
Proposing New Secured Android-based System for Remote Controlling of Agricultural Farms

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ABSTRACT

In the existing time, farmers faced many problems during their cultivation. If they are growing crops in the rainy season, they may not get enough rains, labor problems, groundwater problems, pests and diseases, unexpected rains during harvesting the crops, and insufficient land area. Therefore, the researcher stands to find a solution to this problem. So, the researcher brings the solution to this greenhouse. Greenhouse technology is plant-friendly technology. It is used to protect plants from adverse climatic conditions such as cold, rainfall, wind, high radiation (UV rays), high temperature, insects, and diseases. With the use of the latest IoT stuff, the Researcher hopes to make this project an automated environment in the greenhouse. Environmental conditions have changed so much that any plant can be planted at any time, providing the right environmental conditions with minimal labor (more or less one labor). Agricultural IoT system provides farmers with accurate live data on temperature, humidity, soil moisture, and air quality levels so that products can be improved over time. This research difference is using drones for monitoring and sending information to the owner mobile application for improvements to the main system using GPS. This project utilizes few different sensors, a temperature sensor, a humidity sensor, a soil moisture sensor, Ultrasonic Sensor, a quality measurement(Methane Gas) sensor using digital image processing, and a rain detection sensor, a flame sensor, etc. The sensors are controlling the two actuators which are a pump and a heating fan. Solar panels generate electricity and are connected to batteries that can be recharged for energy use. Hence, reducing electricity costs is another advantage. The app can add values for its main use and set the time interval for automation. Another option of this mobile application, the user is own cell phone can control the storage water level and fertilizer calculation added according to their NPK capacity. The remote control of the plant's needs when using one's vacation or not around the house.

Keywords: Automation Irrigation System, Android Application, Arduino Objects, Mobile Application, Flutter Developing

INTRODUCTION

To implement an IoT-based solution for greenhouse monitoring and climate control, first, we need to know what greenhouse climate factors we need to manage and what methods are in place to control it. Whatever, the Greenhouse Environmental Control Systems are indebted to the interaction of many environmental variables that affect the growth and production. Accurate knowledge of the factors that limit primary production to the explicit need to adapt food production to the needs of the world's population. Therefore, it is imperative to identify and understand these environmental factors that limit the agricultural production and physiological responses of plants to environmental stresses.

RECOMMENDATION SYSTEMS

Background/Overview

Agricultural technology plays an important role in the development of an agricultural country. Agriculture was one of the earliest occupations of mankind, and today no further interference with farming is inevitable. Plants in our country are produced because they can be used to grow plants under controlled climatic parameters that directly or indirectly control plant growth. Greenhouse agriculture must control environmental factors to achieve optimum growth conditions of the crop. Climate change, waste recycling, time management issues, quality, and disease infections are major issues in the agriculture sector. Today, inefficient and excessive use of inorganic fertilizers can constitute environmental risks and require advanced agricultural technology to meet the daily demand for food. Therefore, the need for a measuring tool is increasing.

For these reasons, automated technology has been a topic of interest in the research world for many years. The final stage of the project is the intelligent monitoring of greenhouse environment parameters such as temperature, humidity, gas (In greenhouse area) and intensity of light, and continuously informing and controlling the use of the conditions in the greenhouse using IoT technology.

AgroGen is a new technology that allows solutions for the agricultural field. AgroGen offering many opportunities and can be used for smart farming, smart cities, and many more. In this project, we use this new technology in greenhouse farming as well as in agriculture so that we can make profits like automating greenhouses, remote monitoring, controlling them, and maximizing production at low cost. Likewise, the proposed system would be beneficial for all people to improve their healthy lives and reduce their workload.

GREENHOUSE AUTOMATION

Automation is the integration of disparate systems and software into what is known as automation or self-regulation. In this case, the sensors and operators are connected to obtain a self-contained greenhouse.

PROJECT AIMS AND OBJECTIVES

Aims

This proposed system aims to develop a Flutter based mobile application for automated and remote monitoring of greenhouses using IoT technology. It can communicate with iOS, Android. So, the farmer does not always have to go to the greenhouse and check their condition.

Objectives

Utilization of greenhouse automation opportunities using techniques.

