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Smart Talking Plant Based on IoT with Social Media

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ABSTRACT: **In this universe, oxygen is an important and compulsory parameter for all living things. Across the globe, plants maintain levels of oxygen (O2) and carbon dioxide (CO2) that help human beings live. IoT and social media networks are both among the most promising technologies. The combination of these technologies will create a wide range of applications and services that are intelligent. Plants can tell us what is affecting them with the electrical signals they emit with the help of the (Internet of Things) IoT. In such ways, is your plant thriving under current light levels? Is your plant thirsty? Or even satisfied with your care? People like to grow their favorite plants. They water the plant once a day without even knowing what the plant truly needs—a considerable number of plants are damaged daily. Moreover, the efficiency of the planting process has also been reduced to a great extent. Lack of maintenance is considered one of the major reasons for damaged plants. The primary goal of the proposed technique is to monitor the plants continuously as well as to develop a system that is capable of providing continuous information about the health of the plants by accessing live data from the various sensors, e.g., DHT11 (Temperature and Humidity Sensor), soil moisture sensor, LDR (Light Sensor), and water consumption. It is intended to make a talking plant synched with the Internet of Things (IoT)-based efficient system. ESP32 (Arduino) is an important part of the entire system that accesses the continuous live data from these sensors, evaluates the accessed data, and takes different decisions to perform the right action. ESP32 communicates with online platforms like Facebook and Twitter. An IoT technique is introduced into the system to make it more efficient and easily accessible across the globe. Furthermore, the mobile app makes it an option for the plant to create tweets, Facebook posts, and text messages that tell their owner how thirsty it is by just sending a tweet and, of course, sending the owner a thank-you reply after watering it or removing it from the heat of the sun. This system is quite helpful for the regular maintenance of the plants. Nature-loving people prefer to use such a system in order to take proper care of the plants. Additional features that can be developed for future work include machine learning systems, Natural Language Processing (NLP), voice command, and a webcam attached. This will give an efficient method of understanding user inputs that are inconsistent.**

Keywords: Smart plant, IoT, Sensors, Social media networks, ESP32, DHT11.

1. INTRODUCTION

Everything is becoming more automated these days are so busy in their daily life routines that they have no time to spare for some extra activities like cooking, planting, watering, and a lot of other routine tasks. People want to get updated without or with a little human interaction with their surroundings. They want to do more with less effort [1],[2]. Most of the sectors in today's world have been fully automated, but there are still some sectors that have not yet gone under automation due to several real-life challenges [3-8]. The field of agriculture, or in simple words, taking care of plants, is one of the sectors that has not yet been automated. This sector needs a lot of improvement to ensure the proper and regular maintenance of plants to take care of them. There are different challenges due to the fact that the agriculture system has not been automated. One of the major challenges is its expensiveness [9-12]. In an earlier civilization, agriculture was one of the most adopted professions by men. The monitoring of plants is an important parameter of both the horticulture and agriculture domains [13]. Both of these domains play a key role in growing different types of plants under the controlled conditions of the climate. The growth of the plants can be governed by two factors, e.g., the plant's automation and various conditions for the proper control of the climate [14-18]. As discussed earlier, the regular monitoring of plants was never an easy task for people [13]. There is always a need to automate this process, which can efficiently generate all the updates about the health of desired plants.

At the initial stages of planting, people used to take a lot of care of the planted regions, but after some time, the lack of maintenance has increased and the damage to the plants has started to happen [19], [20]. The proposed idea will be quite helpful for people in order to monitor their plants anytime they want. The system will help them get live updates about the health of desired plants.

The Internet of Things (IoT) is basically known as the shared network. This network consists of various objects and their interactions with each other in the presence of internet connectivity [1-3], [12]. This technique plays a key role in the field of agriculture. According to research, it can feed almost ten billion people across the globe by 2050. Agriculture based on smart systems can maintain efficient fertilizer use and enhance the yield of the crop [14-16]. IoT is a technique that provides reliable solutions to a couple of real-life problems as well as allows the system to be monitored and controlled from anywhere across the globe [21-26]. This feature increases the efficiency of the system and makes it unique as compared to other similar technologies. This document presents an automated IoT-based intelligent talking plant with Facebook and Twitter. The system will be able to communicate with the social media platforms in order to provide regular updates about the health of the plant. This system will act as a helping hand for plant-loving people to take good care of their plants. The proposed system will reduce the damage to the plants to a great extent. In social networks, smart physical objects are connected to the network in order to bring the physical world into the digital dimension of decision-making. Physical objects that communicate with social networks We are publishing information in the interests of users. They are also able to establish social connections according to the rules established by their users.

