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ಬೆಳಗಾವಿ, ಕರ್ನಾಟಕ

A PROJECT PHASE-2 REPORT

ON

"E-Irrigation System and Security"

Submitted to Visvesvaraya Technological University in partial fulfillment of the requirement for the award of Bachelor of Engineering degree in Computer Science and Engineering.

Submitted by

Name	USN
ANANYA KUMAR	4JN18CS011

Under the guidance of

Mr.Narendra Kumar B.E.,M.tech.(Ph.D).

Professor, Dept. of CS&E,JNNCE,

Shivamogga.

Department of Computer Science & Engineering

Jawaharlal Nehru New College of Engineering

Shivamogga-577204

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Department of Computer Science & Engineering

CERTIFICATE

Certified that the project work entitled **E-Irrigation System and Security** carried out by **Mr. Ananya Kumar** USN:**4JN18CS011,** a bonafide student of J.N.N. College of Engineering, Shivamogga in partial fulfillment for the award of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belagavi during the year 2021-22. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of Guide	**Signature of HOD**	**Signature of Principal**
Mr.Narendra Kumar MTech Professor, Dept. of CS&E	**Dr. Poornima K. M. Ph.D.** Professor and Head, Dept. of CS&E	**Dr. K. Nagendra Prasad Ph.D.** **Principal, JNNCE**

External Viva

Name of the examiners	Signature with date
1. ______________________	
2. ______________________	

ABSTRACT

India is an agricultural country and the majority of the population depends on it. use of water resources should be done in an efficient and precise manner for farming. This project proposes to automate the tedious process by proposing a micro-processor-based system for automatic smart drip irrigation and to predict the precise amount of water needed by the crop by using Machine Learning algorithm. Taking into consideration the weather, soil and crop parameters. It will predict the quantity of water that should flow accordingly through drip irrigation with the help of sensors and automated water valves. Also ensures the security for the farm by use of laser module.

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ANANYA KUMAR 4JN18CS011

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INTRODUCTION

India is an agricultural country and the majority of the population depends on it. use of water resources should be done in an efficient and precise manner for farming. Water is an essential thing for crops and plants in agriculture. In traditional agriculture systems are take large amount of time to watering the crops lands and also have a lots of water wastes. Water scarcity is one of the challenges that the country is facing and have to avoid water wastages at all costs.

1.1 Overview:

Irrigation is the process of applying water to the crops artificially to fulfil their water requirements. Nutrients may also be provided to the crops through irrigation. The various sources of water for irrigation are wells, ponds, lakes, canals, tube-wells and even dams. There are many types of irrigation like Surface irrigation, drip irrigation, sprinkler irrigation, sub-irrigation etc.

The Internet of Things is a system of interrelated devices connected to a network and/or to one another exchanging data without necessarily requiring human-to-machine interaction, which means it is a collection of electronic devices that can share information among themselves.

These are often called as “smart” devices because they have sensors and can conduct complex data analytics. Iot devices collect data using sensors and offer services to the user based on the analysis of that data and according to user-defined parameters. Iot are connected to the internet directly or indirectly to another Iot device or cloud, which are used for sharing information through network connections. A cloud is a group of servers connected together to provide on-demand delivery of storage, application services, computer power, ML services etc.

1.1.1 Importance of Irrigation:

Irrigation helps to grow agricultural crops, maintain landscapes and revegetate distributed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection, suppressing weed growth in grain fields and preventing soil consolidation. Irrigation systems are also used for cooling livestock, dust suppression, disposal of sewage and in mining. Irrigation is often studied together with drainage, which is the removal of surface and sub-surface water from a given location. Drip irrigation increase in production & productivity, improves quality and ensure early maturity of the crops, water is saved up to 40% –70%, controls weed growth, saves the fertilizer (30%) and labor cost (10%), control diseases, use of saline water is possible if it does not harm the crop, soil erosion is eliminated and suitable for uneven / undulating land.

It is currently the most effective water-saving irrigation method in arid and water-deficient areas, and the water utilization rate can reach 95%. Compared with sprinkler irrigation, drip irrigation has higher water-saving and yield-increasing effect. At the same time, it can combine fertilization and increase fertilizer efficiency more than twice. The main characteristics of drip irrigation are small amount of irrigation and 2-12 litres of flow per hour of emitter. Therefore, a long duration of irrigation and short irrigation cycle can be used to do small-scale irrigation; low working pressure is needed to control the amount of irrigation more accurately, which can reduce ineffective inter-tree evaporation without causing water waste; drip irrigation can also be managed automatically. Drip irrigation is a kind of micro-irrigation. Water infiltrates into the soil slowly and evenly, which can maintain the soil structure and form an appropriate soil water, fertilizer and thermal environment.

1.2 IOT and Machine Learning in Irrigation:

With Iot technologies growing efficiently at a faster rate has brought an opportunity in Iot to “smart irrigation” system which is highly optimized and high-performance irrigation system using Iot to access, monitor and maintain our data. It has provided an opportunity to measure water levels in resources like river, well or it has brought the sensors to measure the moisture of soil, temperature, humidity and many more to collect data, analyze and act on it. The system can be designed to automate the irrigation process using sensors and micro-controllers or micro-processors along with electronic devices to communicate directly or indirectly through network.

Machine Learning algorithm brings a huge role in irrigation, where all the data collected in database can be used to predict the parameters required to come for the decision of irrigation for a particular day, The branch of machine learning used for irrigation is the supervised learning, where the parameters are labelled and appropriate supervised algorithm can be used for building prediction model for irrigation.

1.3 Organization of report:

This chapter provides the overview on the concepts required for the project.
Chapter [2] provides literature survey, problem statement and objectives of the project along with its summary.
Chapter [3] gives the functional and non-functional requirements along with its summary.
Chapter [4] gives information about the system design architecture for this project, its methodologies and flow charts.
Chapter [5] gives results and conclusion that is arrived after all the process.

Chapter 2

LITERATURE SURVEY

This chapter includes the complete literature survey of all the 10 papers. All the papers were analysed and the methodology, advantages and disadvantages of all the papers were considered. This chapter also contains motivation, problem statement and objectives of this project.

Paper 1: SMART IRRIGATION USING IOT FOR SURVEILLANCE OF CROP (Ashwini B V, 2018)

Arduino is used as a central device for control. Sensors data like Soil moisture, Temperature and Humidity are obtained and transmitted through wireless network. Data is sent to the end users directly using Bluetooth network.

Soil Moisture data is continuously taken and evaluated. Based on soil moisture data reaches threshold a decision is made to turn on or off the motor. Water level of the tank is also monitored.

Advantages:

- Usually irrigate the farm through mobile devices.
- User can directly communicate with the controller through local networks like Bluetooth.
- User can control the irrigation.

Limitations:

- Since the sensor data is directly send to the end users, this may cause high load on network and any loss in the network can make the system behave abnormally.
- Data is processed on user device makes the burden to the user device, which may be incapable to process the data.
- Previous trends in irrigation cannot be monitored since there is no storage of sensor values.

- Cannot deploy the system if there is a long distance between agriculture field and farmer’s house because the Bluetooth range is limited.

Paper 2: SMART IRRIGATION SYSTEM (Porvi pimpalkar, Nisha pedsangi, 2021)

Microcontroller is used as a central device for control, and soil moisture sensor and temperature are connected to the input pins of micro controller, water pump is connected to the output pump.

Data is collected and transmitted by use of Arduino and displayed on serial port monitor. A predefined range of soil moisture and temperature that can be varied with soil type and crop type. If soil moisture varies from predefined range, the watering system will be switch on or off accordingly. In case of heavy rain controller will turn off the pump**.**

Advantages:

- Farmer’s presence is not required
- Smartly detects the climate changes and perform the action based on value.
- Fast irrigation is possible, helps in development of agriculture process.
- Helps for small scale irrigation.

Limitations:

- Farmers don’t have control over the irrigation
- Easy to use interface is not provided for farmers.
- Farmers cannot monitor the irrigation.
- Single pump cannot irrigate different sections of agriculture filed, it may require manual water connection exchange

Paper 3: IOT AND CLOUD BASED FOR SMART IRRIGATION SYSTEM (Thanwamas kassanuk, 2021)

Soil moisture and Humidity sensor data are collected and transmitted to cloud. Arduino Uno is taken as central unit and user device is the mobile which is connected to the cloud.Farmers can set humidity and soil moisture threshold values to the specific crops by using mobile application if humidity and soil moisture is within the range set by farmer then irrigation system turns on the sprinkler.

Advantages:

- Farmers have the control over irrigation
- Easy irrigation is possible by use of mobile interface.
- Farmers can able to set the threshold value for humidity and soil moisture.

Limitations:

- It doesn’t monitor the irrigation.
- Setting values for temperature and humidity can be a burden to farmers as they may not have the knowledge of temperature and humidity.
- It doesn’t consider all parameter for irrigation.
- It doesn’t have feasibility to control water quantity for different crops.

Paper 4: SMART DRIP IRRIGATION SYSTEM (Shilpa. A, 2021)

It uses Wemos D1 ESP 8266, pH , soil nutrient, soil moisture, temperature and rain and LCD as components in this article. The sensors are taken as input and Wemos D1 ESP 8266 is the central controller.

Solenoid valve and Water pump is used as a controller for controlling water flow for irrigation. LCD display is used to display the status of motor ON/OFF condition and also the sensor data.

Advantages:

- Using Wemos D1 ESP 8266 makes it easy to build the connections and also has built-in memory space.
- High yielding
- Low cost

Limitations:

- It does not mention about the quantity of water required for the crop.

- Didi not mention clearly on how to control Wemos D1, and also which interface is used.

Paper 5: SMART IRRIGATION USING IOT (Anubhav Gulati, Sanjeev thakur, 2018)

It uses cloud to store sensor data of Temperature, Humidity, Pressure. It works on the concept of threshold value if the irrigation is required, the water motor is used for controlling the flow of water using micro controller.

Soil sensors are used which are placed in 3 different levels according to the depth of the soil and temperature sensors are placed beside the plants for sensor data. ET water scheduling is used for irrigation schedule.

Advantages:

- With the help of IOT agriculture can be made efficient and accurate.
- With 3 sensors there is better sensor data reading of the soil beside the crop for irrigation decision.

Limitations:

- Since many temperatures sensor is used for each crop the data will be variable and irrigation water quantity won't be accurate for each crop.
- Having ET scheduling for water schedule may not be accurate
- Cost of the system is high.

Paper 6: SMART DRIP IRRIGATION SYSTEM USING CLOUD, ANDROID AND DATA MINING (Subhashree Ghosh, Sumaiya Sayyed,2016)

Water management system is controlled using microcontroller and web application that uses cloud and data mining. It is used to monitor and control water management system from remote location.

Humidity, Temperature, Light and Moisture data are collected and transmitted to the cloud. A decision is made to turn on/off the pump based on the sensor values. Also it predicts the future values of sensors using naive bayes ML algorithm.