Components

- 1) To develop the software used by to which the created to address the control.
- 2) Monitoring existing software and identifying their shortcuts, they can be included as a unique feature of the system.
- 3) Design and implement an algorithm to calculate customer service request costs.
- 4) To identify risks that occurred when the application implementation.
- 5) Identify risks and failures and monitor the status of remote monitoring and remote monitoring.

- 6) Development of software that is widely used by consumers (farmers and gardeners) in agriculture.
- 7) To evaluate the progress of the proposed system by running a test drive.

PROJECT FRAMEWORK

Research papers, surveys, and journals were reviewed and a case study was conducted to establish whether the proposed method was feasible. With the help of these journals, knowledge of the background and current industrial conditions of the proposed system was obtained. A questionnaire was prepared to collect primary data and publish it as social groups. It was decided that the software needed to collect secondary data magazines. After using this analyzed data, it helps to determine the unique elements for the system and the other components. Finally, the desired product distribution for the primary data collected and the methodology or life cycle model chosen by the useful system. The work breakdown structure was built to get a clear idea of the proposed framework, and the use case chart was controlled to distinguish the inner foundation of the frame. The Gantt graph is built to take the proposed method into chronological order. The proposed framework will use the selected Android Studio and prototyping methodology to indicate the life cycle. About the prototype methodology, the proposed framework presents the Iteration wisely.

ENVIRONMENTAL FACTORS

Temperature

Temperature plays an important role in plant growth, and heat is needed for plant growth. It regulates water and nutrient uptake, photosynthesis, and cell division. Each plant has different optimum temperatures with different mineral requirements and different growth stages. Adult plants often have small leaves and flowers, a pale color, distorted stems, and elongated fresh plants take advantage of warm temperatures. Soil temperature is more critical than the air temperature. When the soil temperature is less than 7 C, the roots work slowly and it is difficult to obtain water and nutrients. When the air temperature begins to heat, the soil can dry up, even if there is sufficient moisture to get the slow water. Attempts to warm the soil apart from seedlings are not worth it. The main source of daytime heat in an unheated greenhouse is solar radiation, part of which is stored in the soil. At night, energy comes mainly from the soil in the form of long-range IR radiation.

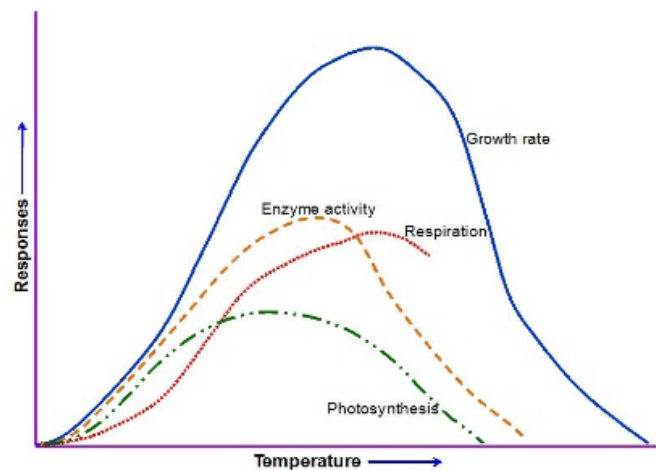


Fig. 1. Temperature Responses

Humidity

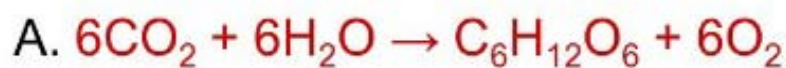
"Relative humidity" (RH) is the term used to describe the amount of water vapor in air expressed as a percentage of the amount required for saturation of the same temperature. The leafy branches have small openings that move gases like CO₂ and oxygen. Also, not all the water taken by plants is used, so a lot of water flows through these openings. These vapors cause excessive humidity with the vapors already in the air. When a small amount of air enters the outside of a greenhouse, the heat is retained and the relative humidity is often very high. Plants grow best with a relative humidity of between 45 and 60 percent.

High humidity can often cause diseases. When the humidity of the greenhouse drops below 45 percent for 45 long periods, the plant suffers and the leaves rapidly lose water and can be replaced. Otherwise, if the humidity exceeds 80% for any length of time, the risk of leaf disease increases. Exterior ventilation causes low humidity and the plants dry up.