The main purpose of the proposed study is to continuously monitor the plants as well as to develop a system that is capable of providing continuous information about the health of the plants by accessing live data from the various sensors, e.g., temperature, oxygen, soil moisture, light, and humidity sensors. It is intended to make a talking plant synched with an Internet of Things (IoT)-based efficient system. The system will be able to communicate with the different social media platforms, e.g., Facebook and Twitter, to provide an update about the desired plants and their surrounding environment. Synching with an IoT-based technique makes it possible to monitor and get live updates from the system throughout the world with high levels of precision. The ESP32 will be used as a microcontroller that behaves as the backbone of a system. ESP32 (Al Could) to get in touch with online social media networks.

2. LITERATURE REVIEW

This section provides a discussion on earlier techniques that have been used for Smart Talking Plants based on IoT and social media. The periodic modifications to these types of systems will also be provided in this section.

2.1 IoT IN AGRICULTURE

IoT has been extended worldwide through connectivity and its unique standards [1-6]. IoT involves devices, i.e., laptops, desktops, tablets, and smartphones, as well as non-internet devices like everyday devices and objects [27]. Interrogation of the internet with these devices can transfer data and communicate all over the world [28]. It has also been monitored, remotely controlled. The IoT has changed due to the get-together of many technologies such as real-time analytics, machine learning, and commodity sensors. Control systems, wireless sensor networks, and automation are examples of current entrenched systems [29-32].

In 1982, the network of the smart device's concept had been discussed with the help of a customized Coke Machine at Carnegie Mellon University, which had invented the first internet-connected device that could report the inventory against each newly loaded data drink when it was cold. In 1991, Mark Weiser's paper about universal figureuring, "The Computer of the 21st Century," was distributed. He also creates scholarly scenes that include UbiComp and PerCom, framing the cutting-edge concept of the IoT. In 1994, Reza Raji presented the idea of moving minor bits of data from one place to another in the sets of large nodes in the IEEE Spectrum. In which everything will be automated and integrated, from home appliances to big industries later, between 1993 and 1997, several companies utilized the concept, including Microsoft, and proposed many solutions. The field becomes vaster when Bill Joy visualizes the device-to-device concept of communication in the part of his SIX WEBS system that was presented at Davos in 1999.

The IoT brings advanced innovations within the automation of ground as the collected data is used to develop expert system strategies to generate forecasts. The deployment of IoT technology in the agricultural field is very important because it occurs in large spaces, which require constant monitoring [37]. IoT helps the farmer monitor field variables such as soil temperature, humidity, atmospheric conditions, fertilization, crop productivity, and livestock. Farmers take advantage of the IoT by utilizing it in a more innovative way to increase crop productivity [38]. The Internet of Things (IoT) can be integrated into agricultural applications to provide accurate mapping of air, noise levels, temperature, and dangerous radiation. The IoT is used to gather and store environmental information, ensure accuracy of climate change with domestic policies, initiate alerts or send an advisory message to individuals [39-40].

2.2 SOCIAL MEDIA

Social media is typically defined as digital forms of communication where people can form communities where they can communicate ideas, information, photos, videos, images, and other types of content. It is also a subset of social media. It typically involves developing and maintaining online connections, both professional and personal, through different platforms [39]. These platforms can be classified as social networking websites (SNSs). Many of the activities carried out on social media platforms, including creating and sharing content, are also carried out on SNSs. More than two-thirds of American people and nearly three-quarters of Internet users have at least one SNS [40]. While young people (aged between 18 and 29) enjoy the greatest social media usage rates (90 per cent), other age groups, such as, e.g., teenagers, teens, and older adults, are also seeing rapid growth in the rate of social media use [39]. On various websites, user numbers are in the hundreds of millions, and in some instances (i.e., Facebook), they surpass the number of people in the world's most populous nation. The most distinctive feature of the current social media world is its capability to provide unlimited bandwidth to develop and spread new platforms and services every day. Although Twitter has been the buzzword in the past few years, reports of its decline have garnered the attention of users and investors [41]. While Twitter might be disappearing and being replaced by newer and trendier services such as Instagram and Snapchat, Although Facebook is still a source of trust among younger adults, it is becoming a non-issue for teenagers who are moving towards Instagram or Snapchat [42]. The evolving nature of the social media industry makes for an intriguing comparison of the top platforms.

The World's Largest Country plays host to the fastest-growing movement on Facebook. Facebook is among the most well-known SNSs. According to their website, "Facebook's mission is to provide people with the ability to share their experiences and create a world that is more open as well as connected" [40]. Facebook allows users to communicate with family, friends, and acquaintances. It also lets users publish and share images or status messages. Since its inception in 2004, the site has had more than 1 billion active users daily and more than 1.65 billion active monthly users, with the majority of people using mobile devices [40]. Three-quarters of Internet users have a Facebook account, and seven out of 10 users access Facebook daily, indicating the routine and repetitive nature of Facebook usage [39]. A majority of young people (18–29 years old) use Facebook (87 per cent).

