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A Novel Approach of Digital and IOT Base Solution to Automatic Polyhouse

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ABSTRACT: A Crucial act in cultivation farms has been played by currently comprehensive automation. The technique in which human contact is avoided is known as Automation. Polyhouse system controls the atmosphere inside it and it helps the agricultural plants. This process benefits the farmers to cultivate the plants without any external hindrance. Our aim is to Automate the system and reduce human efforts along with extracting useful information from collected data to help making confident decisions. Smart irrigation helps in the minimum wastage of water. It also allows controlling the supply of water to distribute it to the plants when it's vital and smart temperature humidity controlling saves the farmers time and there will be a pre-set module so farmers do not have to go in the field and check all the fertilizers are well going. The project is focused on building a system specifically for the poly-house environment to remove the need of a specialized person to maintain the fertigation and irrigation of plants. Also provide the ability to the user to remotely control and view real-time status of the system.

KEYWORDS: Polyhouse, Automate, Smart irrigation, Temperature control, Humidity control, Pre- Set modules, Fertigation

I. INTRODUCTION

This document In India the fastest growing business sector is Farming. Farming is the income of more than 50% of Indians. Also many businesses depend on farming. So it's necessary to reduce the efforts and increase the production and profit rate. Mechanization and modernization of agriculture must infuse telecommunication and the internet so as to make considerable impact[1]. The use of the Polyhouse system is to protect the plants from abrupt variation in inner climate and monitor the environment in Polyhouse. It aids farmers via marvelous gain of plants beyond any external interference. Farmers in India face many challenges namely small land holding, infrequent supply of power, bad harvest due to interdependency on disorganised mode of agriculture farm, dependency on climatic conditions like rain and paucity of awareness for advance technique of agriculture.[2] Polyhouse is the best method for the increased profit and production. It creates a virtually real and comfortable environment for the crop. This method yields more crop than the normal method and it is more organic. Primarily the integral factors for the growth in a Polyhouse are moisture, thermal reading, and light. So, the greenhouse supports in sustaining the adaptability and good return in farming[3]. In our project we try to Minimum the farmer's efforts and try to automate a system that helps the farmer. The main ambition is to regulate, according to what farmers use the structure of automated irrigation with an adequate economy in a small amount of time to associate few electrical factors.

A. Polyhouse automation task; Fertigation

Most greenhouse operations apply soluble fertilisers through irrigation systems, thus the use of the term 'fertigation'. This is accomplished by drip (pipes) where soluble fertilisers are injected using injectors at a calculated quantity of concentrated solution (stock solution) into the irrigation line so that the water from the hose (dilute solution) carries as much fertiliser as planned. Fertigation provides not only greater resource optimisation, but also better adaptability for suitable placement and delivery of inputs, thereby increasing nutrient uptake efficiency, predictability, precision as per the requirement of the plant or the media formulations. The fertigation method varies based on the variety of plant, irrigation required also the size and technological status of the greenhouse[4]. The simplest method is to combine soluble fertiliser in a watering container or use a hose injector or sprinkler to water plants by hand. This method is tedious and time-consuming but may be best when growing a variety of species with different fertiliser needs in small areas. Therefore, fertiliser injector is relevant for use where fertiliser requirements of large numbers of plants are nearly uniform. Fertigation is a precise, controlled and tested method of applying fertilisers, nutrients and other water-soluble products through drip lines and sometimes by micro- sprinkler irrigation systems as per crop requirements, its stage, canopy size, soil or season, etc.

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A. Polyhouse automation task; Temperature and humidity controlling

People are using a lot of green vegetables that are created in polyhouse such as vegetables using a greenhouse to cultivate. There are two key factors: first is temperature and second is humidity monitoring which helps to regulate the hike of plants and fields ,as a result the different temperature and humidity is required for the growth of different types of greenhouse plants every time which requires consistency in a certain temperature range. Authors have designed a simulation model for forecasting the temperature in a greenhouse. The result shows that the solar air heater will maintain the temperature inside the greenhouse throughout the year and also the heat swap in the soil of the greenhouse, impacting the internal temperature by generally 12% [6].

