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Aggrigated Controlled Environment for Cultivation

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Abstract

Closed farming system has the upside of shielding the plants from outside brutal conditions and giving appropriate conditions to plant development; it can viably improve the harvest yield. In any case, the conventional checking and control costs a great deal and the control interface isn't friendly and they are based on manual technology. With the coming of the distributed computing and ease Internet-of-Things frameworks, we can apply these ease and powerful advancements to monitor the closed farming conditions, plant development and control the closed farming environment conditions By monitoring the surrounding environment in Real time the data obtained from the sensors can be analyzed and can be used to improve the cultivation of a specific crops. In this framework a low cost closed farming monitoring system is being implemented for medium sized areas. With AWS, Crate Db, Raspberry pi 4, Apache Kafka, and Flink, we build up a proficient and very effective framework to accomplish the above objectives.

Keywords: *AWS, Raspberry Pi 4, Crate Db, Flink*

1. Introduction

Agribusiness in India is behind in incorporating current advancements. Around 65 level of Indian populace has been occupied with agriculture and partnered exercises which establish just 10 percent of GDP so it turns out to be a lot of significant for the stake holders involved to leave the traditional farming practices and modernize the horticulture utilizing innovation. The economic contribution of horticulture to India's GDP is consistently declining with the nation's expansive based financial development while large number of individuals keeps on working in agrarian sector. In urban regions, the citizens have all the fundamental necessities like Electricity supply with negligible number of electricity cuts, Food supply, good streets and yet, the situation is completely different with village regions, where dominant part of towns endure power deficiency, agrarian issues, inappropriate stockpile and less amount of water required for day to day basis[1] .Hence, there is a quick need to improve the system, which can expand the yield and simultaneously improve the natural food nourishment. Spots like Punjab, which get plentiful measure of water through stream and channel water system framework, faces issue of soil saltiness because of overabundance water system. Spots with restricted water supply like Rajasthan, faces issue of intense water deficiency for agriculture. Excessive utilization of manures, bug sprays and pesticides makes the dirt reliant on them, disintegrates richness, in-wrinkles, contaminates groundwater and close by water bodies. Different plants require distinctive measure of moisture, humidity, temperature and light frequency, and absence of consciousness of this data or carelessness of a person will spoil the plants before it gets matured. In most of the rural areas there[9] is long duration of power cut especially in summer seasons, this results in delay of supplying water to the crops and it affects yields of a crop.

By applying the closed farming method in cultivation it protects the crops from harsh climate conditions and it has many advantages than growing it in outside field. It increases reliability and higher yield of crops by 25% more when compared to the

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outside field, different types of vegetables can be grown throughout the year irrespective of the seasons as the environmental conditions can be manipulated easily and most important part is disease free crops are obtained it results in reduction of fertilizers used. With the help of IoT technology the closed farming system is improved, the water is automatically supplied to the specific crop when the moisture content drops below the threshold limit and it maintains a constant moisture content as required by the specific crop and even the surrounding temperature and humidity is maintained as required by the crop. Incase if the temperature and humidity raises above the fixed threshold limit an mini-exhaust fan turns on automatically till the temperature drops to an fixed point. An farmer can easily get to know the status of moisture and surrounding environment of the closed farming by an application and by SMS modes and incase if there is deficiency in sunlight for photosynthesis growing led lights are automatically switched on this ensures rapid growth. Ecological factors including temperature, humidity, light rays and so on can mirror the environment condition inside the closed environment. These environmental variables can be observed by utilizing different environmental sensors put inside the closed environment which are operated by Raspberry Pi 4 Wireless Network and Dual axis solar tracker is being used to harvest solar energy and pass the electricity to the system modules, due to the power cut the monitoring and controlling of the closed farming is temporary halted and this might cause many issues such as detecting the pests, intruder and the constant temperature, moisture content and it results in delay and eventually it affects the yields so by using the Dual-solar track these issues can be rectified and it can lead to reduction in electricity bills. The data obtained from closed farming system by the different types sensors is being processed by Apache kafka, Flink, Crate Db for storage and Sql dashboard to visualize the data in Real time and analyze it accordingly.