It was founded in 2006, and Twitter was classified as a microblogging website that allows users to communicate in "real time" with 140-character tweets to their fans. People can interact with each other using comments, mentions, and hashtags [40]. A third of young people aged 18-29 reported using Twitter. Twitter announced that it has an active user base of 320 million with one billion unique monthly visits to websites that embed tweets [41].

2.3 *DATA ANALYTICS IN AGRICULTURE*

In the earlier agriculture era, the most used method for a plant's maintenance was a manual process to check various parameters. In this method, all the farmers are responsible for the verification as well as the calculation of all the parameters. This was a relatively difficult method to use for such actions. This method was consuming a lot of time, even when performing a small task. This difficulty attracted the attention of research scientists to design and develop the latest tools to make this system easy to use [8]. With this evolution in the development of such automated tools, the agriculture system was enhanced and automated using IoT techniques [9]. The tools for cloud computing were introduced, and they were quite capable of creating a complete computing system [10]. After a small gap, a novel system was introduced for multiple agricultural safety purposes. A wireless communication technique was introduced in this system, which was a great evolution in the field of agriculture at that time [11]. This system proposed an efficient and cost-effective method to get information about the temperature and soil moisture of the soil from the desired regions of the farming area [12]. Another method, named the partial zone method, was introduced after a few decades and was used on a larger scale [13]. The conditions of the surrounding atmosphere were observed with the help of an Ethernet network (802.3) [14].

Raj Lakshmi et al. proposed a research methodology that monitored the crop field with the help of humidity, temperature, light, and soil moisture sensors [1]. He accessed the live data coming from the sensors interfaced with the system and sent the accessed data on to a server via wireless transmission technique. In order to manage the database of the server, the JSON format was used to encode the desired data. According to him, in an agricultural field, when the temperature and soil moisture level decrease by the threshold value, the system will start behaving autonomously. The live updates had been sent to the farmers' cell phones, and they were totally capable of monitoring their plants from anywhere. DHT11 was used for temperature measurement, Light Dependent Resistor (LDR) was used to deal with the surrounding light, and NRF24L01 was used as a server for transmitting and receiving purposes. This system was way more efficient in comparison to the other approaches, and it was considered more useful for the areas where there used to be a shortage of water. A PHP script was used in order to store the desired data in the MySQL database. For all the requirements of water and for one motor, 2 Ah/day (ampere hour per day) was the total consumption of power by the implemented system.

Gondchawar et al. introduced an efficient and smart agriculture system based on IoT. His major goal was to utilize IoT and different automation techniques to make the system more unique in comparison to other similar technologies [2]. He designed and built a small robotic structure for sensing soil moisture and spraying and watering plants. The designed system was consisting of the various features e.g., warehouse management and efficient decision-making system. It could monitor the maintenance of humidity and temperature as well as observes the detection of theft inside the warehouse.

Baranwal et al. performed strong research to provide safety to the different products of agriculture from severe attacks by different types of insects [3]. To provide immediate notification of any unusual condition, a proper security system was introduced in the project. The Python script has been used to integrate the different electronic sensors and devices. At the time of testing, the device was attached to a corner and the test was performed within an area of ten square meters. After the successful testing of the system, almost 85% working efficiency and accuracy were achieved [19].

FarmBeats is an end-to-end IoT platform that ran a six-month long deployment programme at two US farms for agriculture data collection with the help of various sensors, cameras, and drones. The reason FarmBeats uses sensors, cameras, and drones is to keep costs low but also to give a more accurate estimation of precision map for precision agriculture. If only sensors were to be used for creating a precision map, a dense deployment of in-ground sensors would be needed, which would be very costly to deploy and use. To lower the cost further, solar panels were used as an energy source. FarmBeats is a good example of how to use smart farming on a large scale while also being environmentally and economically efficient. The key concept is that technologies involving IoT have great potential when applied in the domain of agriculture [21]. The focus of this article's discussion lies on the business aspect of smart agriculture, sector issues, technological issues, and business model issues. Setting rules and standards is a big issue that needs to be resolved before smart agriculture can be implemented Europe-wide.

3. RESEARCH METHODOLOGY

This section represents the development and design stages associated with the proposed technique. A visual display of the proper working of the system would also be part of this section.

*3.1 **RESEARCH DESIGN***

A research design serves as the architectural blueprint of a research project, linking design, data collection, and analysis activities to the research questions and ensuring that the complete research agenda is addressed.

*3.1.1 **APPLICATION DEVELOPMENT METHODOLOGY***

The research adopted the Rapid Application methodology, which was deemed best due to its iterative approach to applications development as it also delivers systems faster at a lower cost in time-constrained projects. This methodology was suitable for our research given the time constraints in developing the application. The requirements planning stage entailed gathering information on what the model should contain and how the model is supposed to function. Secondary data was used to determine the aspects of water quality that require monitoring. Interviewing the smart plant operators also provided information on what should be incorporated into the model. After gathering the design details, the researcher used the software and hardware tools described in chapter four to develop the model, incorporating the user's design suggestions. The model would then periodically evaluate the intended users to check whether the modules were functioning as desired.