B. Polyhouse automation task; Fuzzy logic role

Author here implements a fuzzy logic used to supervise the thermal reading and relative moisture of the greenhouse. In the greenhouse environment we are using this logic to forecast the humidity and temperature present in the greenhouse. The end results here show the capability of the monitor to accomplish an adequate surrounding in the greenhouse[7]. Author implemented a MIMO system which proposes a fuzzy model of a greenhouse applying actuators for climate control like ventilation, heating, humidifying, and dehumidifying function.The result shows that a fuzzy controller is useful for reducing the production amount of crop in a greenhouse[5].

C. Polyhouse automation task; Drip irrigation

In drip irrigation we have to give water in a very proper manner and at the proper time . In this project adequate use of irrigation water is being highly crucial,with a substitute operation of water like drip[8]. Drip irrigation helps to provide nutrients and water both at the same time, which is much more efficient for crops. This also expands the quality of irrigation through the fields.The Author, for the good harvest of crops, used Wireless sensor networks to irrigate the farm, which as a result sustained water till a great intensity and soil erosion also diminished[20].

II. LITERATURE SURVEY

Polyhouse automation is nothing but controlling the environmental parameters like temperature, humidity, light intensity, etc using wireless systems. Automation is done using IOT devices like sensors and actuators and they are connected through wireless technologies such as Bluetooth, WiFi. Jianwen Li [9] using IOT technology built a system to automate fertigation and irrigation with help of temperature and humidity. Omer Mohamed Elhassan Ahmed [10] using automation focused to obtain data from sensors and operate the system depending on the data. Adesh Kumar Pandey [11] used HIVE hadoop , HDFS algorithm to Propose a system where data from sensors are given manually through Arduino, a serial monitor and data will be stored in HDFS and analyzed for decision making. They used cloud computing, iot and big data technologies to obtain these results. The Sensors collect data from polyhouse and send it to raspberry pie (RPi). RPi will send data to the cloud where data will be processed with algorithms and predict the future values. All the raw data

and processed data will be sent to the application on a mobile phone from cloud (firebase) with the help of APi[12]. Here the neural Network technique is used to predict values and algorithms to process the received data.Continuous monitoring and transmitting that info to the user device can be seen in [13]. They also have a system which if an accident occurs, a text message is sent to farmers over GSM alerting them. According to Author[14] their system consists of solenoid valves and relay boards, they can restrain the flow of water as well as the flow of electricity of a particular part and have a facility to test manually. Author here studied on a project in which temperature, humidity sensors along with sprinklers, exhaust and heating pipes are being used to make a balance in the environment of the Polyhouse[15]. Author proposed a solar operated mechanised irrigation system which senses parameters like humidity and moisture present in the soil and sprays the field according to the vitality of the crop[16].The farm analysis system by Roshan Paturkar [17] delivers a steady and intelligent system for supervising the sensors. In future, the possessed data can be valued for concluding forthcoming temperature and humidity of greenhouse and poly-house[18].Water logging, Increase salinity, obstruction of air towards roots of plants, Temperature contractions, land becomes soggy, Formation of excess nitrate in soil, acidity of soil. All this can be monitored by ultrasonic sensors in Smart greenhouse[19].Monitoring and controlling the temperature, and obtaining soil data containing Ph and moisture to yield the soil capacity can be seen in a system presented by Mohanraj[20].

III. PROPOSED METHODOLOGY

The Approach of embedded systems design in a polyhouse is to control various parameters automatically. The parameters like Temperature, Humidity, Fan and Fogger Control, Drip control, Fertiliser control are observed and contained with the help of Raspberry Pi, which is spread through the WiFi module to the Firebase and transmitted then

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to the android mobile phone via a Wi-Fi or internet connection. The intention is developing and designing a system which is user friendly and helps farmers to monitor and control their farms effectively without visiting farms.