Air: (Carbon Dioxide and Oxygen)

Carbon dioxide in the air is essential for photosynthesis. Its normal level of air is about 3% of the air we breathe. When CO₂ is scarce, plant growth slows down. But when the supply of CO₂ goes up to a certain point, up to 300 ppm. (Photosynthesis, 2020)

III. Photosynthesis



carbon dioxide + water → glucose + oxygen

PHOTOSYNTHESIS SONG! !

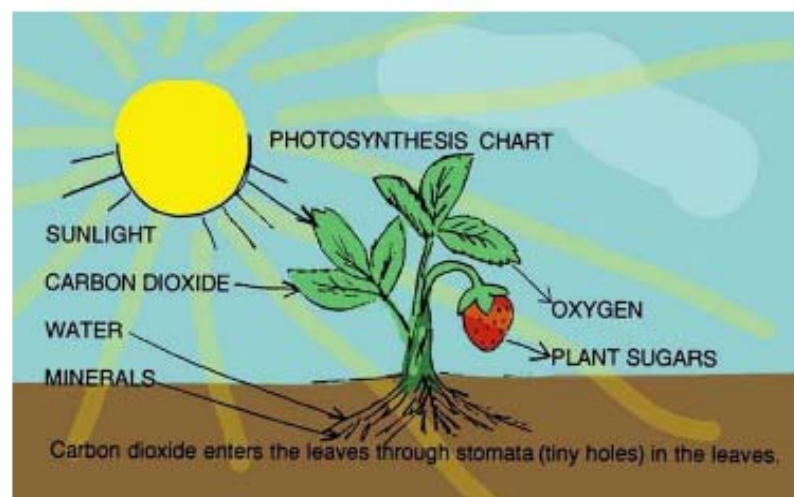


Fig. 1. Carbon and Oxygen

Years of Experience in the Greenhouse Industry

Those growers who responded to the survey represent years of experience in the greenhouse industry (Figure1, Table 1). The number of respondents ranged from 1 to 50 years. (Needs Assessment Survey of the Virginia Greenhouse Industry, 2020)

Table 1: Greenhouse Category (2002)

Plant production topic	Mean level of interest by greenhouse category ^y							
	Other		Small		Medium		Large	
	n	Mean	n	Mean	n	Mean	n	Mean
Automation of greenhouse functions	18	1.9 c	139	2.6 b ^z	46	2.9 ab	37	3.2 a
Managing wastewater and runoff	19	1.8 b	138	2.2 ab	44	2.6 a	38	2.5 a
Nutritional management	20	2.5 b	136	3.1 a	46	3.4 a	38	3.3 a
Plant growth regulators	21	2.2 b	141	2.5 ab	47	2.9 a	38	3.0 a

^y Level of interest scale: 1 = no interest to 4 = great interest.

^z Values within a row, not followed by a letter in common, are significantly different by Duncan's multiple range test, 0.05 level.

PROJECT PLAN

A project plan is a critical process for implementing a perfect product. By engaging with dissolved ideas, you build a way to achieve the expectation and meet the ultimate artifact or product. Without a superannuation plan, it is difficult to meet project goals before the due date. The main thing is making artifacts, it depends on the project plan and the overall project. Therefore, all artifacts should be neat and orderly. The following proposed system was created using the Gantt Graph prototype. Project planning, requirements gathering process, system design, implementation phase, test phase, timely evaluation, project evaluation can be completed in due course.

Work Breakdown Structure (WBS)

As well as designing the presented androgen system, the breakdown structure has been designed. The WBS is the main component that helps to manage and plan the project. WBS understands the project and helps to manage the entire system easily by dividing the larger responsibilities into smaller bookings. WBS is not restricted and can be used for any type of project.