Advantages:

- Remote control for Drip irrigation is beneficial.
- Web applications provides easy way for farmers to monitor and control the system.
- It gives graph reading and predict the future values using ML algorithm naive bayes

Limitations:

- Based on temperature, humidity and light sensors alone we cannot efficiently irrigate.
- It doesn’t consider the different types of crops for irrigation.
- It doesn’t give the clarity on future implementation by using predicted future values of sensor.

Paper 7: FUZZY LOGIC BASED SMART IRRIGATION

(R santhana Krishnan, Golden Julie,2019)

Soil moisture, Humidity and Temperature data is continuously collected and transmitted to the web server by use of microcontroller. A decision is taken to turn on/off the irrigation pump based on set of rules called fuzzy rules.These set of rules consider the moisture, temperature, humidity to determine irrigation applicability and do the action accordingly.

Advantages:

- User interface provides features such as fast irrigation and easy to control irrigation.
- Set of rules smartly determines the irrigation applicability thereby reduces user interaction.
- Irrigation and sensor data can be monitored.

Limitations:

- It automates the irrigation only within the bounds of rules. If a new parameter comes, it cannot determine the result.
- It frequently requires change of rules.
- Large set of rules cannot be programmed to microcontroller in case of scalability of system.

Paper 8: IOT & ML APPROACHES FOR AUTOMATION OF FARM IRRIGATION SYSTEM (Aashima Bassi, Aarushi Sharma,2019)

In this article, Arduino and micro controller are the central part, where inputs are taken from wireless sensors like soil moisture, water level sensor, water quality. Water pump is immersed in the water source and it is automated using Iot and it is connected to a relay switch which in turn controlled by Arduino.

A mobile application is used to control the micro controller operation wirelessly and Machine Learning algorithm is used for decision making process from different sensor data, the app is also used for analyzing the data.

Advantages:

- Cost effective and improve performance.
- Conserve energy and water resources.
- Algorithm shows improved accuracy and less error

Limitations:

- Unavailability of structured data of the crop.
- Extreme weather condition poses as a serious threat to the solution proposed in the research.
- More training on large set of data is required.

Paper 9: AN IOT BASED SMART IRRIGATION SYSTEM USING SOIL MOISTURE AND WEATHER PREDICTION (Dr. S Velmurugal, V Balaji,2020)

Arduino is used as a controller, statistical data is acquired from sensor such as temperature, humidity, moisture and light intensity. These data are transmitted to the web server. Mobile app can be designed to receive these data and can be analyzed.

Decision can be made either manually by user interaction or automatically. It uses ML algorithms to predict the weather data and soil moisture values based on the results it will suggest the user for irrigation or automatically do the irrigation. Water pump is used for automation.

Advantages:

- Web and mobile interface provide flexibility for the user.
- Previous trends in irrigation can be analyzed using stored data.
- Suggestion of the irrigation by predicting the future values makes it much more user friendly.
- Complete automation can be done.

Limitations:

- System environment changes are not considered for sensor reading.
- It does not predict the amount of water required for particular crop.
- It does not have the feasibility to control water quantity.
- Therefore, over irrigation or under irrigation may happen which decreases crop yield.

Paper 10: CROP WATER REQUIREMENT PREDICTION IN AUTOMATED DRIP IRRIGATION (Shilpa Chandra, Samiksha bhilare,2021)

Soil moisture and Humidity data is collected and transmitted to the cloud by use of Arduino. Uses KNN algorithm to predict quantity of water required for crop by considering variations in the collected data.Quantity of water given to the crop is recorded and the pump is used for automation of irrigation by use of microcontroller.

Advantages:

- An efficient irrigation for the farm can be achieved.

- Wastage of water in irrigation can be reduced.
- Overall production is increased.

Limitations:

- It doesn't consider all parameter required for calculating the quantity of water.
- Example: Age of the crop, temperature, evaporation rate sometimes plays important role in water quantity prediction.
- Controlling the water quantity is not clearly mentioned, pump automation is included in the future work.
- If the pump is selected for controlling the water quantity, they need to calculate time schedule which may not be accurate to control water quantity.

2.1 Motivation

- Irrigation is one of the real-world problems, so we move towards the solution by considering the difficulties faced by the farmers.
- Determining right quantity of water for particular crop under specific environmental condition is more challenging work for farmers.
- By using the water resources judiciously, we can increase the crop growth quality by controlling the water from flood irrigation to drip irrigation.
- Monitoring the trespassing activity to farmers in the farm of remote location is challenging.
- We want to bring technology to make farmers life easier.

2.2 Problem statement

Irrigation is one important challenge in agriculture process because more often the agriculture field and farmer's house will be far away from one another. In this case it is so hard to make irrigation by moving long distance and waiting in the field until irrigation gets completed. Determining right quantity of water for particular crop under specific environmental condition is more challenging work for farmers. Water management is the one of the main aspects in the agriculture process. Water saving is crucial. Because of unprecise water usage gave rise to bacteria in soil which decreases the crop yield. To provide security to the field by implementing laser module to the surrounding field

2.3 Objectives

Objectives of this project are:

1. To provide good user interface which can control and monitor irrigation process.
2. Suggestion of right quantity of water for particular crop under specific environmental conditions.
3. To control quantity of water flowing through water channel.
4. To prevent manual work and to ensure security for the farm.
5. To make multi user system and ensuring authentication for user account

Summary:

The chapter provides the results of the literature survey conducted regarding the irrigation automation where many publishers have used different methods to solve the irrigation problem. Also contains the problem statement where the problem has been found and objectives provide the solution to the problem statement.

Chapter 3

SYSTEM REQUIREMENTS

This chapter includes the functional and non-functional requirements of this project. Functional requirements contain hardware and software requirements and non-functional requirements contain performance, compatibility, security, availability etc of this project.

3.1 Functional requirements

3.1.1 Hardware requirements

Raspberry pi

Minimum: 2 GB of RAM

Minimum: 2 GB of Hard disk space

Processor speed 1.4GHz

Android

Minimum android version: 5.0 Lollipop

Minimum 2GB of RAM

Minimum 1GB of memory

Processor speed 2GHz

3.1.2 Software requirements

Raspberry pi

Operating System: Raspberry pi OS

Tools: shell or command prompt

Programming Language: Python

Android

Operating System: Linux based Android OS

Tools: Android studio

Programming Language: Kotlin

3.2 Non-Functional requirements

- **Performance:** E-Irrigation system must be able to serve user request at acceptable time and speed.
- **Compatibility:** Android app should be compatible with multiple android versions.
- **Reliability:** System should be able to serve the user request without any failure for long periods of time.
- **Availability:** System should be up and running such that user can access the system anytime in a day.
- **Security:** System should be highly secured and It should prevent unauthorized access.
- **Usability:** System should provide good, easy to understand interfaces to interact with it.
- **Cost:** System should be easy to deploy and should be cost effective.

Summary:

This chapter provides the system requirements that include functional and non-functional requirements to build the project. In functional requirements it deals with hardware and software requirements.

Chapter 4

SYSTEM DESIGN AND METHODOLOGY

This chapter includes the system design and the components required for this project. It also contains E-Irrigation PCB board and the Linear regression algorithm. And also contains the circuit diagram and description of pins required for this project and the flow charts for each and every function of this project.

4.1 System Design:

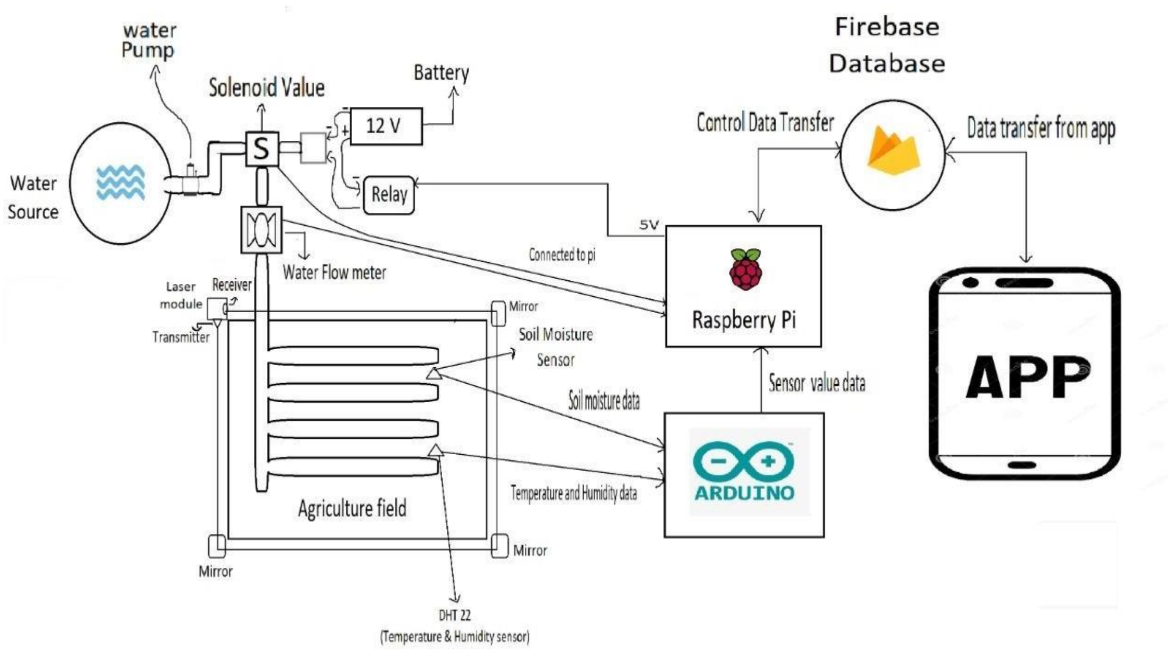

Fig 4.1: System Architecture

The figure 4.1 shows complete blueprint of the system. Here water source and agriculture fields are identified.

This system uses Raspberry pi as central processing system which takes the parameters like temperature, soil moisture and humidity from the sensors apart from sensor data some other parameters like soil texture, crop age are also considered. Machine learning algorithm are applied to predict the quantity of water required for the irrigation.12V DC water pump is used to control the pressure of water. To control the water supply solenoid valve is used and placed at the main channel. When the button is pressed in app it triggers the solenoid valve for this 12V DC voltage is needed. Relay which controls the 12V supply to the solenoid valve is connected to outputs of Raspberry pi and to control the water quantity through the channel water flow meter is used. It continuously monitors amount of water flowing in channel is calculated. Solenoid valve can be turned off when quantity of water flowed through the channel reaches predicted water quantity. All the sensor data and irrigation data are recorded and transmitted to the cloud for future processing. Laser sensor detects the trespassing activities and notifies the user immediately. User can have full control over the irrigation by means of user interface.

4.1.1 Components Required:

Raspberry Pi:

Fig 4.1.1: Raspberry Pi

Raspberry Pi is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring. Because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB devices.

Solenoid valve:

Fig 4.1.2: Solenoid valve

Solenoid valve is an electrically controlled which is used to control water supply in water channel. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) in its center. An electric current through the coil creates a magnetic field.