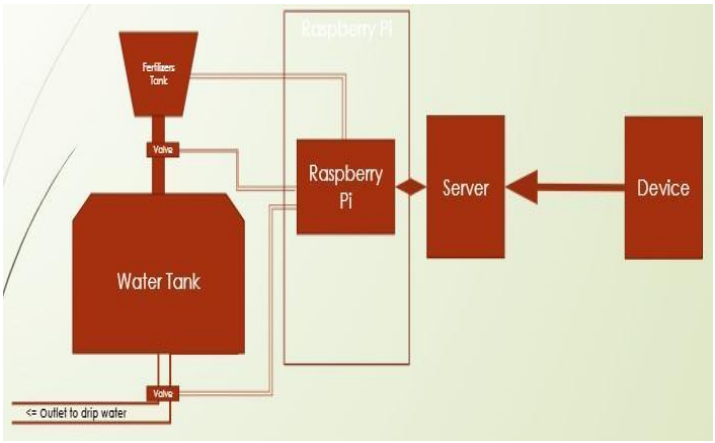

Fig. 1. High Level Diagram for the Automation System

A. Fertilizer Tank

When liquid comes in the fertilizer tank the fertilizer tank will hold all the liquid form of fertilizers.

B. Water Tank

After fertilizer water comes in the water tank the fertilizer mixture and water does not mix with each other till the Water tank will contain the amount of water defined in the pre-set profile in which the fertilizer will mix.

C. Valves

Then the mixture gets out of the tank and ready for drip irrigation through valves and Valves will be controlled by the Raspberry Pi approved to control the flow of water and drip irrigation.

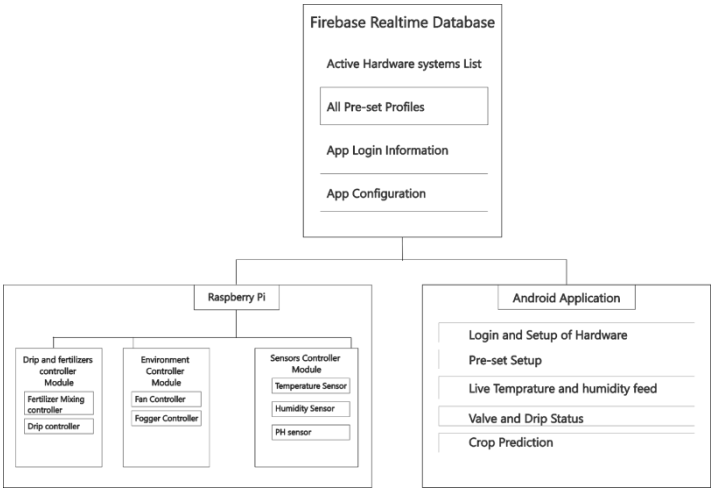

Fig. 2. Low Level Diagram for the Automation System

A. Firebase Real-Time Database

In this Active hardware connected with database, This will store the list of all active Raspberry Pi unique identifiers connected with firebase.Then in the Pre-set profile Each type Of crop has different requirements for watering, fertilizers, etc. Pre-set will hold that information.

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B. Raspberry Pi

The sensors controller module controls temperature, humidity and PH of water.The environment controller module takes the input from sensors and maintains the inner temperature and humidity.The drip and fertilizer controller module takes the input from pre-set and at the specific time it starts the mixing of fertilizer and starts the drip system.

C. Android App

The app shows all the Realtime values.It allows the remote control of the drip system. It gives the option to set the preset profile once that is done the system will operate based on that pre-set.

IV. PERFORMANCE ANALYSIS

The performance analysis of Automatic Irrigation And Fertigation for Polyhouse is performed using Raspberry pie. In the live status the sensors give Temperature and humidity data in every 15-20 seconds interval which is then updated to the database. This data of Temperature and humidity can be observed in a graph which is made on an everyday basis informing the user about the climatic condition of his polyhouse. The system uses this information to maintain the temperature of the polyhouse by turning on the fan/ cooler. As observed in Fig 3.

