467.90
Congo, Democratic Republic	52,052.00	540.00	5.40	6.60	552.10
Cyprus	790.90	1,682.30	349.30	353.80	2,385.40
Israel	6,134.00	1,790.50	253.30	259.00	2,302.70
Niger	11,272.10	3,411.00	87.10	20.50	3,518.70
Saudi Arabia	21,114.20	1,131.20	447.50	270.60	1,849.30
United Arab Emirates	3,329.80	1,921.20	570.60	644.20	3,136.00
United States	288,958.20	1,968.30	238.90	635.30	2,842.50
World	**6,154,564.20**	**1,015.40**	**153.30**	**216.50**	**1,385.20**

Table 2:- Worldwide water footprint from 1996-2005.

experiments are suggested in the paper for the development of the IOT based water conserved smart irrigation system. Are inspired by [1] Anneketh vij, Singh vijendra , Abhishek jain . proposes a system where the data of the soil is used for managing the water supply in the field according to the data gathered from the sensors . via microcontroller like raspberry pi or the arduino uno for the data collecting and sending via gprs module .

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There are many system for smart irrigation but out system uses machine learning for prediction weather which is helpful in taking better decision for crop irrigation according to the data captured from the sensors .

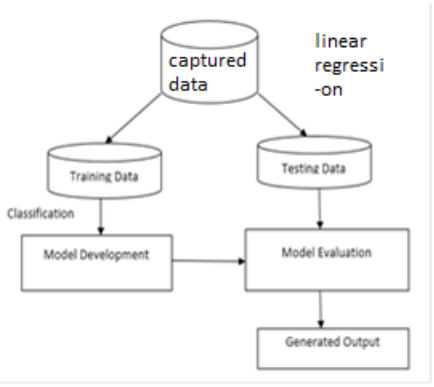

Fig4 : Block diagram of the linear regression

For the explanation of a situation once the user get log in to the system the user can have access to the data of the farm and can set time for the crop irrigation like setting time for motor to turn on/off , solenoid valve are controlled according to the moisture level in the soil which help the farm from over watering . machine learning helps better if it has data regarding the task of irrigation and it can compile the data for the faster irrigation process.

➢ Linear regression Approaches

In linear regression, the relationships are model using linear predictor functions whose unknown model parameters are estimated from the data. Such models are called linear models.Most commonly, the conditional mean of the response given the values of the explanatory variables (or predictors) is assumed to be an affine function of those values; less commonly, the conditional median or some other quantile is used. Like all forms of regression analysis, linear regression focuses on the conditional probability distribution of the response given the values of the predictors, rather than on the joint probability distribution of all of these variables, which is the domain of multivariate analysis. Linear regression was the first type of regression analysis to be studied rigorously, and to be used extensively in practical applications.This is because models which depend linearly on their unknown parameters are easier to fit than models which are non-linearly related to their parameters and because the statistical properties of the resulting estimators are easier to determine. Rain prediction model is show below:-

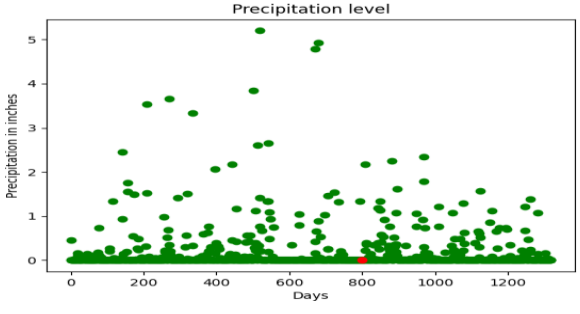

Fig5:- rainfall prediction using linear regression

4. PROPOSED METHOD

4.1 Overview:

To proceed with our proposed method of implementation, we need to follow few basic steps. The Figure shows overview of the steps to be carried out for the implementation of our proposed technique .we have used liner regression method in the machine learning for data analysing in our system .

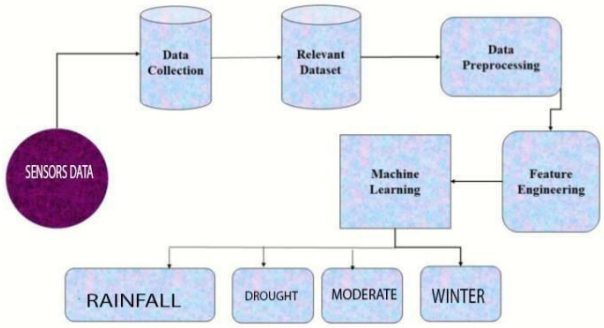

Fig 6 : Overview of steps for implementing proposed method

The implementation starts with collection of sensors data. We are predicting the weather and water necessity from the data set. Then pre-processed the data and then give the final results using various kind of machine learning algorithm.