Water flow meter:

Fig 4.1.3: Waterflow meter

A water flow meter is a device able to measure the amount of water crossing through a pipe. Water flow sensors are installed at the water source or pipes to measure the rate of flow of water and calculate the amount of water flowed through the pipe. Rate of flow of water is measured as litters per hour or cubic meters.

DHT22 sensor:

Fig 4.1.4: DHT22 sensor

The DHT22 is a basic 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, no analog input pins needed.

Soil moisture sensor:

Fig 4.1.5: Soil moisture sensor

The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

Laser module:

Fig 4.1.6: Laser module

Laser module consists of laser transmitter and laser receiver. A laser transmitter projects a beam of laser light outward while raising and lowering the beam. A laser receiver receives the laser line.

Relay module:

Fig 4.1.7: Relay module

The relay module is an electrically operated switch that can be turned on or off deciding to let current flow through or not. They are designed to be controlled with low voltages like 3.3V like raspberry pi, or 5V like your Arduino.

Water pump:

Fig 4.1.8: Water pump

The pump is used to control the pressure of water. It is exposed to the water pressure via a small diaphragm. When the water reaches a pre-set pressure, the diaphragm engages the pressure switch which turns the power off at the pump.

4.1.2 E-Irrigation PCB

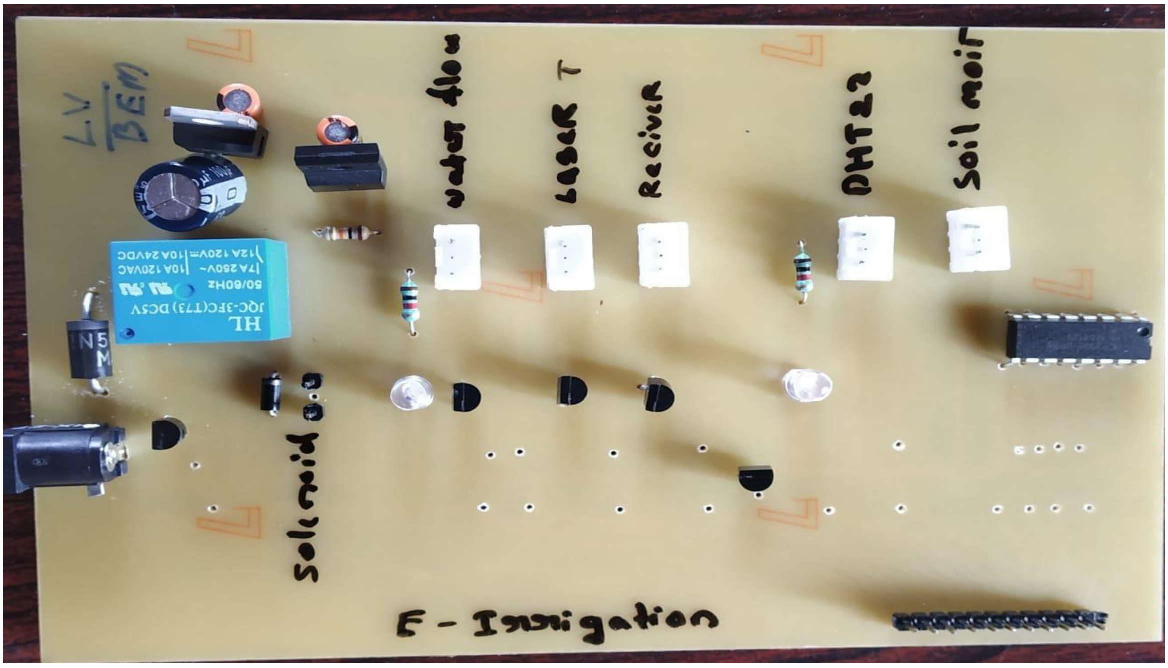

Fig 4.1.2 E-Irrigation PCB

This project involves wiring of various sensors and actuators which is more complex and difficult process for debugging. With some basic knowledge in electronics, we have designed a printed circuit board (PCB). So, every component like relay, transistors, resistors are integrated on the single board. Sensors and actuators can be plugged with a dedicated sockets on PCB board.

This board operates at a DC voltage of 12V. Pump and valve needs 12V to operate, whereas relay operates at 5V so 5V regulator is used to step down 12V to 5V. All other sensors and actuators operate at 3.3V hence 3.3V regulator is used to step down 5V to 3.3V. There are 11 pins on PCB board to communicate with sensors and actuators. Detailed explanation about the pins is discussed in circuit diagram.

4.2 Methodology

4.2.1 Linear Regression Algorithm

Linear Regression is a machine learning algorithm based on supervised learning. It performs a regression task. Regression models a target prediction value based on independent variables. It is mostly used for finding out the relationship between variables and forecasting. The linear regression model provides a sloped straight line representing the relationship between the variables. Linear regression is one of the easiest and most popular Machine Learning algorithms. It is a statistical method that is used for predictive analysis. Linear regression makes predictions for continuous/real or numeric variables such as sales, salary, age, product price, etc.

Hypothesis function for Linear Regression;

$$y = \boldsymbol{y = \theta_1 + \theta_2 x}$$

x: input training data (univariate – one input variable(parameter))

y: labels to data (supervised learning)

Linear regression algorithm shows a linear relationship between a dependent (y) and one or more independent (y) variables, hence called as linear regression. Since linear regression shows the linear relationship, which means it finds how the value of the dependent variable is changing according to the value of the independent variable.

Algorithm:

1. Start
2. Read Number of Data (n)
3.For i=1 to n:
   Read Xi and Yi
   Next i
4. Initialize:
     sumX = 0
     sumX2 = 0
     sumY = 0
     sumXY = 0
5.Calculate Required Sum
   For i=1 to n:
     sumX = sumX + Xi
     sumX2 = sumX2 + Xi * Xi
     sumY = sumY + Yi
     sumXY = sumXY + Xi * Yi
   Next i
6. Calculate Required Constant a and b of y = a + bx:
   b = (n * sumXY - sumX * sumY)/(n*sumX2 - sumX * sumX)
   a = (sumY - b*sumX)/n
7. Display value of a and b
8. Stop

4.2.2 Circuit Diagram

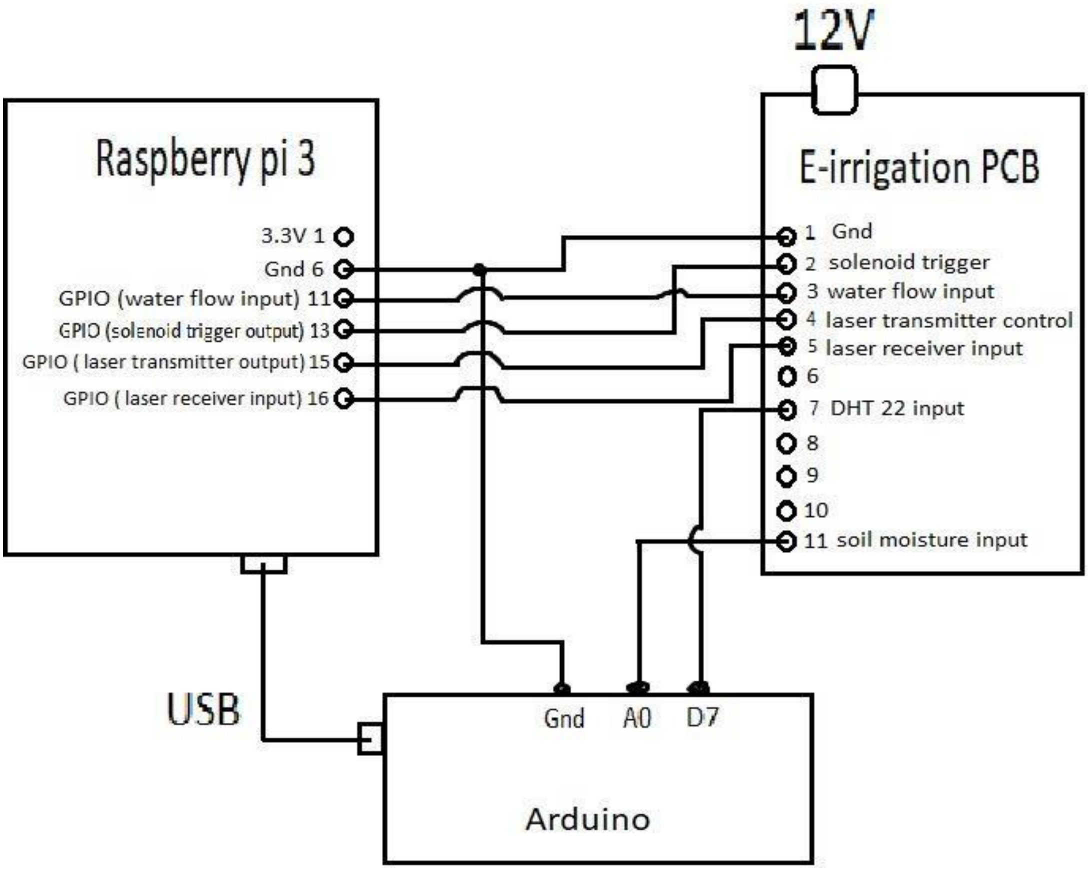

Fig 4.2.2: Circuit diagram of E-irrigation system and security

Raspberry pi 3

Pin		Description
1	-	3.3V
6	-	Ground
11	-	GPIO (waterflow input)
13	-	GPIO (Solenoid trigger output)
15	-	GPIO (Laser transmission control)
16	-	GPIO (Laser receiver input)

E-Irrigation PCB

Pin		Description
1	-	Ground
2	-	Solenoid valve
3	-	waterflow input

4	-	Laser transmission control
5	-	Laser receiver control
6	-	Not used
7	-	DHT22 input
8,9,10	-	Not used
11	-	Soil moisture input

Table 1: Connection Table of the circuit

Raspberry Pi pin	PCB board pin	Ardino
6	1	Ground
13	2	
11	3	
15	4	
16	5	
	7	D7
	11	A0

Table 2: Flag Mode Communication

Flags	Communication path	Description
Trigger	Android --> pi	Used to request for pi to fetch sensor values with prediction value
Sensor_value	Pi-->Android	Used to indicate that pi has written sensor data to database expecting android app to use those values

Valve	Android --> pi	Used to request for pi to turn on the pump/valve and control the water quantity as given by the app
Force_stop	Android --> pi	Used to request pi to immediately turn off pump/valve.
Running	Pi-->Android	Used to indicate that pump/valve is running state expecting android to not to receive any other irrigation request.
Laser status	Android --> pi	Used to request pi for on and off laser security.
Laser cut	Pi-->Android	Used to indicate that laser threat is detected by laser receiver module expecting android to read timestamp and notify the user.