2. Related work

In this "Implement Smart Farm with IoT Technology Parameter Monitoring for exactness Agriculture"[2], The ecological information collected by the sensors from the growing field are being sent to the main hub through every networks available. They have utilized different types of sensors such as temperature, carbon dioxide and the detected sensor information is transmitted with no delay. The communication takes place between the server and hubs simultaneously with no delay. The network medium utilizes MQTT so the communication is done only by the specified IP network address. In this manner, the server gathers data simultaneously from the ecological field and stores it in a database and simultaneously updates it.

In this “Automation of Hydroponics Green House Farming using IOT”[3]In this system the water system control strategy show that it is acceptable option in contrast to the right now accessible procedures utilized for water system and supplement supply control. Water system tuning is accomplished in a simply feed forward circle. Precariousness issues because of the postponement in the criticism circle are stayed away from since input is utilized distinctly for tuning the model parameters. Contrasted and hearty control structure, the proposed strategy requires for all intents and purposes no exertion for its application on a particular is explained in a straight forward way.

In this paper "IoT based smart Crop-Field Monitoring and automation Irrigation system"[4]. The author points a high exactness observing the information and control horticulture computerization framework with IoT innovations. Modules such Raspberry pi and cloud platforms have been utilized based on IoT framework to observe the ongoing information originate from the harvest field. The framework fundamentally centers soil conditions relate with temperature changes information by IoT sensors and controls water system framework. So as to giving the cloud based processing to framework the exactness level has increments as appropriate to utilize the framework by an user.

In this paper Long-range & Self-powered IoT Devices for agriculture and Aquaponics Based on Multi-hop Topology"[5]. The IoT modules for horticulture and aquaponics have been designed and dependent on the NRF52840 with a protocol known as Multi-hop protocol. The hubs don't require any human interaction during their lifetime of the modules, and they harvest vitality a few times more than the utilization. Specific nodes are installed with ecological sensors, with the option of including outer sensors for soil estimation. hub for soil dampness and air temperature estimation.

In this paper "Intelligent command of an underground irrigation and fertilization system "[6]. The author represents an answer for wise control for a underground water system and treatment framework. Water system and use of synthetic composts through underground establishments is a considerably more compelling strategy for horticultural harvests. This strategy takes into consideration better authority over the way which water system and treatment are performed. The arrangement proposed right now a smart order and control framework for water system and treatment utilizing the underground office. From one perspective, we have a lot of info parameters identified with soil quality and a lot of yield parameters identified with the water system framework control of the manure. A clever calculation will decide the arrangement of orders that will improve the info parameters and arrive at ideal water system and treatment focuses.

In this paper “PROTOTYPE MODEL OF POLY HOUSE FARMING USING SENSOR AND IOT TECHNOLOGIES”[7]. In this paper sustainable poly house agriculture arrangement with completely mechanization as for water system and crop yield management is clarified. It has been seen that the yield

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under polyhouse or nursery cultivating can be accomplished at a more significant level around 6-9 times when contrasted with cultivating done in open field. Despite the fact that the underlying venture is high, yet advantage cost proportion can be high whenever utilized appropriately

In this paper "Solar (PV) Water Irrigation System with Wireless Control"[8]. This model consistently gives sufficient amount of water to the paddy field to overcome from underfilling. Furthermore, the energy received from the sun gives enough vitality to the framework to make it manageable .This technique gives remote data regarding soil condition by the different types of sensors which can help users in seeding and collecting of yields convenient alongside labor sparing. The persistent water level checking and water siphon computerization are remarkable highlights of this exploration.

In this paper "Exploiting Flexibility in Irrigation While Maintaining Optimal Crop Productivity"[9]. In this paper they have proposed a model and an answer for the issue of planning water system time to limit power costs while fulfilling crop water necessities. Numerical examination is performed to approve their model in view of genuine information obtained from a soybean and from the relating power administrator and finally proposed water system scheduler and adaptability distribution components increment the capability of the network to have sustainable power sources while decreasing the power costs in horticulture.

3. Methodology

Proposed system: The main aim of this work is to develop closed farming controller which might be equipped for dealing with two factors that influence plants development, water and temperature by utilizing a progression of conditionals, the model ought to transfer the information to a server so it might be broke down later. The principal to be illuminated was which stage ought to be the most fitting to address the issues. The one chose for this is the Raspberry pi4 , because of its adaptability and diverse equipment alternatives of this board, it simply has Wi-Fi and has the ability to connect to the Internet and simultaneously process the data received from the sensors and take decisions. The main aim of this work is to develop closed farming controller which might be equipped for dealing with two factors that influence plants development, water and temperature by utilizing a progression of conditionals, the model ought to transfer the information to a server so it might be broke down later. The principal to be illuminated was which stage ought to be the most fitting to address the issues. The one chose for this is the Raspberry pi4 , because of its adaptability and diverse equipment alternatives of this board, it simply has WiFi and has the ability to connect to the Internet. The engineering works along these lines, the Raspberry pi4 takes the data originating from the sensors introduced close to the plant. This data is changed over into numbers and analyzed by the controller which consists the different types of sensors placed in the closed farming system At last the sensors data is sent to the server so the data might be taken by the application.