*3.2 **DATA COLLECTION INSTRUMENTS***

The research used both primary and secondary data. The data formed the basis of developing the various application components. The techniques involved were:

a. The literature review: data from various sources, e.g., thesis, government reports, conference papers, and journal articles, formed the bulk of secondary data sources. The sources mostly provided information on the water quality aspects that should be monitored, the challenges in monitoring water quality, and the deficiencies in the current architecture used in monitoring water quality. They provided authoritative information regarding aquaculture.
b. The questionnaires were structured to provide information regarding the user requirements and usability of the proposed application. The questionnaires were administered both online and on-site. On site, the administration was necessary for instances where farmers were not literate enough to fill out the questionnaires, especially where the farmers could not fill them online. The questionnaires were administered in two stages, i.e., before developing the application to gather the requirements and after development to get feedback on the functionality and usability.
c. Qualitative interview: This is a type of interview where the interviewer has no specific preset questions to be asked in a particular order. The respondent does most of the talking. During site visits, these interviews were used to gather in-depth insights into how plants and crops are monitored.

*3.3 **DATA ANALYSIS PRESENTATION***

Quantitative data analysis and presentation were done using Microsoft Excel. Data gathered from questionnaires was downloaded into the excel sheets and was graphically presented in the form of pie charts.

*3.4 **SYSTEM PLANNING***

Planning is the discipline of stating how to complete research within a specific timeframe, usually with defined stages and designated resources. First, we found some common problems in our real lives. Then find this problem and think of a smart way to solve it within a specific timeframe. We discussed this with our team members and teachers. I studied many books, journal papers, and research papers. In order to overcome this problem, the authors have devised a smart system that can detect water temperature, water pH, and water level, etc. This system is a smart talking plant based on the IoT with a social media condition detector. It can also determine the condition of the plant for which it is needed.

*3.4.1 **SYSTEM FLOW***

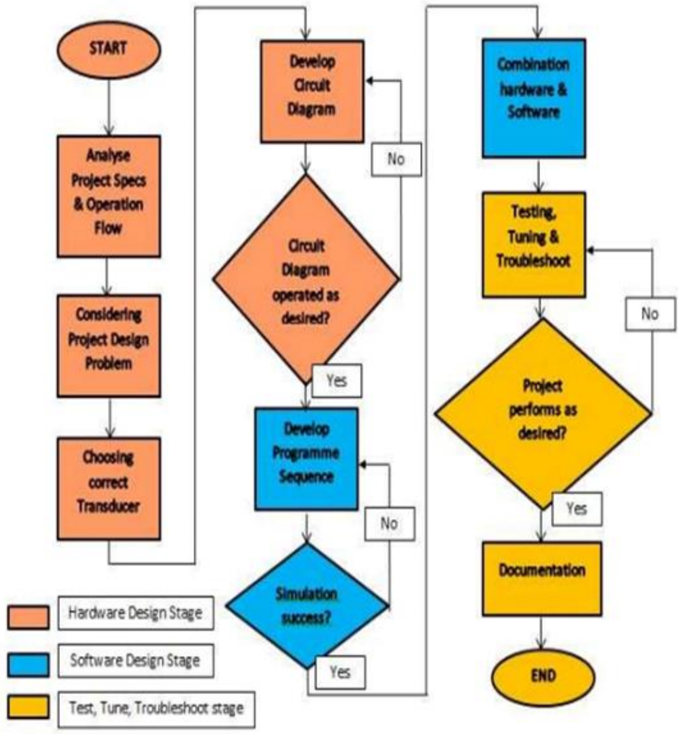


Figure 3.1: System Flow

The design specification, as shown in figure 3.1, is determined based on the objective of the system. The system is divided into three stages. Initialize with the hardware design stage, then the software design stage, and the last step is testing, tuning, and troubleshooting the system design. The hardware design stages act as tools to determine whether the transducer used is correct and compatible with the circuit diagram. At this stage, the transducer is chosen based on experimental characteristics such as accuracy, precision, factors affecting the measurement and the performance under forced conditions.

The software design stage is designed according to the operation flow of the system. The software part itself is divided into two categories, which are sequence programming and interface programming. Both parts must be joined together and run simultaneously in order to produce the approved intention of the system. The testing, tuning, and troubleshooting stages are the keys to the design process. These stages are subsequent after the combination of both hardware and software components. Therefore, a slight error in design can be time-consuming and may result in retracing to previous stages for affirmation.

3.5 SYSTEM REQUIREMENTS ANALYSIS

Requirement analysis encompasses those tasks that determine the needs or conditions to be met for a new or altered product or project. After gathering the information, we are thinking about a requirement to make this system successful. Three sensors have been utilized in the proposed system. Requirement analysis is the technical analysis of a system that is critical to its success or failure.