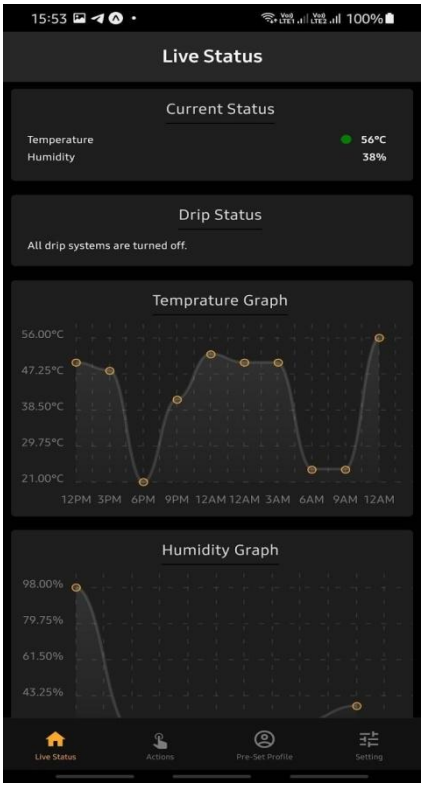

Fig. 3. Live Status Of Drip And Temperature Humidity

The Fertilizer panel (Fig4) displays the amount of fertilizers left in the tank. And also a warning will be posted to the user if the level of fertilizers in the tank are low.

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Fig. 4. Fertilizer Panel

The figure below (Fig5) displays, The Water Drip System has two modes to control it. First is the manual, in which users can turn on and off the water drip with the use of a button present on the mobile app. The manual turning on and off information is then reflected in the database. The second way is using the preset values where the system automatically turns on and off the drip system by measuring and calculating the parameters. A command has been sent to Raspberry pie by the database on operating the drip system.

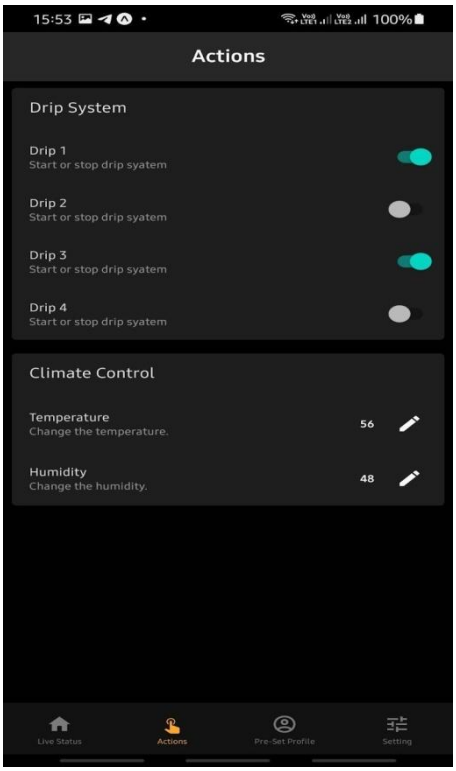

Fig. 5. Parameter Control Panel

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The preset profile has the preset data of various numbers of plants, their suitable temperature, required water, amount of fertilisers per day, humidity and suitable climatic condition. All this data is stored in a database. The database then gives command to raspberry pie, and according to that raspberry pie operates the sensors. Controlling all the parameters for the betterment and good growth of crops in the polyhouse can be observed in the below figure (Fig 6).