4.2 Machine learning classification.

The classification is performed to classify the given text into four different types of seasons. The four classes of season monsoon , winter, summer spring. Various supervised machine learning algorithms are being used to classify the text into these categories. The machine learning algorithms like support vector machine (SVM), multinomial Naive Bayes (MNB), logistic regression, decision tree, random forest, bagging, Ada boost and stochastic gradient boosting were used for performing this task.

1. Logistic regression

This algorithm predicts the class of numerical variable based on its relationship with the label [7]. The algorithm generally calculates the class membership probability. Here we have four classes. y 2 f g 0; ...:3. The posterior probabilities can be calculated.

2. Multinomial Naive Bayes

MNB computes class probabilities of a given text by using Bayes rule [1]. Let C denote the set of classes in our problem we have four classes C = 0, 1, 2 and 3. Moreover, N is the set of features here we have N = 40 (40 features are taken using TF/IDF).

3. Support vector machine (SVM)

Support vector machine (SVM) is a supervised machine learning algorithm for classifying text into different categories [1]. It takes 'n' number of features for the particular text with the given label. Here we have taken 40 features that are of nature unigram and bigram as the dataset is small. Here the data points of the training set n 1, where n is the number of features taken. The 40 features that have been selected in feature engineering with values are represented in the form of a table and are supplied as an input.

4. Decision trees

An alternative approach for classification it partitions the input space into regions and classifies every region independently [7]. The 40 features that have been selected in feature engineering with values are represented in the form of a table and are supplied as an input. It splits the space recursively according to the inputs and classifies at the bottom of the tree. The leaf nodes classify the text into four classes. While building a decision tree, a vital function needs to be considered which is known as the splitting criterion. The function defines how data should be split in order to maximise performance.

A. Data Collection

Data collection is important part of this research. Because dataset can affect to the result significantly. As water scarcity is everywhere in the world so we are able take many datasets form the online ways which are help full in predicting weather.

B. Relevant dataset

Since our work is regarding weather data so we extracted weather data. weather dataset various data about the different types of weather on the particular date like on 1-1-2020 there is winter likewise it can have data of every days weather . In our dataset, we have four classes rainfall , summer , drought , winter , summer , snowfall .

C. Data Pre-processing

The data is unstructured so it needed to be refined such that machine learning can be done. Various steps are being followed in this phase; the text is being cleaned by removing unnecessary text. Punctuation and lemmatisation are being done such that the data is refined in a better way. Stop words, symbols, URL's, links are removed such that classification can be achieved with better accuracy.

E. Accuracy result

The results showed that logistic regression and Multinomial Naïve Bayes Algorithm shows better result than all other algorithms by having precision 94%, recall 96%, F1 score 95% and accuracy 96.2% other algorithms like random forest, gradient boosting also showed good results by having accuracy 94.3% respectively.

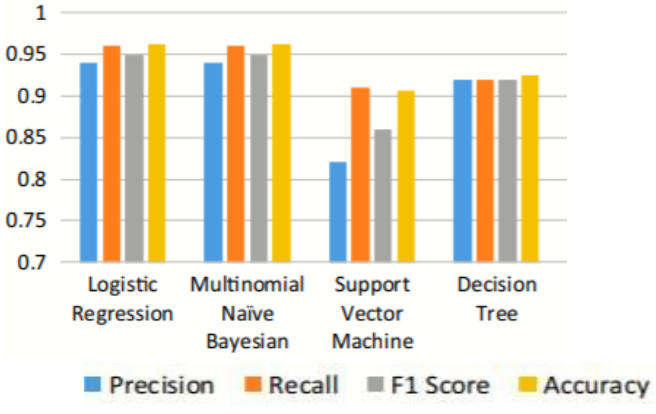

Fig 7:- accuracy result

Tools and Technology of our system

Tools:- Arduino , Breadboard, Moisture sensor,Dht11 temperature sensor, Solenoid valve, Water motor,12v power supply cable ,M2M M2F F2F cables, pipes.