4.3 Flow charts

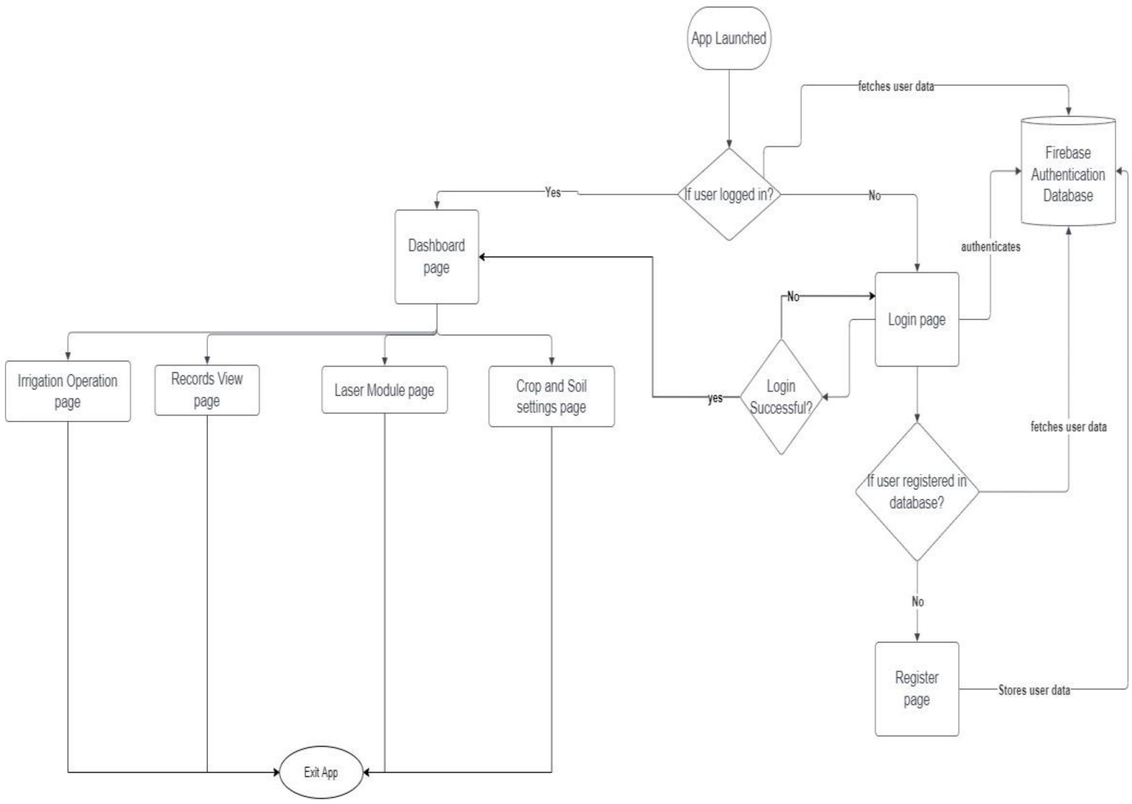

Fig 4.3: Flowchart of E-irrigation System and Security app

Fig 4.3 shows the flowchart of E-irrigation system and security app that gives the working of the app. The app is launched and it takes the user to the login page, the user prompts the login by authenticating to the firebase authentication database and if successful takes the user to dashboard page else fails the user can click the link to register page for registering the user's details to the firebase authentication database, then it takes back to login page for login. In the dashboard the user can access Irrigation Operation page, Record View page, Laser module page and crop_soil settings page or can close the app from there.

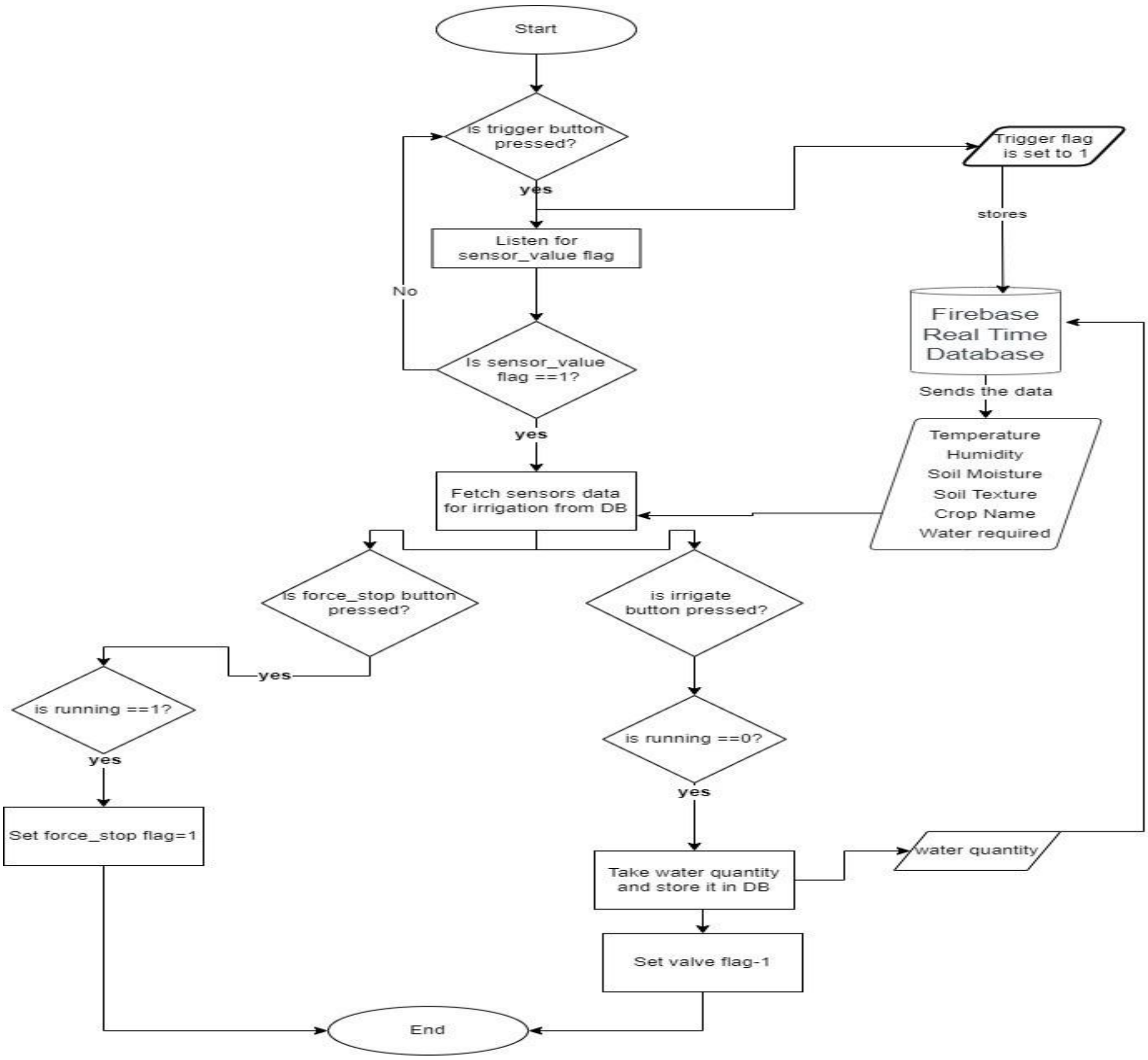

Fig 4.4: Flowchart of Irrigation operation page

Fig 4.4 shows Flowchart of Irrigation operation on android. When the user clicks on the irrigation operation button the app brings the user to the irrigation operation page where the user just clicks the get the current data button, which is the trigger button if pressed it listens for the sensor_value flag. If the sensor_value flag is 1 then it reads the sensors data from the firebase real-time database. If the irrigate button is pressed the running flag is checked whether it is 0 or 1, if it is 0 then the irrigation takes place when valve flag is set to 1, after irrigation the water quantity is stored into the database and the operation is ends. If the force_stop button is pressed during irrigation process then it sets the force_stop flag to 1 and the user can end the operation.

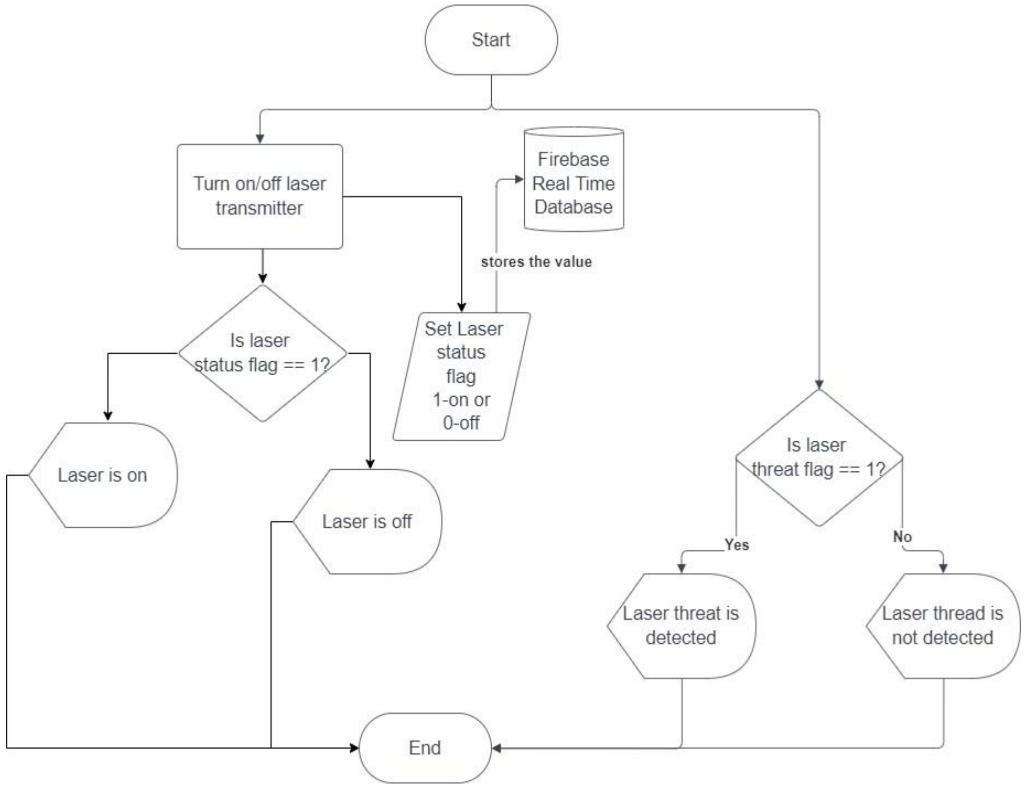

Fig 4.5: Flowchart of laser module page

Fig 4.5 shows Flowchart of laser module operation on android. When the user presses the laser operation button in dashboard the app brings the user to laser module page, here the user can turn on or off the laser module, when it is "on" the laser_status flag is set to 1 and store it to firebase real-time database and displays the message that "laser is on", else "off" the laser_status flag is set to 0 and store it to firebase real-time database and displays "laser is off" in app. It also listens to the laser_threat flag, if it is 1 then it displays a laser threat detected in the app else if it is 0 then it displays a laser threat is not detected and user can end by closing the app or leave the page.