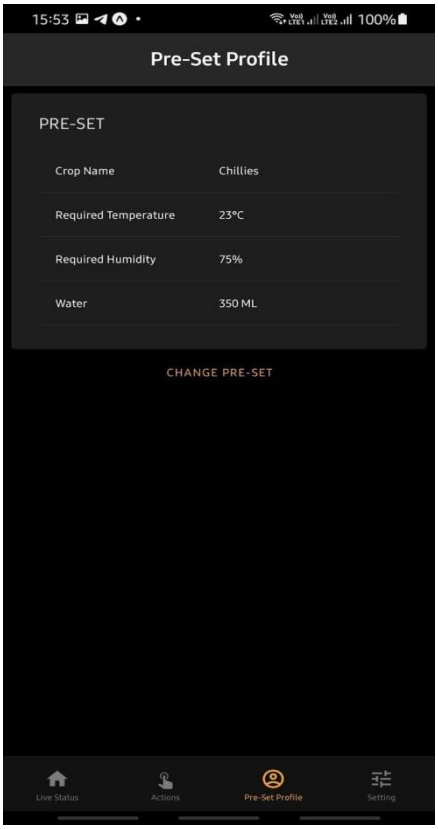

Fig. 6. Preset Profile

The graph (Fig 7) shows the temperature value of each hour. On the Y-axis the temperature is shown and on the X-axis the time is being shown. This data can be used in analysis and prediction.

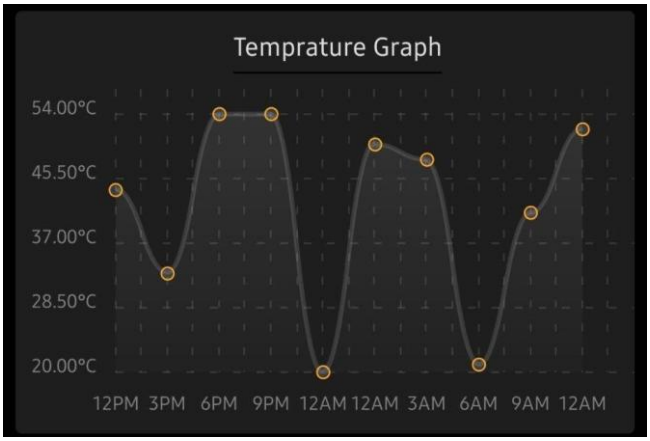

Fig. 7. Temperature Monitoring Graph

The Humidity graph (Fig 8) shows the humid value of the polyhouse for every hour. On the Y-axis the humidity percent is shown and on X-axis the time is being shown. Each crop has a specific requirement for temperature and humidity. The data from sensors get stored in a database and is analyzed and used to predict which crop is suited for

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that specific environment. This will allow the farmers to get an idea whether the crop can grow in that environment or not. This will help farmers to make better decisions.

Fig. 8. Humidity Monitoring Graph

A. Deployment Of The System

The following diagram shows the deployment of polyhouse automation which is done using firebase, firebase is active as the server along with the database. The authentication is handled with the firebase auth module which takes care of creating new users and authorizing them. Raspberry pi has an application which updates the database and that will be processed by the firebase tensor flow model.

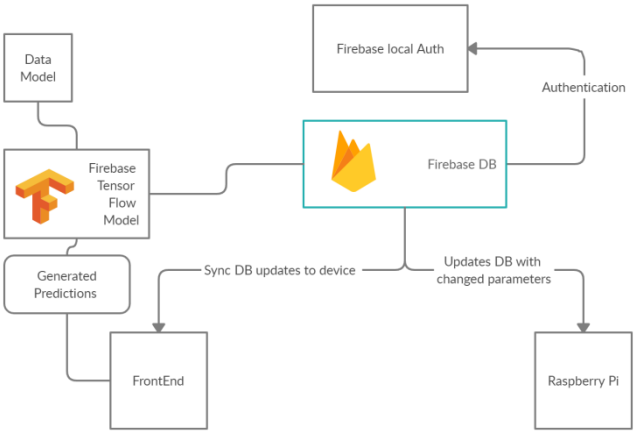

Fig. 9. Deployment Diagram of the system

V. CONCLUSION

The use of the sensors and IoT to generate control for the irrigation of the farm, there is a significant saving of the resources.In this paper, we have presented the concept of automation in polyhouse using various sensors and actuators. We have worked on the project in terms of research and gathered the related information. The problem which we have seen so far, is being tired to find the solution throughout this project. That means farmers do not always have to visit the polyhouse and keep an eye on every parameter. The time saved can be used for administering the rest of the activities on the farm. Even the manual mistakes of farmers will be prevented by the system and will also fix up some surveillance for cautious activity.

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