5. PROPOSED SYSTEM

The proposed solution depends on the arduino uno as it is cheap as compared to raspberry pi , with the use of various sensors like soil moisture sensor, temperature sensor, the variable parameters will be constantly monitored and irrigation suitable to crop and specific to the type of crop will be done .the following fig.1 provides the major enablers of the proposed work .

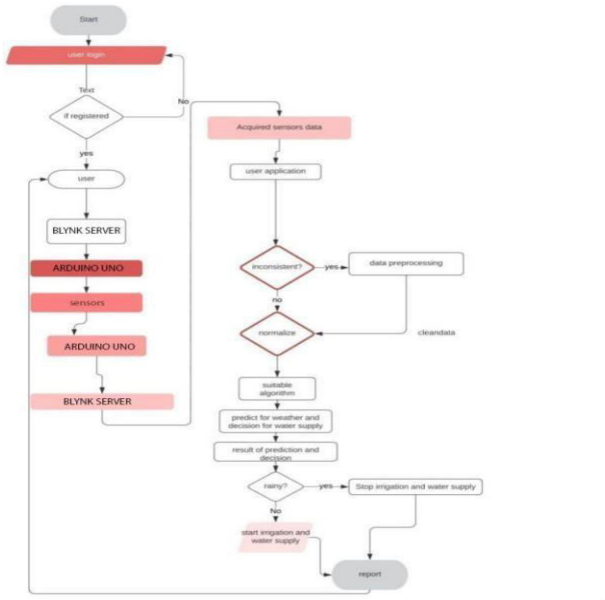

Fig 8: FLOW OF THE SYSTEM

5.1 SENSOR SECTION

[1] The **DHT11** is digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. It's fairly simple to use, but requires careful timing to grab data. It helps the user to fetch data from the sensor and send to the user app using BLYNK.

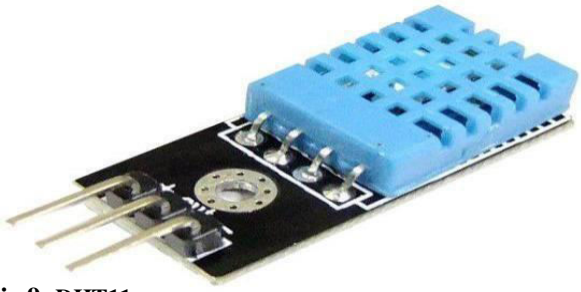

Fig 9: DHT11 sensor

[2] Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation system more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during criticalplant growth stages. Moisture sensor sends data to the user app

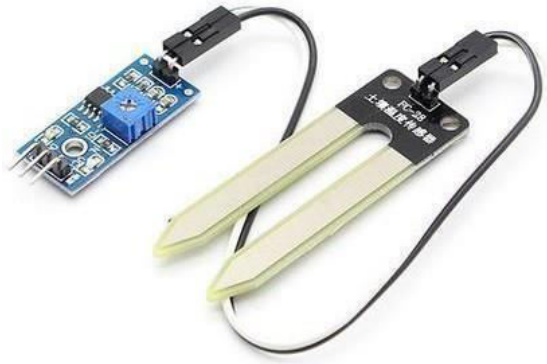

Fig 10: moisture sensor

5.2 CONTROL SECTION

Information from the sensors is transmitted to the arduino board. The arduino board consists of microcontroller relay which is responsible for controlling the switching on/off of the motor on which water sprinklers can be attached. Sensor values from arduino are transmitted to the wifi modem(node MCU). A wifi router is need which helps the wifi modem to connect to the user .The wifi modem plays necessary role in sending data to the user application which lets the user to take decision according to the Sensor data which is beneficial for the irrigation of the farm.

6. METHODILOGY

Water motor and solenoid valve control is achieved by setting threshold value at which irrigation should begin when the sensors detect moisture content before the threshold and the motor , solenoid valve is turned on until the soil is completely moist.
Here temperature sensors also plays vital role by collecting data of the temperature and humidity which helps the application to decide the weather condition is good for the irrigation or not.
The data captured the send to the arduino which is connected to the node MCU which sends data to the user via BLYNK servers which is supports the IOT platform , then the data is processed using machine learning in to the application which controls the water flow using solenoid valve which is benificial in conserving the water .