Fig. 2. Plantlink Micro Structure

METHODOLOGY

There are many methodologies used in mobile application development. They all have strengths and weaknesses. This IoT device-based innovative automated greenhouse monitoring and outdoor water management system is developed using System Prototyping methodology to implement this proposed method. The system operates using algorithms, Arduino programming code, AI libraries, and the WI-FI P2P API. The reason for using this method is to engage users for system evaluation and feedback sessions and modify the system until the user is satisfied with the final system. This system provides a system for users to evaluate and then receive feedback from the user and adjust the system. A prototype model is a system development system that builds, tests, and rebuilds the prototype as needed until a system or product is obtained. This model works best when all the project requirements are not known in detail. It is a repetitive, trial, and error process between developers and users.

DESIGN

Designing phase is the next phase of the Methodology. The Gantt graph and Work Breakdown chart are designed to take the project on the timeline. Use to determine how users interact with the system. AgroGen: Proper algorithms need to be designed and implemented in the next stage of the process to be implemented in the IoT based automated greenhouse system (Arduino). All the GUIs in the proposed system are created using the Android studio.

SOFTWARE DESIGN

Mobile application

The mobile application has to offer:

- 1) Real-time monitoring of the environmental factors of a greenhouse.
- 2) Real-time weather information (the weather outside the greenhouse).
- 3) The ability to see the running actuators and manual controlling them.

This is a significant part of the development process. The proposed system was designed to meet the requirements and this work was completed in three sub-steps such as,

- 1) System Design
- 2) Interface Design
- 3) Database Design

System Design

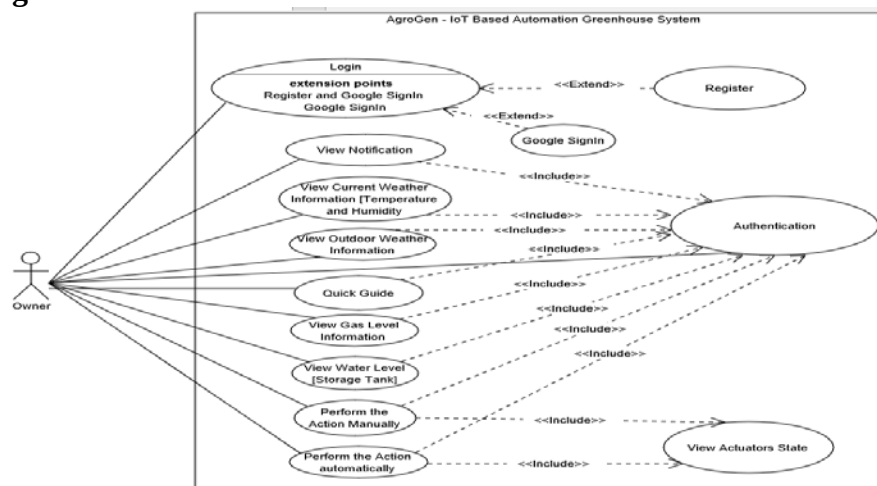


Fig. 3. Use Case Diagram

The following diagram illustrates the Use case diagram of the application.

Using the app, the user can monitor the greenhouse (see current values of environmental factors, operator status, and weather information), perform a manual operation (enable or disable operator), and view notifications.

High-level architectural diagram produced to classify the overall idea of the proposed system.

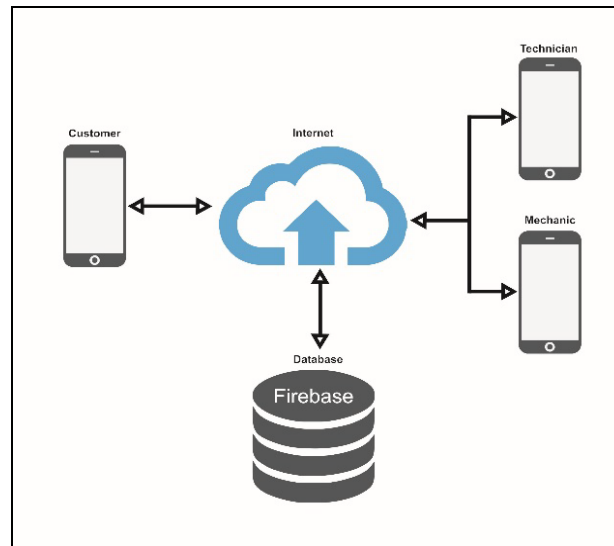


Fig. 4: High Level Architecture Diagram

The following diagram illustrates the High-Level Architecture for Greenhouse.