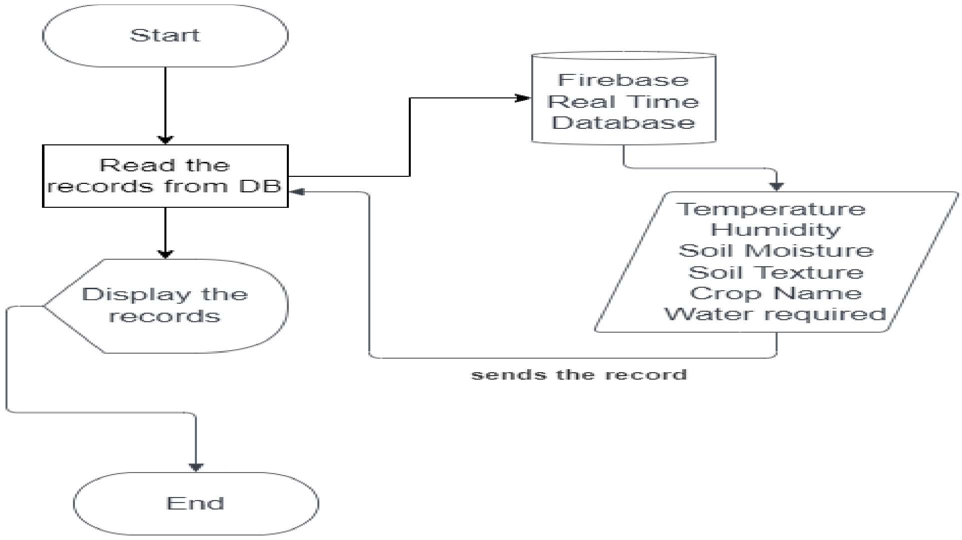

Fig 4.6: Flowchart of Record View page

Fig 4.6 shows Flowchart of record view operation on android. When the user presses the record view button in dashboard the app brings the user to record view page, here the app listens to the database and reads the records from the database and displays it on the app. The record would contain temperature, humidity, soil moisture, soil texture, crop name, water required data.

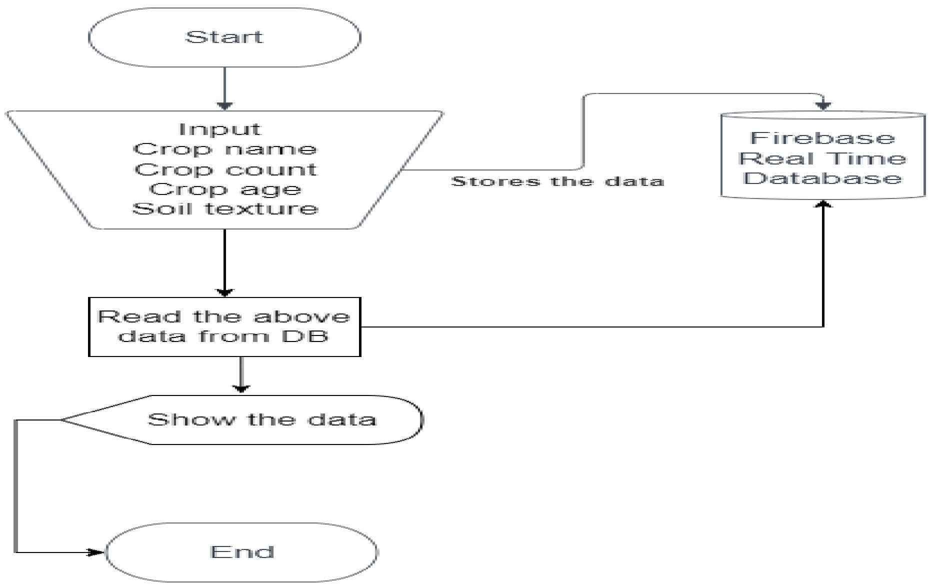

Fig 4.7: Flowchart of Crop_Soil Settings page

Fig 4.7 shows the flowchart of crop_soil settings page. When the user presses the crop_soil settings button in dashboard the app brings the user to the crop_soil settings page here the user can input the age of crop, how many crops present in the field which is crop count and soil texture and which crop planted on the field in crop name, by the press of the button it stores the details into the database and shows the stored data on the app screen and it ends the process.

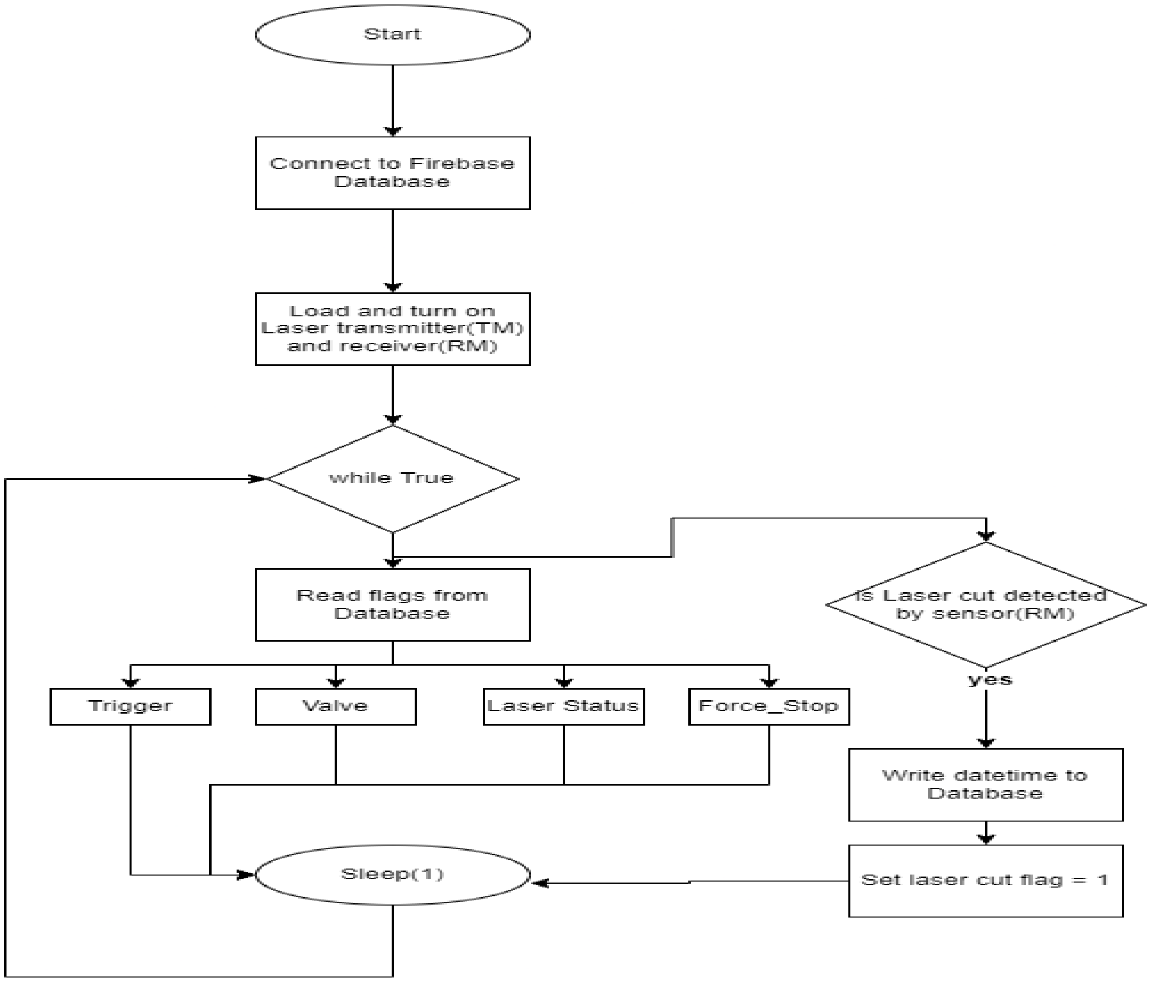

Fig 4.8: Flowchart of Raspberry pi process

Fig 4.8 shows the flowchart of Raspberry pi process. When Raspberry pi process starts with connection to firebase. It will load the laser transmitter and turns on the transmitter module (TM) and receiver listens receiver module (RM). While loop runs infinitely with 1sec delay between iterations. At each iterations control reads various flags from database such as trigger, valve, laser status, force_stop and process the request. It also listens for laser receiver, if laser threat is detected the sensor writes date and time to the database and turns on the laser cut flag.

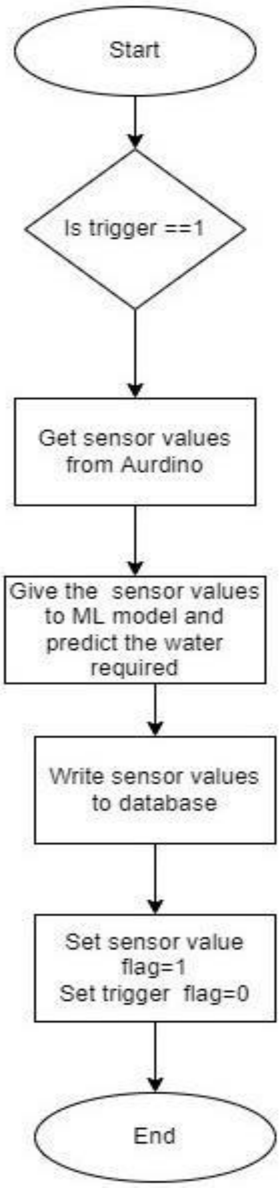

Fig 4.9: Flowchart of trigger flag

Fig 4.9 shows the flowchart of trigger flag. In infinite loop if trigger is turned on control will fetch the sensor values from Arduino and gives these values to ML model to predict the water required. After that it will write sensor values with predicted values to database then turn on the sensor value flag and turn off trigger flag.