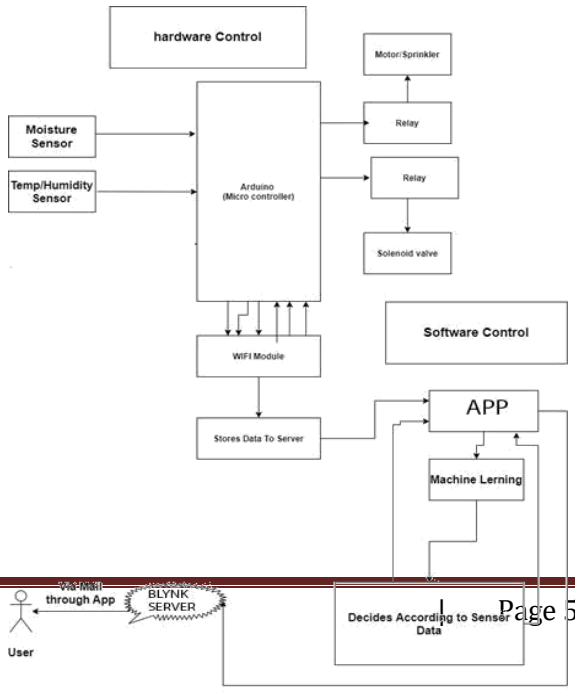

Fig 11: PROCESS OF THE SYSTEM

Here the BLYNK server help the system to fetch data from the Arduino and lets the user to analyses the data and act according to the fetched data from the sensors which is good for better irrigation of the crops and machine learning helps in making better decision for water supply.

7. RESULTS AND DISCUSSION

The images given below are the images of the app developed for monitoring and controlling of the farm irrigation without the help of any human. the irritation and monitoring process starts by login in to the app which shows moisture level of soil, temperature and humidity level of surrounding atmosphere, the data is send to the user app via Arduino UNO which is connected to the BLYNK server then the data is processed in the app for irrigation and turning on and off of the motor. app provides basic functionalities like login , signup , monitoring of the farm irrigation .

By the automation , the irrigation of crop is lot easier for the farmer to preserve water and which is prevent excess loss of water during irrigation of crop as the app stop pumping water when the moisture level attain threshold level in the process of irrigation. Notifies the user on the screen image 4 shows the info about the level of the moisture.

Below table states the data of the temperature and moisture in the soil which is essential for the irrigation.

Time (IST)	Temp/Humidity	Moisture
15:53:21	32/48	100
16:00:22	32/48	100
16:11:23	32/48	100
16:16:44	32/48	100
16:30:05	33/48	100
16:34:45	35/48	100
16:43:06	36/48	98
16:48:07	38/48	97
16:56:08	33/48	90
16:59:48	33/48	88
17:00:08	34/48	88
17:05:49	34/50	88