To peruse the factors on each plant, a progression of sensors were utilized; to monitor the surrounding temperature DHT11 is used. The framework must transfer information to a server for storing and processing the data. To do so the less difficult approach to get information into a server was to utilize AWS server.

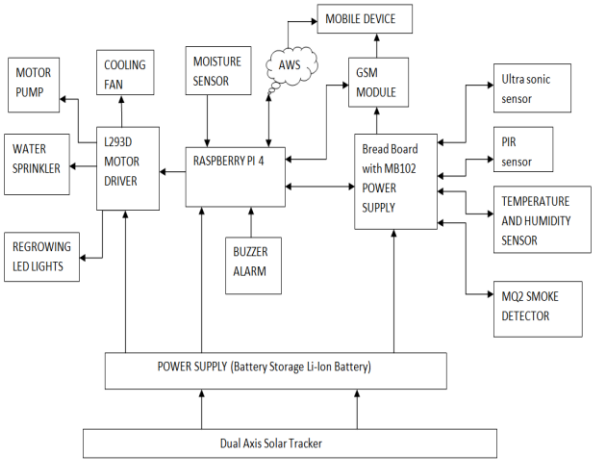

Figure 1: System Architecture Block Diagram

A. Controlled Environment for Cultivation

In a closed cultivating framework the temperature and humidity sensors are placed inside to monitor the general surrounding environment conditions. Incase if the temperature increments over than the fixed limit as required by the harvest crops, Raspberry pi 4 will naturally pass the order to turn ON the fogger and to turn on the exhaust fan , with the assistance of fogger it will sprinkle little water in the encompassing territory, and this aides in lessening the temperature. At the point when the temperature drops to as fixed limit the modules will automatically turns OFF and at the same time it updates the current state to the farmers mobile by SMS mode and by the application warnings. So as to keep up the steady moisture content in soil required by the predetermined yield. The moisture sensors have been deployed in the field which estimates the moisture content in Real-Time and it automatically passes the command to the Raspberry pi4 to turn ON the motor as soon as the moisture content drops below than the required level as required by the specific crop and it automatically turns OFF when it reaches the maximum level of the specific crop moisture limit and at the same time simultaneously it updates the farmers mobile device by SMS mode and by application warnings with respect to every choice taken by the main controller. During morning, leaves receive legitimately amount of sunrays from the sun , so as to support up the pace of growth, we have given the Closed farming system regrowing led lights which switches on automatically at whatever point the perusing from LDR sensor drops underneath the threshold value. Progression in LED

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technologies have made it conceivable to manufacture LED lights that radiate the light in a quite certain spectra to accomplish unmistakable results in a plant development. To avoid any unwanted intruders entering the closed farming environment, Ultrasonic sensors are being used to track movements and PIR sensor is used to track Pests as soon as it detects any movements an buzzer alarm is turned on automatically and notifies farmers mobile immediately by SMS modes and can see the status in his android application installed , MQ2 smoke gas sensor module is used to detect any flames, smoke and immediately turns on the sprinkler system and notifies the farmer mobile by SMS mode. In this system for the SMS medium we have used Textlocal service PHP API and its handled by postman service for sending the SMS to the farmers mobile regarding every decision taken by the Raspberry pi 4, the domain name set up in textlocal service is BP-ADARHJ. Incase if the server goes down it gets relinked to GSM module and it is used in communicating with the farmer. An website has been created to monitor the data remotely, analyze and take control over the modules of the closed farming system