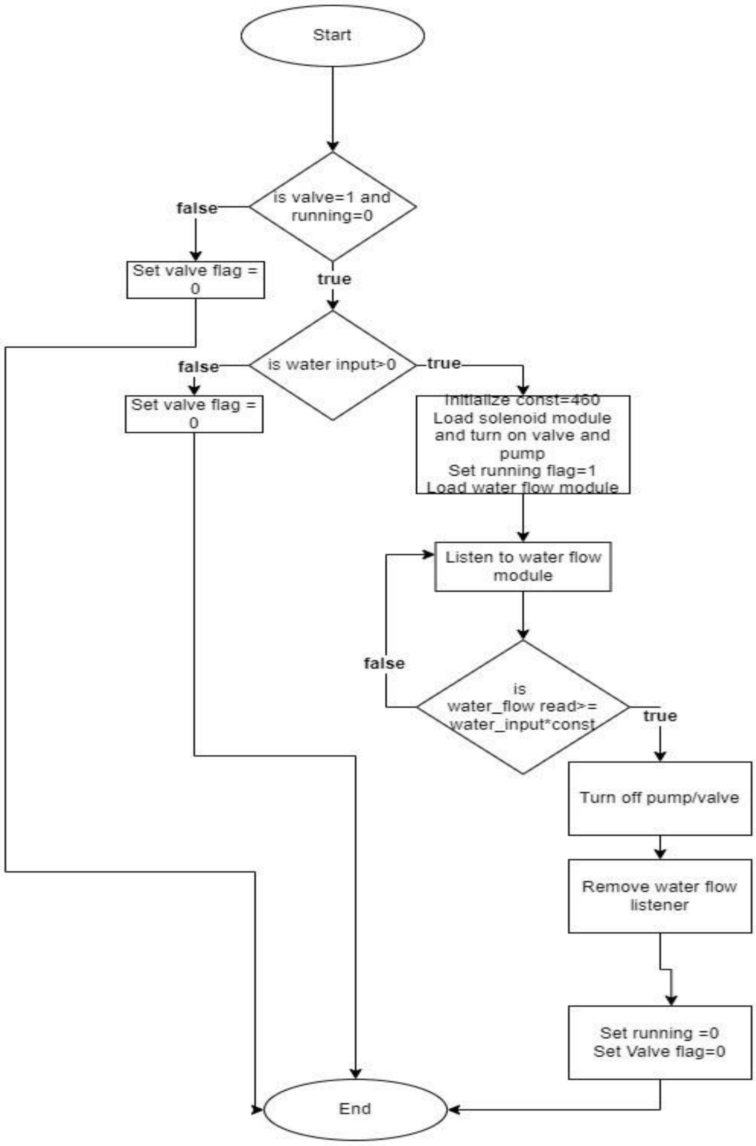

Fig 4.10: Flowchart of valve flag

Fig 4.10 shows the flowchart of valve flag. In infinite loop, if valve is turned on and pump/valve is not running then it checks water input given by the user is greater than 0L or not. If not then set the valve flag to 0. Initialize const and load, turn on the pump/valve module and turn on the running flag. Listens water flowing through water channel through water flow meter module. Check the water flow meter reading with water input until both matches. If they matched means water irrigation has reached threshold. At this point turn off the pump/valve, remove water flow listener then turn off the running and valve flag.

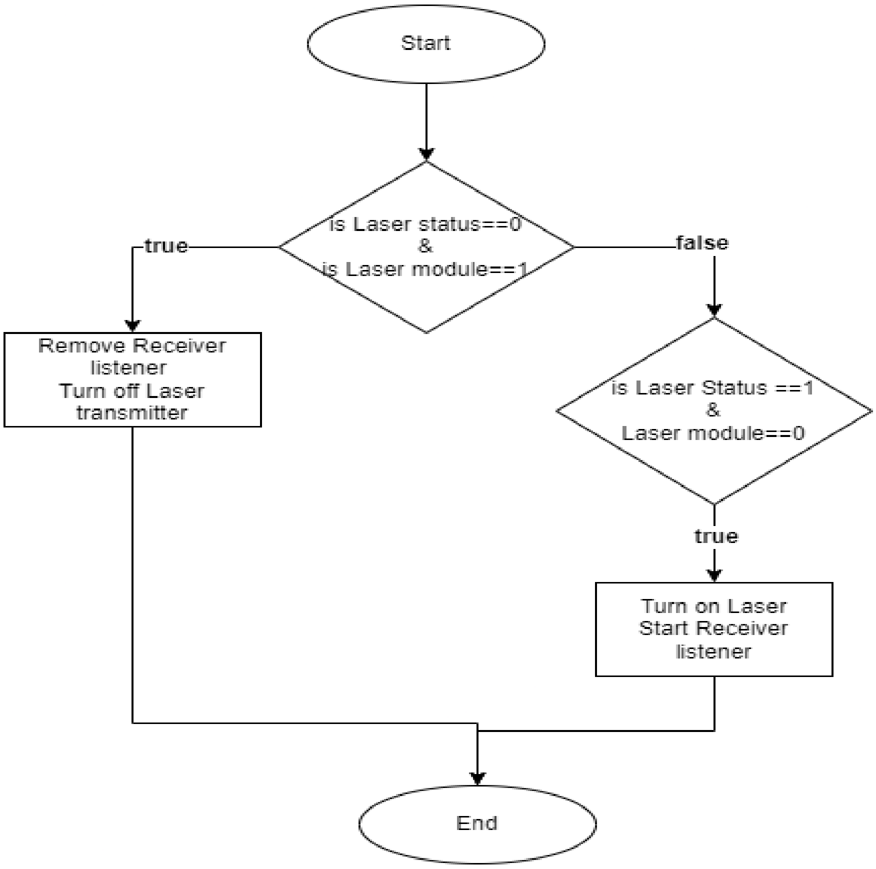

Fig 4.11: Flowchart of laser status page

Fig 4.11 shows the flowchart of laser status page. Laser security module can be turned on and off with the help of laser status flag. If the laser status provided by user is 0 and actual laser module is turned on then it will remove receiver module listener and turn off laser transmitter module. Otherwise, it checks for laser status given by user is 1 and actual laser module is turned off then it will turn on laser transmitter module and adds laser receiver module.

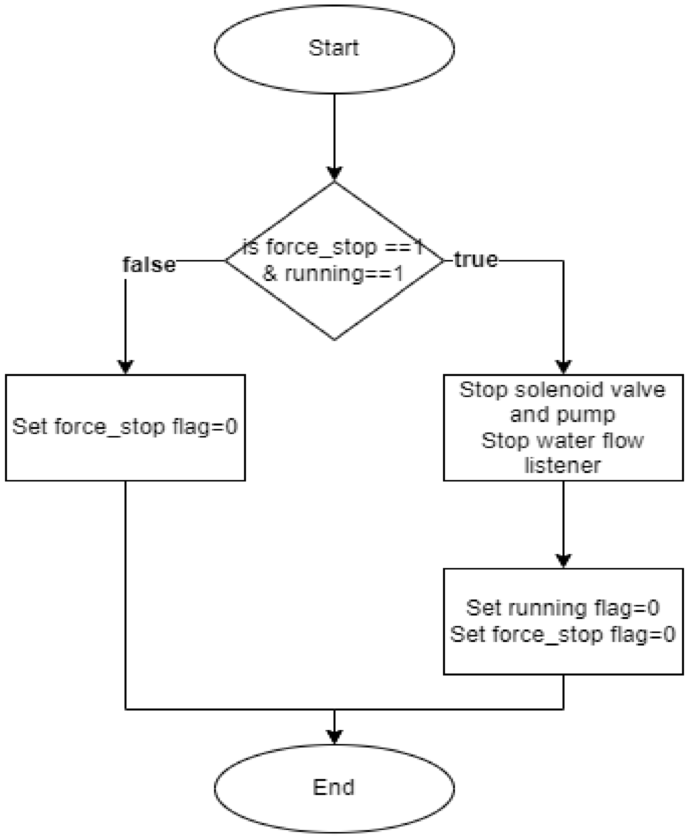

Fig 4.12: Flowchart of force_stop flag

Fig 4.12 gives the flowchart of force_stop flag. In some situation if user wants to turn off the irrigation process, the system will provide force_stop flag. In Raspberry pi control will check if the pump or valve is turned on (running flag) and force_stop is turned on, then it will stop the pump or valve and stops the water flow listener and turn off the running and force_stop flag. Otherwise it simply turns off the force_stop flag.

Summary:

This chapter includes the system design, methodologies, circuit diagram and flowcharts that are required for automation of irrigation.

Chapter 5

RESULTS AND ANALYSIS

This chapter includes all the result snapshots of this project along with its description and analysis and accuracy results of the datasets.

Results:

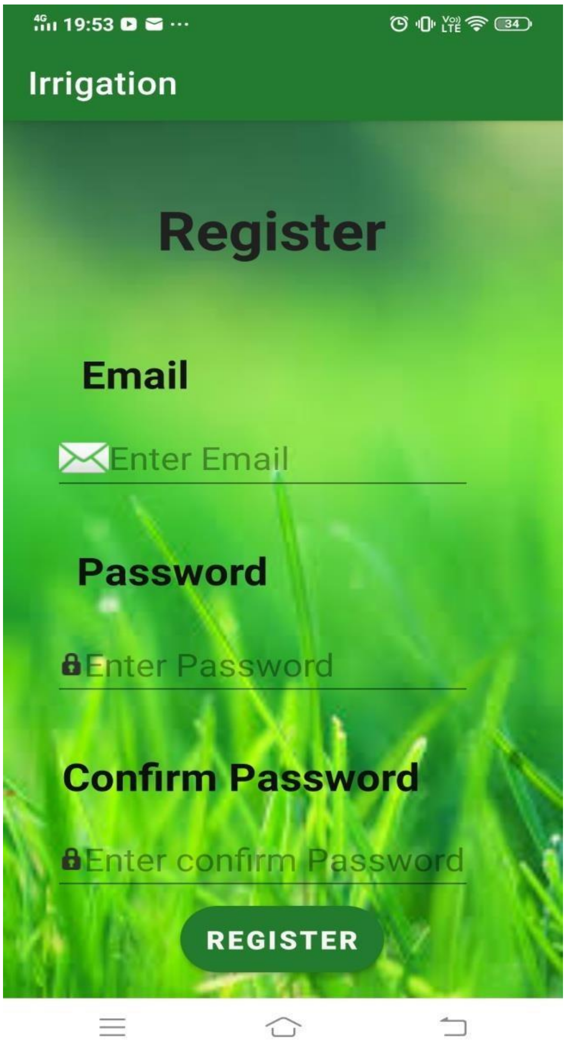

Fig 5.1: Register page

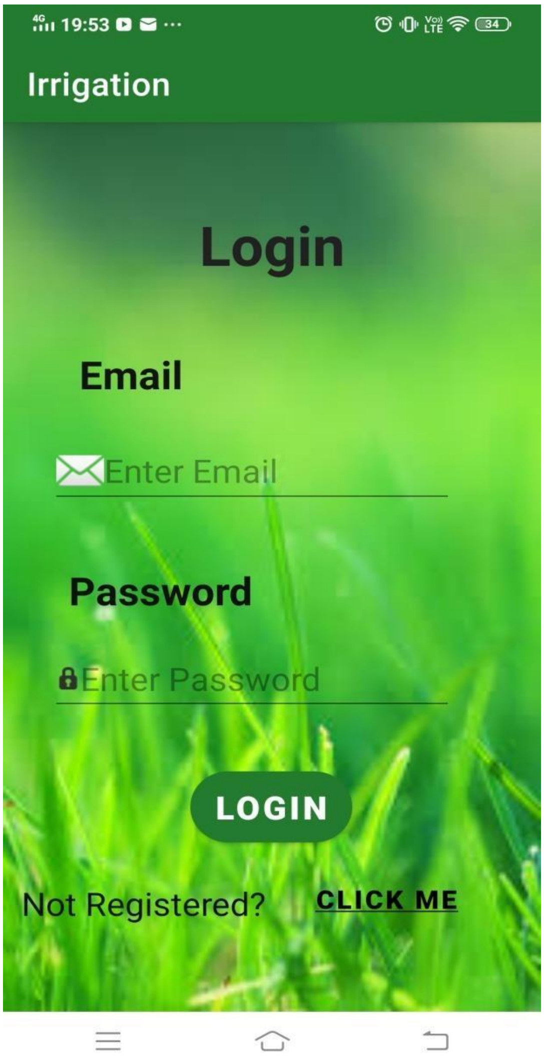

Fig.5.2: Login page

Fig 5.1 the first page in our app, if the new User is logging then he should register first By giving its email and password.