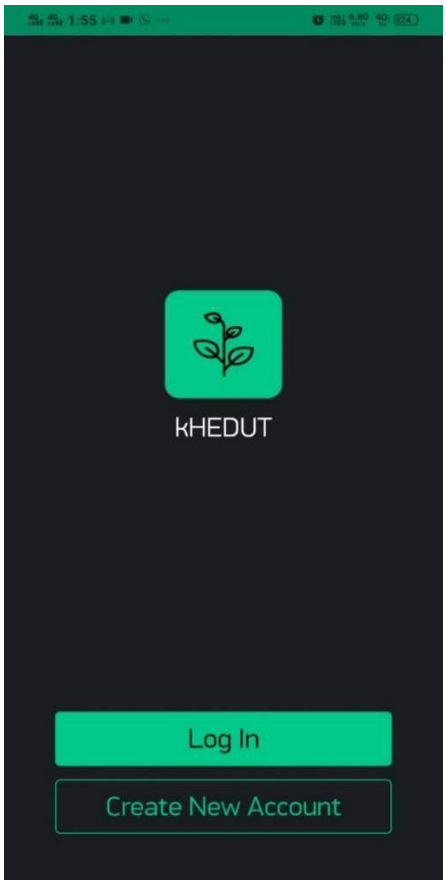

Fig 12: main page

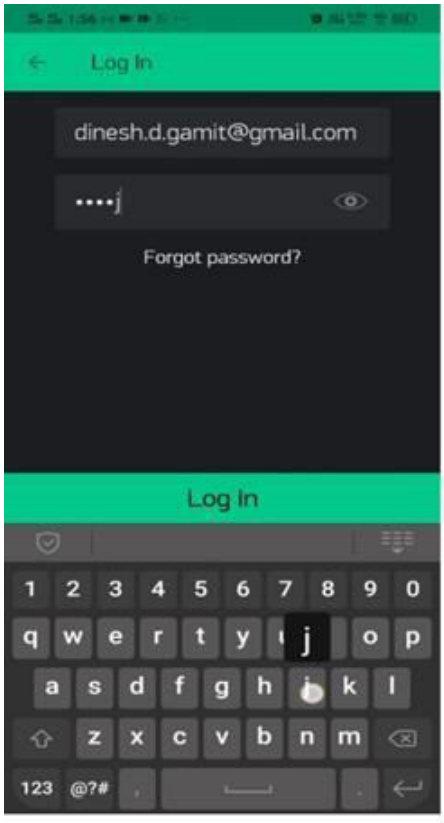

Fig 13 : login

Fig 14:- sensor reading initial state

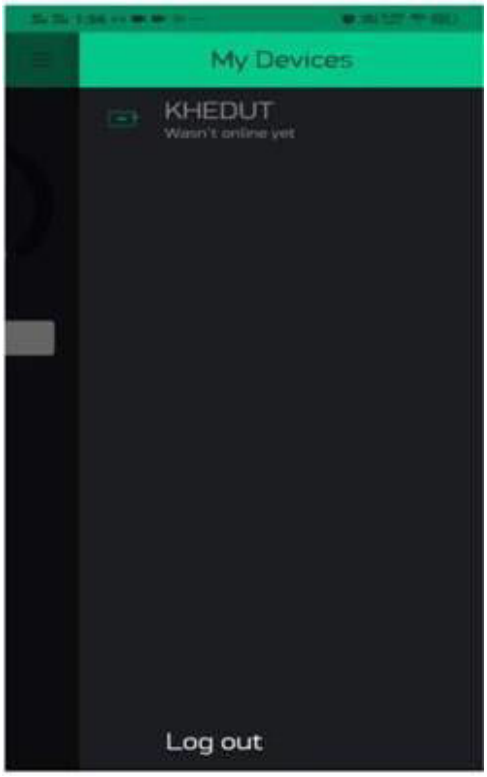

Fig 16:- logot

Fig 15 :- sensor reading after irrigation

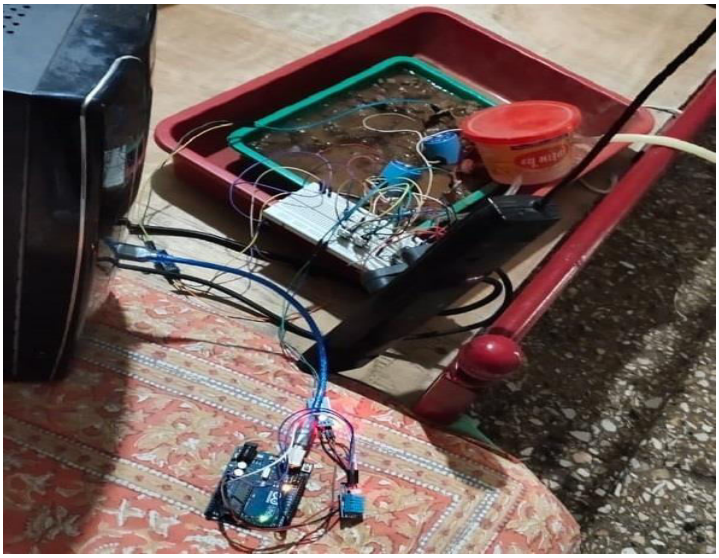

Fig 17 : hardware setup of the system

8. CONCLUSION

This system will help farmer and other user in controlling wastage of water and irrigation process of the farm, garden , other irrigation fields. It has simple UI which lets user to easily control the things in the app. Other aspect is that this app controls irrigation by the data captured from the various sensors connected to the Arduino uno where the wifi module sends data to the blynk server which provide the data transfer from Arduino to the user app where the app analysis the data and turn on/off the motor which helps in preserving the water.

9. ACKNOWLEDGEMENT

I would like to thank my guide Mr. Dhaval J. Rana who supported me through the different phases of the project. Also, I am grateful to R.N.G.P.I.T for providing me the resources which led to successful implementation of the project.

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