3.6 HARDWARE & SOFTWARE REQUIREMENTS

3.6.1 HARDWARE REQUIREMENTS

The proposed system can be designed with commonly available electronic components and sensors. All the components are connected to each other in order to get the desired results. The hardware component list for the proposed system is given below. The details associated with each individual component are given below.

- ESP32 (Arduino compliable)
- DHT11 (Temperature & Humidity Sensor)
- Soil Moisture Sensor
- DS18B20 Soil Temperature Sensor
- LDR (Light Dependent Resistor)
- MOTOR (Water Pump)
- TP4056 (charging board)
- Rechargeable Li-ion Battery
- Jumping Wire

3.6.1 SOFTWARE REQUIREMENTS

The proposed software design consists of three major parameters, which are listed below.

- Arduino environment
- IoT implementation
- Communicating to social media network

4. IMPLEMENTATIONS & DISCUSSION

This section discusses how the application was designed based on the data collected from the users. The discussion presents the interrelation between various application modules and their functions. The analysis process entails understanding the current situation, identifying improvements, and finally defining the requirements of the proposed solution. This chapter discusses how the application was implemented and tested. The various hardware and software platforms that were used will also be disclosed. Sample codes and their implementations will be displayed. The testing methodology and results will also be discussed. IoT devices like sensors, RFID, and GSM/GPS have been used for sensing and monitoring different agricultural parameters. The following sub-domains have been recognized: air monitoring (20%), soil monitoring (17%), water monitoring (20%), plant monitoring (30%), and others (13%), as shown in Figure 30. It is important to point out that many of the selected components recovered in this SLR can be distinguished from more than one sub domain.

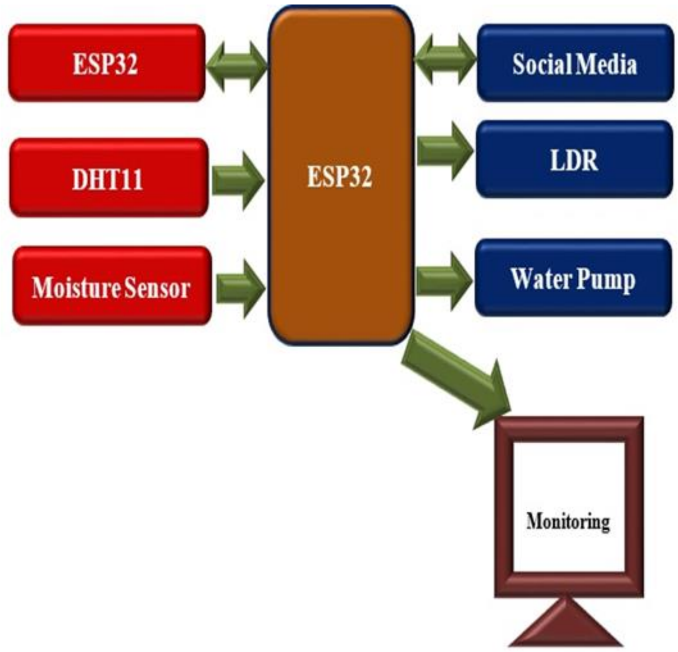


Figure 4.1: Components of the System

The Smart Talking Plant System is built with various IoT, electronic components such as the ESP32, DHT11 (Temperature and Humidity), LDR (Light), Relay (Switch), Soil Moisture, and AI Could. All these sensors are interfaced with the system in order to obtain the desired results. ESP32 is an important part of the entire system that accesses the continuous live data from these sensors, evaluates the accessed data, and takes different decisions to perform the right action. AI could be interfaced with ESP32 to communicate with online platforms like Facebook and Twitter. An IoT technique is introduced into the system to make it more efficient and easily accessible across the globe. The system has a capability to provide the health status of the plants by posting live updates on social media networks. This system is quite helpful for the regular maintenance of the plants. The nature loving people prefer to use such a system in order to take proper care of the plants. The flow of the working of whole system is shown in the Figure 4.2.