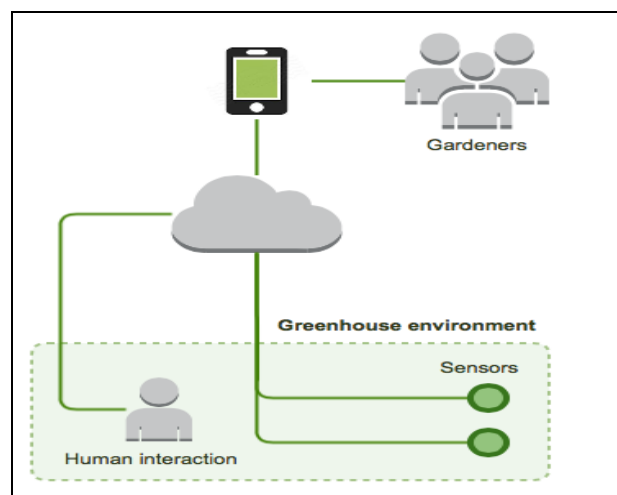


Fig. 5. Greenhouse Architecture Diagram

Interface Design

There are two types of service. Mobile and web app improved the base Flutter app for mobile apps. It can dually communicate with iOS and Android. Provides web applications for marketing series. Since the app has four main objectives, its user interface should have three tabs for a specific target. The following wireframe represents the result and explains the various components of the application. All the interfaces in the AgroGen app are designed with user-friendly behavior. Since the AgroGen app usually uses a wide variety of characters

(age and cultural wise), it is important to display the interfaces and make it attractive and simple, as well as requiring different people to use the app for their regular activities.



Fig. 6. AgroGen Application

The app icon is built with the app logo and attractive color options. The androgen icon is high in comparison to professional applications. To get a quick and simple idea of logo viewing. The Activity window of the dashboard displays the real-time information of each sensor collecting greenhouse changes. The user can remotely control the greenhouse sensors using functional functions over Wi-Fi. Similarly, all the interfaces in the androgen application are designed and the performance is user-friendly.

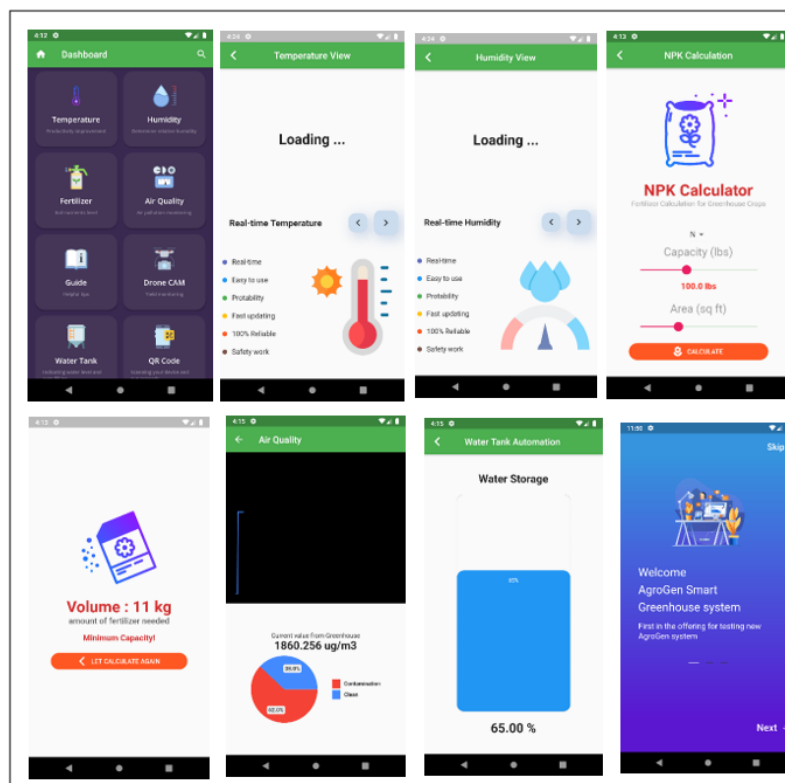


Fig. 7: AgroGen Performance View

TESTING AND RESULTS

The tests were carried out by a variety of test methods. White boxes are given priority. The white box can be interpreted as an inspection method that checks the internal structure and the examiner knows it. The main purpose of this white box test method is to detect errors and problems easily.