Fig 5.2 shows the login page, Once the user is registered then he can directly login by providing required Credentials that are needed.

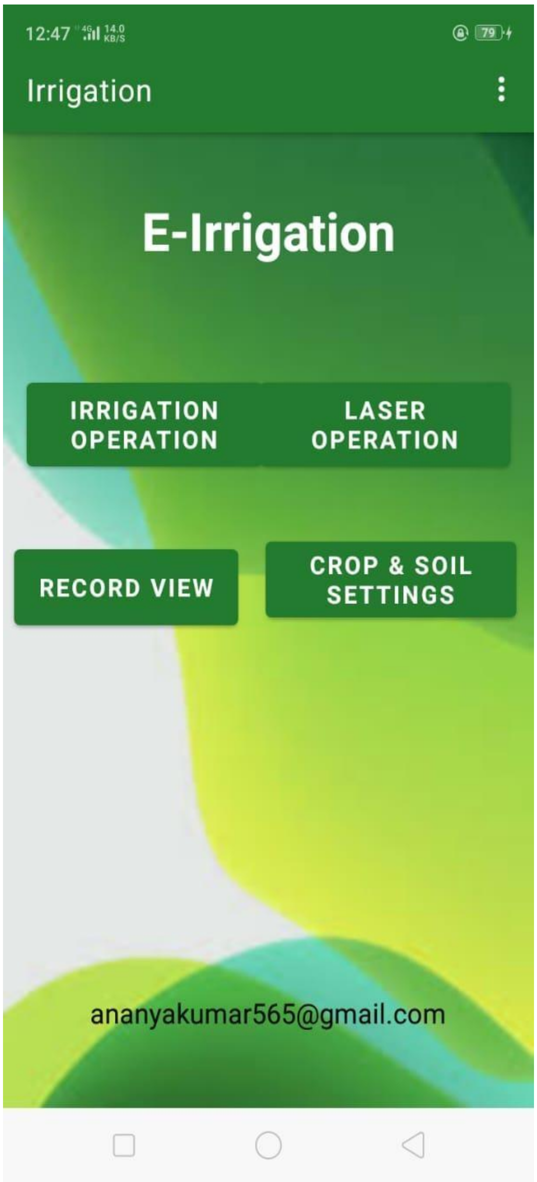

Fig.5.3: Dashboard page

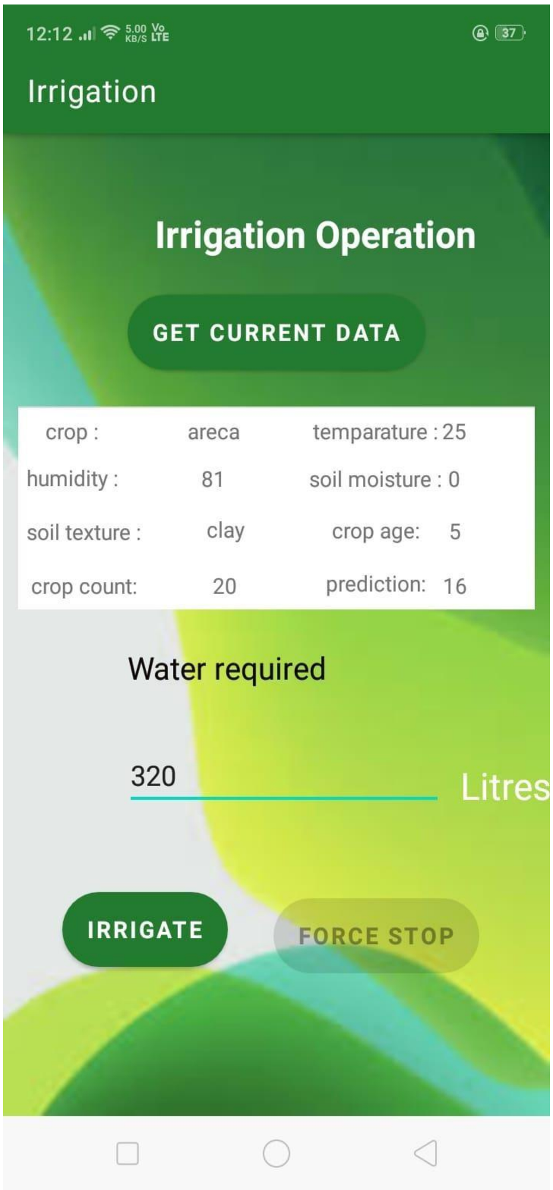

Fig.5.4: Irrigation operation page

Fig 5.3 shows Dashboard page, this is the dashboard of our project that contains 4 different modules such as Irrigation operation, laser operation, Record view and crop & soil settings. Whenever any button is pressed then It redirects to its corresponding page to perform the operations.

Fig 5.4 shows the main irrigation page, whenever get current data button is pressed it fetches all required values from sensors & based on climatic conditions water is predicted and then plant can be irrigated. Irrigation can be stopped by using force_stop.

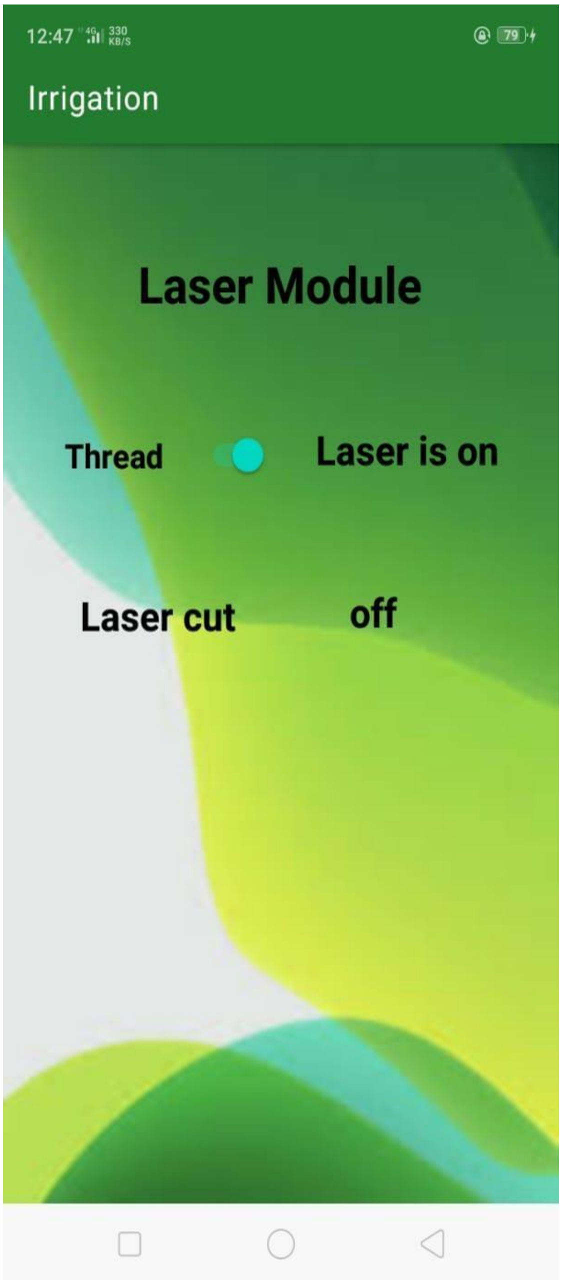

Fig.5.5: Laser module page

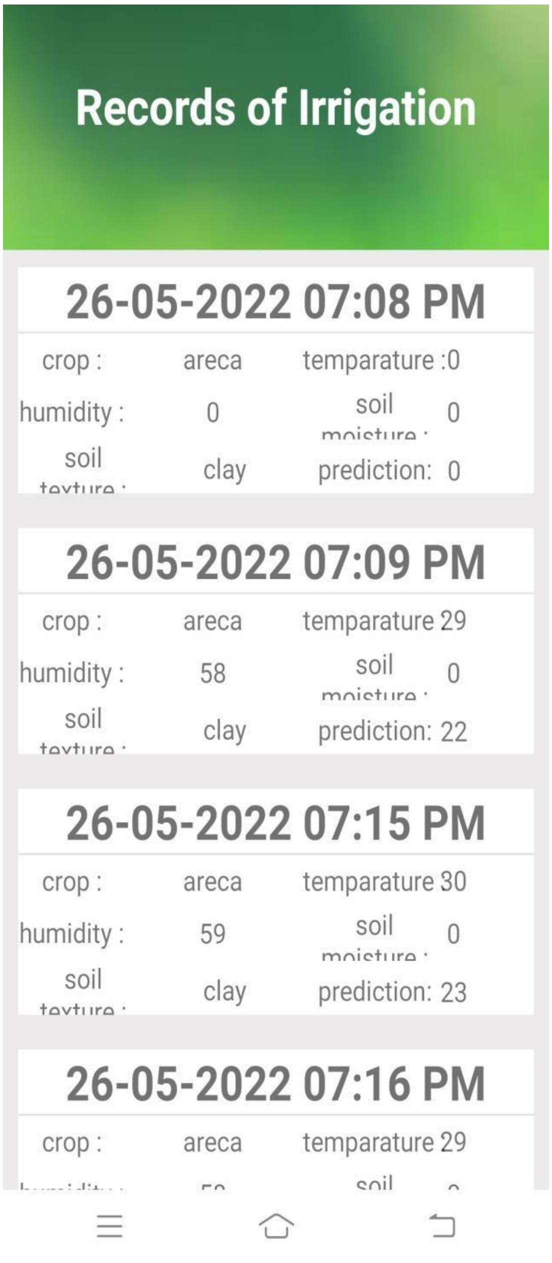

Fig.5.6: Records view page

Fig 5.5 shows the laser module page, If the threat comes then this page displays the laser status and notifies the user by sending notification message

Fig 5.6 shows the Record view page, this page records the complete log of the irrigation process along with date, Time and parameters.