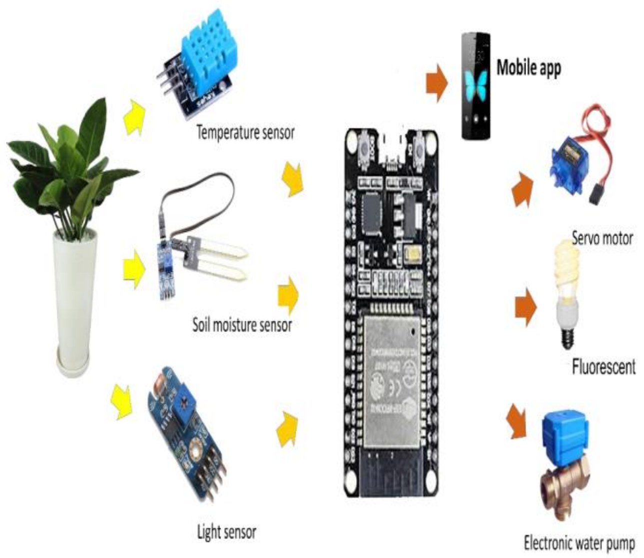
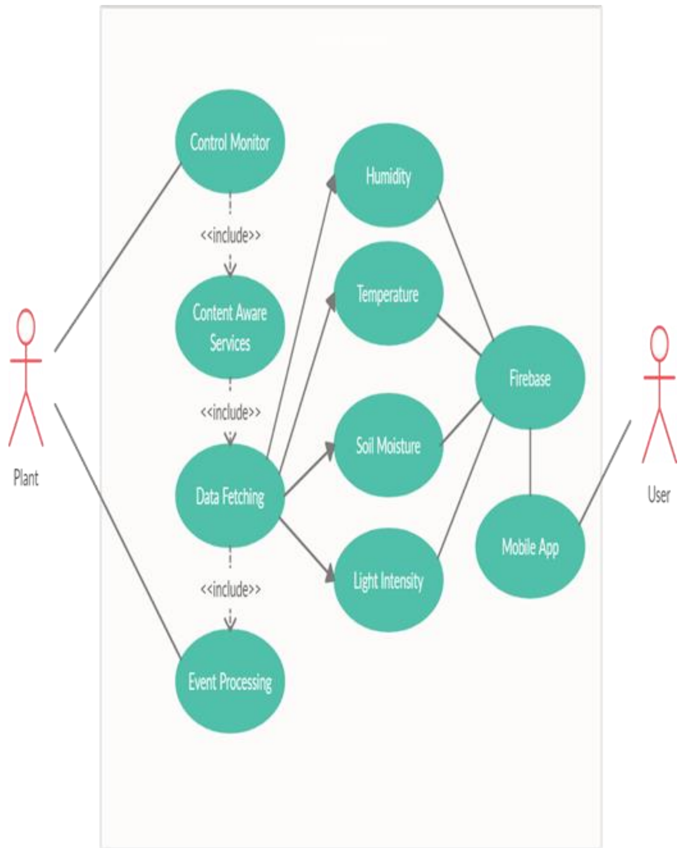


Figure 4.2: Working Flow of the System



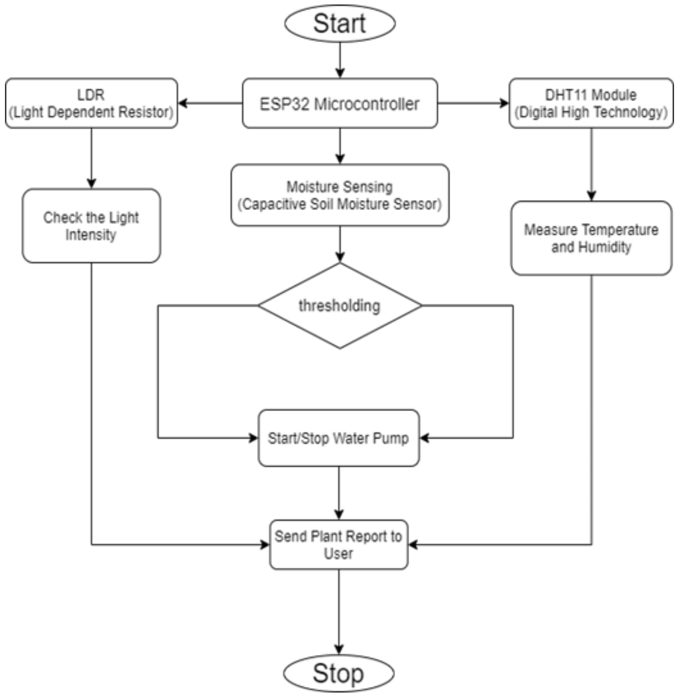


Figure 4.3: Use Case Diagram of the System
Figure 4.3: Process of Smart Plant Watering System

Architecture of the System comprised of two primary components, which are the cloud and the Talking Plant service. To use Talking Plant in this system, it is necessary for a user to be the person who initiates an interaction with the bot using the Facebook chat feature. When our bot is notified of an email, Facebook server will convey the information to the cloud servers via the services offered by Heroku in which both the processing and data have been designed to cooperate according to the specifications. The status of the output of the output to Raspberry Pi is stored in the database on Heroku's server to be retrieved. In addition, specific services have to be created to link and process information between Facebook API as well as Google Maps APIs to enable the on-timer feature, based on your current whereabouts. To accomplish the above, Heroku has to analyse the message that is sent by an individual via webhook, with the proper authorization via Facebook and the Heroku server, and modify the state of Smart Talking Plants in the database. When the messages are dependent on time and space. The current location of the user will be analyzed via Facebook API and once granted the location, the longitude and latitude will be transmitted via Google Maps APIs to further analyze. The outcome of this analysis will provide data on the distance, as well as the estimated arrival time (ETA). Then Heroku uses this information to anticipate and adjust the status that is associated with the appliance(s) according to the information. The main function of IoT gateways, or Raspberry Pi is to periodically examine the state of the database that is stored on Heroku and activate the relay according to the information.