This was done by creating test cases according to a test plan. Here are some test cases as samples. This is primarily necessary to determine whether the desired requirements are met or not. This test will test all the functions of the system as well as the code segment and whether they work as expected. Separate tests were performed for each task to avoid the difficulty of detecting errors when testing tasks together.

And then Acceptance testing is also done for the application. Acceptance testing is a kind of testing method used to test the acceptability of a system. And also this testing was done to test whether the system matches the requirements of the customer. Acceptance testing was done for all the functions including buttons and text fields from start to the end of the AgroGen application. Test cases were written for every function. Negative testing was done in priority under the acceptance testing. This was done by giving incorrect values for the text fields as well as the user name, password, mobile number, and mobile verification code. Tested the functions work for incorrect values or not.

You need to understand not only the required functions but also the interfaces and application procedures. The interfaces were therefore tested in parallel with other functions and features.

During the test, it helped to diagnose and correct the bugs and gave you an idea of how to develop the application more successfully as well as future requirements.

EVALUATION

The proposed system, the IoT-based Automated Greenhouse System or "AgroGen," will be designed and implemented based on the contextual report requirements. The AgroGen system contains all the features of the software that are needed in the software, which extends all the highlighted functions and will be used in the proposed method. The technician under the farmer will provide the system for someone to sample for evolution and the requirements are checked after development. It is also a kind of testing strategy name beta testing which is not discussed in the testing phase. As evaluators, farmers and technicians (related to agriculture) will be provided with the opportunity to test and experience AgroGen automated greenhouse technology. Following the aforementioned audience evaluation system, the data collected helps improve the future of the proposed system. All of these evaluators were selected according to different farmers and agriculture technicians. The evaluation process was done according to two procedures,

First Procedure - After Complete developing the proposed system, the final product APK has been distributed with the agriculture department. To collect feedback from them, the system contains a feedback portal. It has been added as a function of the application. Users will be able to submit their feedback about the application through the feedback portal.

Second Procedure – The Arduino system was given to the real user and interviewed them after they are using the application. The collected feedbacks were kept in a document file.

According to the Final Feedback Results, Agriculture department acceptance the given a project their viewing garden. Because it is the fully auto controlled greenhouse. And also it can be getting sensor parameters everywhere.

CONCLUSION AND FUTURE WORK

Business or other marketing employees when introducing a new product to the market Enterprises are generally concerned with building opportunities in the marketplace identifying the right price and customer needs. The focus of product designers is the product of the look and features of the new product aimed at attracting customers. Recommendation systems help users find items they haven't found Attract potential customers to support targeted and efficient manner marketing by building personal shopping for each customer.

To understand the recommendations, I make are many of the logic of the system literature survey. This helps to design the system. It's always important to do a basic study when starting any project to get started on a solid foundation. After defining greenhouse climate factors, techniques for controlling them, and important aspects of our problem of using IoT in greenhouses, we are ready to use them in the next phase of system analysis and design. As a summary, their existing system does not have this fertilizer management system and this water storage control management system, *etc.*

In this part, we successfully implemented the solution of using the Internet of things technology in monitoring and controlling the greenhouses environment. We can't say that we didn't face any problem during this phase especially that we couldn't realize all the possibilities with the sensors and the actuators we have which forced us to only test one greenhouse with some actuators and simulate the other actuators and greenhouses. We also wish that we had all the project requirements and more time to test it in real conditions.

BENEFITS

AgroGen App built-in using Flutter application. Many and more useful for the client. Because application uses android also iOS.

LIMITATION

In this project, we worked on agriculture, precisely in the greenhouse cultivation part. We successfully employed Internet of Things technology in the automation of the greenhouses and the remote monitoring with failures detection ability through mobile and web applications. It is important to mention that here we were interested only in the environmental factors and not about plant growth which includes watering, treating diseases, and grow monitoring which is the second part of the project.

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