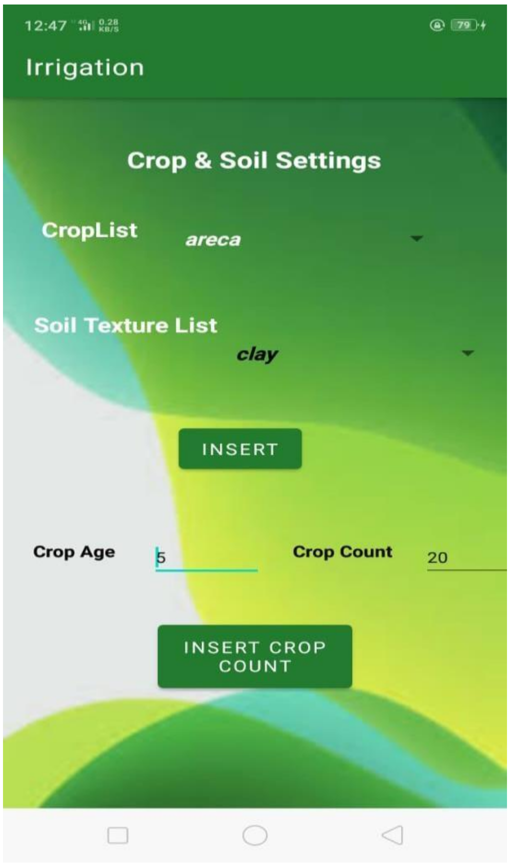

Fig.5.7: Crop and soil settings page

Fig.5.7 Includes list of crops and soil settings, crop count etc. These settings can be changed according to the crops and considering this crop can be irrigated.

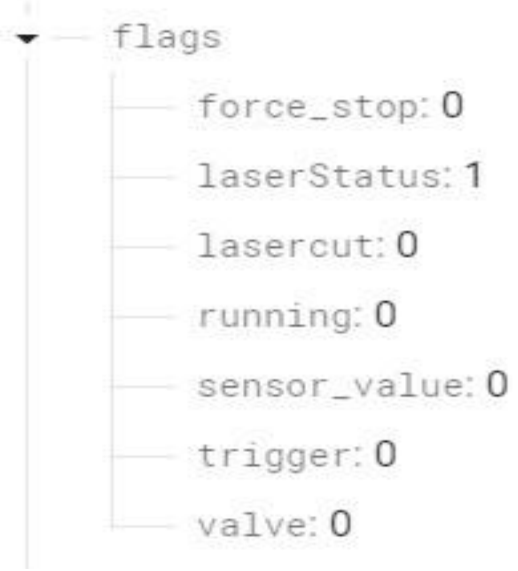

Fig 5.8: Flag variables

Fig 5.9: General crop variables

Analysis:

	crop	temp	humid	moisture	cropage	texture	water
0	areca	10	0	0	A	clay	8
1	areca	10	0	10	A	clay	6
2	areca	10	0	20	A	clay	4
3	areca	10	0	30	A	clay	2
4	areca	10	0	40	A	clay	0
...	...	...	...	...	...	...	...
27894	areca	40	90	50	C	sand	37
27895	areca	40	90	60	C	sand	35
27896	areca	40	90	70	C	sand	33
27897	areca	40	90	80	C	sand	31
27898	areca	40	90	90	C	sand	29

Fig.5.10: Dataset of areca

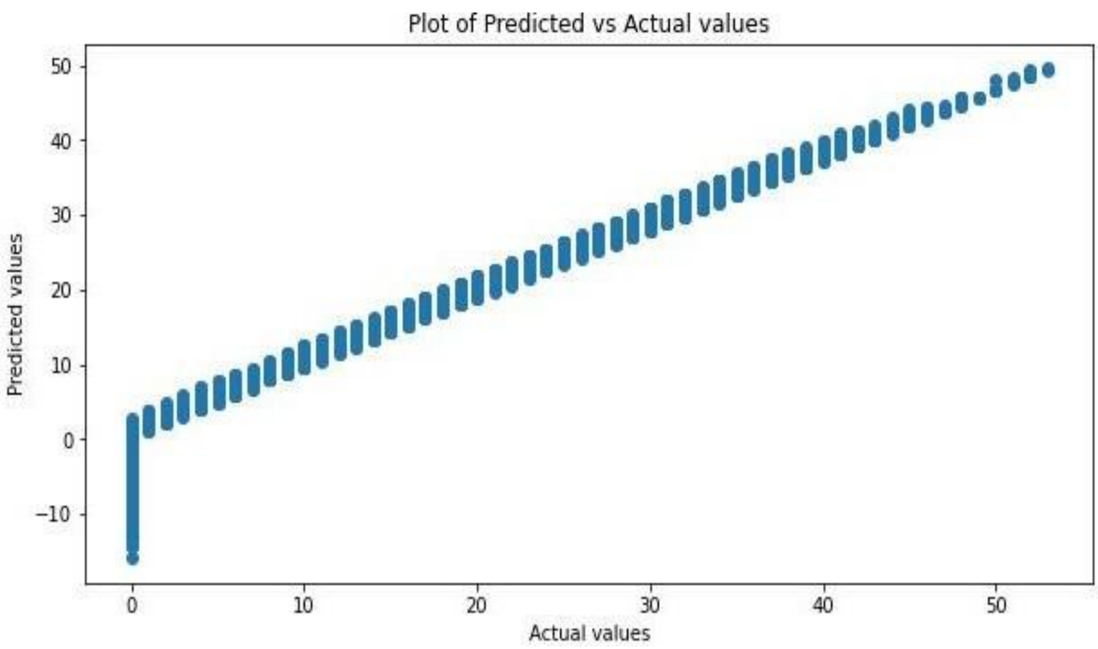

Fig.5.11: Graph of predicted v/s actual values in areca

Accuracy of the model = 97.76

	crop	temp	humid	moisture	cropage	texture	water
0	coconut	10	0	0	A	clay	84
1	coconut	10	0	10	A	clay	76
2	coconut	10	0	20	A	clay	68
3	coconut	10	0	30	A	clay	60
4	coconut	10	0	40	A	clay	45
...	...	...	...	...	...	...	...
27894	coconut	40	90	50	C	sand	113
27895	coconut	40	90	60	C	sand	98
27896	coconut	40	90	70	C	sand	83
27897	coconut	40	90	80	C	sand	68
27898	coconut	40	90	90	C	sand	53

Fig.5.12: Dataset of coconut

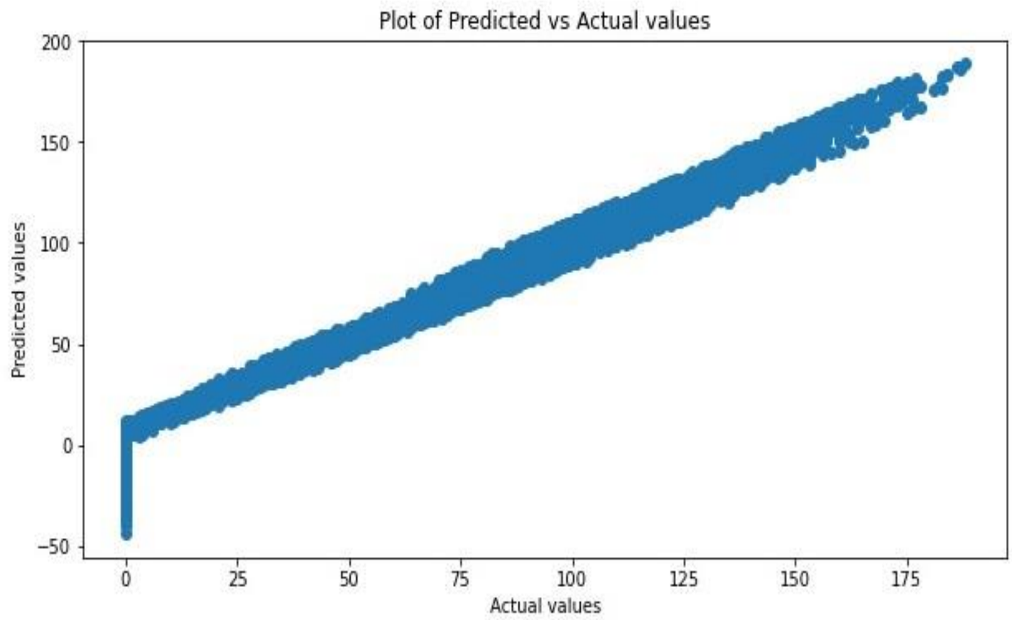

Fig.5.13: Graph of predicted v/s actual values in coconut

Accuracy of the model = 98.224

Fig.5.14: Model of E-irrigation system and security output-1

Fig.5.15: Model of E-irrigation system and security output-2

Chapter 6

CONCLUSION

E-Irrigation system is helpful for farmers by providing efficient irrigation process. Prediction of right quantity of water for specifies crops and controlling the water quantity reduces the burden to the farmer in irrigation. Laser security is useful as it detects security threats for the farm and notifies immediately. Availability of cellular network or internet connection in the remote area is needed for proper working.

The system provides intelligent prediction on water requirements of the crop. This prediction varies as weather condition at that particular area varies. Over irrigation problem can be reduced as it controls precise amount of water flowing through the channel. Hence it can also control unnecessary bacteria growth due to over irrigation. Finally farmers can control the irrigation from anywhere in the world.

FUTURE SCOPE

- Crop yield detection and weather prediction.
- Implementation of Camera module and Sirens to enhance the field security.

Bibliography

[1] Ashwini BV, Udaya Rani V, Smart Irrigation using IOT for surveillance of crop, IJARCCE., Vol. 9 Issue 1, p86-90. 5p. 2018.

[2] Poorvi Pimpalkar, Nisha Pedsangi, Priyanka Phapale Smart Irrigation, IJARCCE, Vol. 10, Issue 11, 2021.

[3] Thanwamas Kassanuk, Malik Mustafa, Dr. Prashant Panse, Shivanand R, Khongdet Phasinam, Thakur Santosh, IOT & Cloud based Smart Irrigation system, Annals of R.S.C.B., ISSN:1583-6258, Vol.25, Issue 4,2021.

[4] Smart Drip Irrigation, Shilpa. A,IJTSRD, Vol 2, 2021.

[5] Anubhav Gulati, Sanjeev Thakur, Smart Irrigation using IOT, IEEE,2018

[6] Hyder Ali Hingoliwala, Subhashree Ghosh, Sumiya Sayyed, Kanchan Wani, Mrunal Mhatre, Smart Drip Irrigation System using cloud, android, and data mining, IEEE, 2016.

[7] R Santhana Krishnan, E Golden Julie, Y Harold Robinson, S Raja Raghavendra Kumar, Pham Huy Thong, Le Hoang Son, Fuzzy Logic based Smart Irrigation, Journal of Cleaner Production, Vol 252, 2019.

[8] Aashima Bassi, Aarushi Sharma, Anneketh Vij, Singh Vijendra, Abhishek Josh, Shivam Bajaj, IOT & ML approaches for automation of farm irrigation system, Procedia Computer Science, Vol 167, 2019.

[9] Dr S Velumurugan, V Balaji, T Manoj Bharathi, K Saravanan, An IOT based Smart Irrigation System using Soil Moisture & weather prediction, IJERT, ECLECTIC – 2020 (Volume 8 – Issue 07),2020

[10] Shilpa Chandra, Mugdha Argekar, Ramya R B, Samiksha Bhilare, Crop Water Requirement Prediction in Automated Drip Irrigation System using ML and IOT, IEEE,2021.