4.1 DEVICE PROTOTYPE

The hardware forms the core of the application. The various sensors were integrated onto a printed circuit board. The sensors were connected to the processor via esp32 using wire jumpers. Each sensor was connected and tested separately before they were integrated into one unit. Figure 4.4 represents three sensors (Soil Moisture and Temperature, Motor Status, and Water Level Sensor), ESP32, and Android. The system state will be properly restored when we generate power into the system and login to the Android App. We use rechargeable batteries for power generators.

The System we designed and now we have implemented as we designed it. In this section of the report, everything will be defined that is used in the implementation of the project. We implemented hardware and used an application for the user interface, and as a bridge to establish communication between hardware and application, we used Firebase for retrieving data from the database. The system is sub-divided into two modules: hardware interface (Circuit) and software interface (Android App).

Figure 4.4: Designed Prototype

The Android app is another advantage for users to monitor the plants' details etc. remotely from anywhere. The Android app provides an easy way to keep in touch with the current status of devices.

4.2 MOBILE APPLICATION REGISTRATION INTERFACE DEVICE PROTOTYPE INTERFACE

In the registration interface, the user can register themselves by filling in the device ID and password.

- Login Interface

The user can simply log into their registered account in the login interface by providing their device ID and password.

- When it Comes to Talking Plants

The owner clicks the "get all data" button, he or she will get three pieces of information (temperature, pH, and water level) in his Smart Talking Plants.

- Examine Comparative Analysis

A specific pond for specific fish has been implemented in the system. When the device is put in water, it will count the overall pond information and sort this data for a decision. When the farmer clicks the "Compare" button, he will see which fish is suitable for cultivation in his pond.

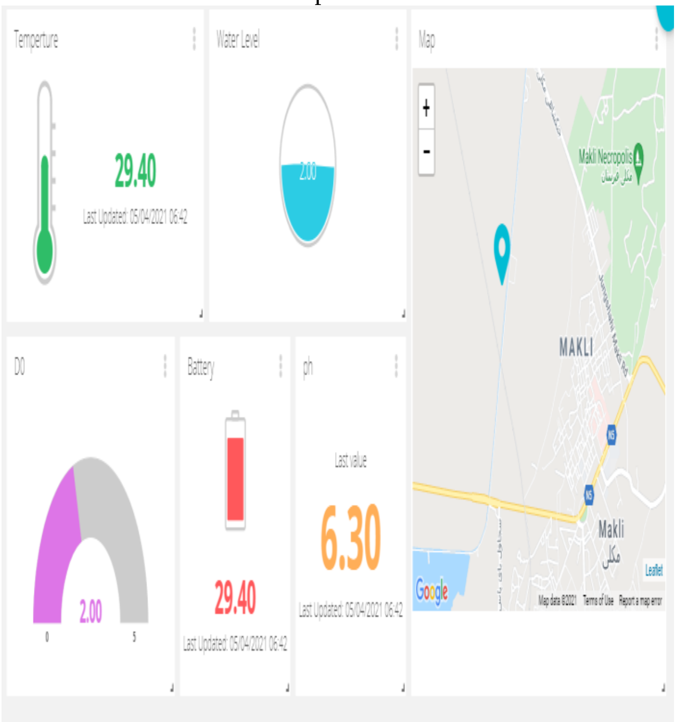


Figure 4.5: View Comparative Analysis

- **Real-Time Soil Moisture and Temperature Monitoring**

A real-time temperature monitoring system has been implemented in the system. When the device is put in water, it displays the water's temperature value.

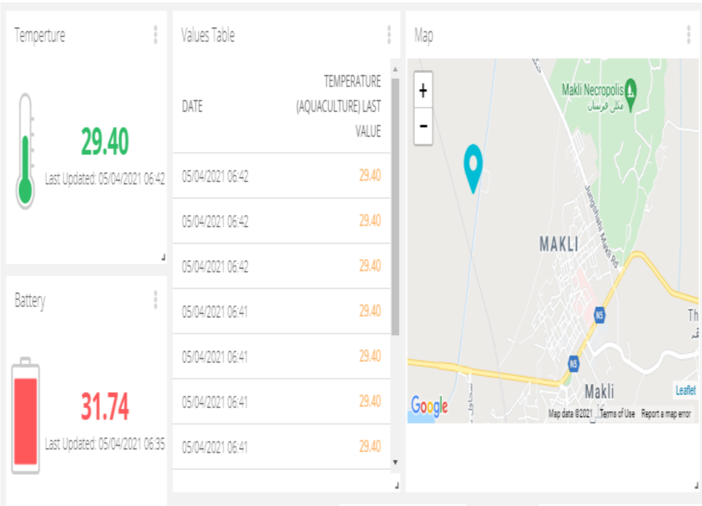


Figure 4.6: Real-Time Temperature Monitoring

- **Dangerous and specific warming of Smart Plants**

After getting the complete information, assume that plants cannot be grown in the environment. In that case, it will warn that it is harmful for plant cultivation. The remaining plants will show how much value can be cultivated.