B. Dual axis solar tracker for interupted power supply

In rural areas there is an immense long stretches of electricity cut this directly influences the Closed cultivating framework for development and it neither be controlled or checked because of the absence of power and there is a need to reduce the use of electricity as it can prompts to decrease in electricity bills. To solve these issues dual sunlight tracker Light Dependent Resistor known as a light sensor has been utilized. The two light sensor used are isolated by the divider which will make shadow on one part of the light sensor area incase if solar panels aren't directly proportional to the sun. The controlling circuit device microcontroller 16F667A is being used that controls the rotation by the relay information got from the sensors and the microcontroller process the obtained information. The microcontroller will send an information to the Bi-directional DC motor by relay method to guarantee the solar tracker board is opposite towards the Sun. Rotation of the motor either clockwise direction or anti-clockwise direction is controlled by the motor .The motor takes complete control off the solar tracker board direction by this method the solar panel track the sunlight and adjust it accordingly with the sunlight rays, it increases more absorption of solar energy. The electricity energy received is stored in a Li-Ion battery and it is directly supplied to the modules.

C. Android application

An Customised android application is been developed that is compatible to all android version. With the help of android application an farmer can monitor all the aspects related to closed farming system and take control of every aspect like turning the motor ON/OFF whenever required and can even be monitored by an website which is being linked to Amazon aws , khafka, flink and crate Dba.

D. End to end network medium

In this project we have used aws khaka , flink, crate db and sql dashboards in monitoring and for analysis it is simultaneously linked with mobile application.

Apache Khafka: AStack utilizes Apache Kafka on the cutting edge, to line messages got from IoT sensors from the closed farming systems and make that information exceptionally accessible to frameworks that need it . It is a circulated, high-throughput message lining framework dependent on a dispersed submit log. The center reflection is a subject that is divided into numerous allotments. The Kafka solidly endures approaching messages utilizing the configurable maintenance strategy that decides to what extent messages are accessible for utilization. Each seperation keeps up the permanent, requested succession of messages

Flink: It is utilized in handling the information got from the sensors . It utilizes Apache Flink to process the data obtained and infuse the sensor information stream that has been lined by Apache Kafka and transfer it to the CrateDB database. Flink ensures that prepared messages influence the conclusive outcomes precisely once, considerably under framework disappointments. Apache Flink is mainly utilized in stream handling structure that executes information pipelines and stateful calculations in day to day tasks upon the information streams.

CrateDb: It is being used in storing the data and inquiry information and it advanced by Apache Flink. CrateDB is another sort of appropriated SQL database that makes the stack very skilled at taking care of mechanical time arrangement information because of its convenience data is processed in Real-time with no dealys. Expanding or diminishing database limit is a straight forward of including or evacuating nodes. The data obtained is integrated to a website in which an user can monitor the data and analyze the data of the surrounding environment of a closed farming remotely and take control over it.

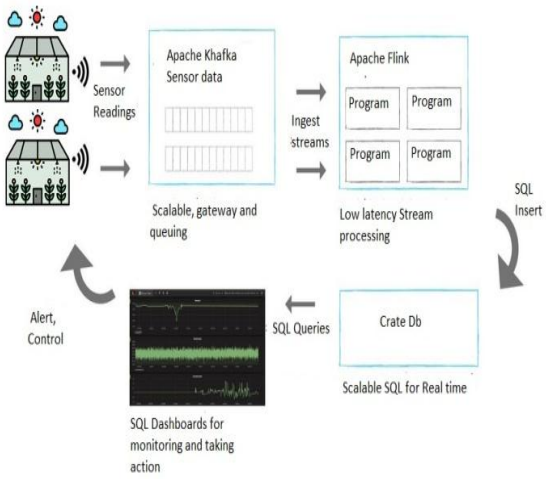

Figure 2: Role of each particular software

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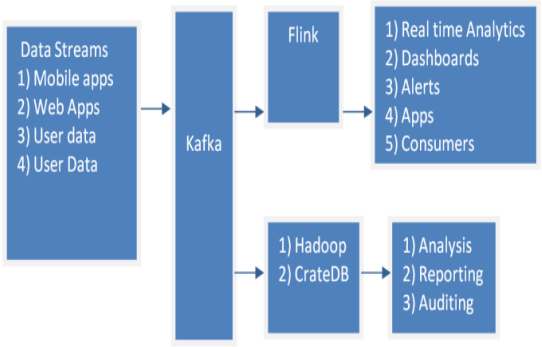

Figure 3: Schematic Block Diagram of Softwares

Hardware components used in this project are:

1. Raspberry Pi4
2. ULTRA SONIC SENSO
3. PIR SENSOR
4. GSM MODULE
5. WATER SPRINKLER FOGGER
6. MOISTURE SENSOR
7. REGROWING LED LIGHTS
8. MOTOR PUMP
9. L293D MOTOR DRIVER
10. MINI EXHAUST FAN
11. TEMPERATURE AND HUMIDITY SENSOR
12. LDR SENSOR
13. MQ2 SMOKE DETECTOR
14. BI-DIRECTIONAL DC GEARED MOTOR
15. SOLAR PANELS
16. LITHIUM ION BATTERY PACK
17. Microcontroller 16F667A
18. Buzzer alarm

Softwares:

1. Cloud platforms: AWS khafka, Flink, Crate Db
2. Text local service API is integrated to cloud platforms to send sms regarding every status
3. Andoid studio used in creating the custom android application.

4. Results and Discussions

In this work different types of sensors are used, Raspberry pi4 acts as the main controller and different types of sensors are attached to it with the help of breadboard. In a closed faming system area as soon as the moisture sensor detects lesser moisture in soil below avg=99 the motor was turned on automatically and an sms was sent to the famers regarding the status and the motor remains in "ON" state unless and until it reaches avg=100 and it turns off automatically, the main aim is to main a constant moisture content, the moisture parameters can be changed according based on the specific crop and when the temperature increases above 28 degree Celsius an exhaust fan, fogger was turned on automatically, it helps in reducing the ambient temperature and it gets turned "OFF" when it matches the requirement conditions by the crops. The movement of intruders and pests was tracked by Ultra sonic sensor and PIR sensor successfully and immediately it passed a command to the buzzer alarm and sent an sms to the farmer, growing LED lights were automatically turned on when there was lesser amount of sunlight. With the help MQ2 sensor smoke was detected and immediately the sprinkler was turned on.

Every decision taken by the Raspberry Pi4 will be updated to the farmer phone by SMS (figure 5) and App notifications with the help of android app the closed farming environmental conditions are monitored in Real time and the environment conditions can be controlled by the application(figure 4). By this closed farming cultivation there have been a huge improvements in growing all types of crops and the results obtained were better than growing the specific crop in outside fields and there was a total reduction in electricity bill as dual solar tracker was used in supplying the current to the modules.

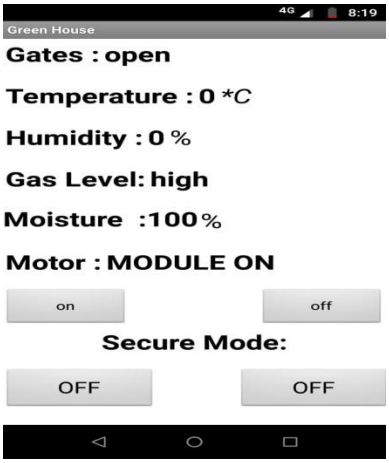

Figure 4: Android application used for closed farming

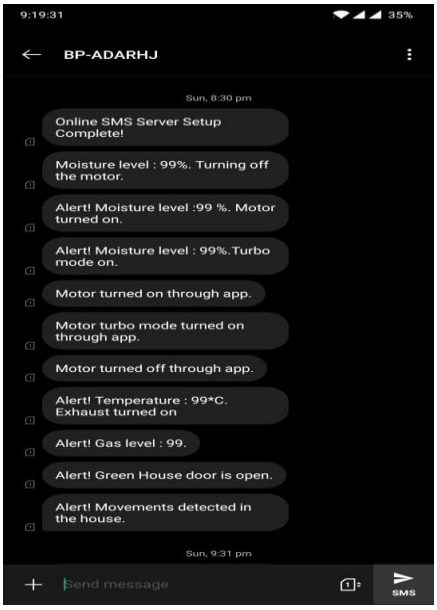

Figure 5: Text local service API SMS MODE

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5. Conclusion and Future Scope

There is a greater necessity for closed farming cultivation system and implementing the technologies like Bigdata Apache kafka, flink that can be able to process large amount of data received from sensors in closed farming cultivation and parallelly take decisions. By this method higher yield and production is achieved from growing the specific crops and these is less maintenance as all the process is autonomous and it can be remotely monitored and controlled from anywhere.

Future Scope: Infrared concept and Thermal imaging techniques can be applied to calculate the harvest time required and detect disease in plants and simultaneously upload the images to the database and search for a particular disease and finding a cure for it.

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