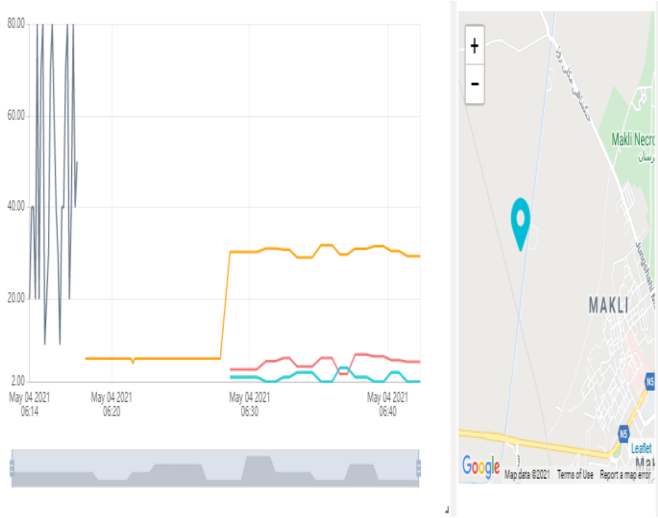


Figure 4.7: Smart Plant Harmful warming

- **The interface of the cloud database**

Firebase has been used as a cloud database to access data from the device through the mobile application.

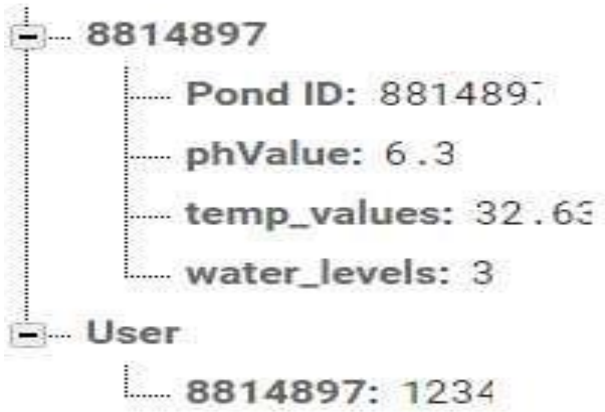


Figure 4.8: Interface of Cloud database

5. *RESULTS*

As we have done black box testing and unit testing of our app, in this section, we will show our testing results in tabular form along with the results of each question in the form of a chart.

Black box testing is also known as behavioral testing. It is a software testing method in which the internal structure, design, or implementation of the item being tested is not known to the tester. These tests can be functional or non-functional, though they are usually functional. The following are the black box testing results for our system.

No	Questions	Yes	No	Maybe	I don't know
1	Do you have plants indoors?	66.67 %	33.33 %	N/A	N/A
2	Do you worry about your plants while gone for vacations or work?	66.67 %	16.66 %	16.66 %	N/a
3	Are you people aware of or have ever used iot based smart talking plant with social media	52.77 %	38.88 %	5.56%	2.77%
4	Would you suggest yourself this project for your plants while you are gone for vacation, so the IoT based smart talking plant with social media get water automatically without your intervention?	80.55 %	5.56%	8.33%	5.56%
5	Is water being wasted by the Project or not?	11.11 %	58.33 %	22.22 %	8.33%
6	Is it saving the time of farmers or not?	86.11 %	5.56%	8.33%	N/A
7	Is it beneficial for farmers?	91.66 %	8.33%	N/A	N/A
8	Are you satisfied with the GUI of IoT based smart talking plant with social media	86.11 %	5.56%	8.33%	N/A
9	Is the idea of checking the Soil moisture and temperature in this project impressive?	83.33 %	2.77%	13.88 %	N/A
10	Do you think that the IoT based smart talking plant with social media	69.44 %	N/A	30.55 %	N/A

	fulfills the user's need?				
11	Can the life of a plant be saved from this idea/project?	75%	N/A	25%	N/A
12	What do you think the use of iot based smart talking plant with social media will reduce dependency, and plants will perform activity efficiently?	75%	8.33	13.88 %	2.77%
13	Do you agree that the development of such technology can change the life of plant in this kind of global warming condition?	72.22 %	2.77%	19.44 %	5.56%
14	Do you recommend any future updating in this system?	61.11 %	22.22 %	13.88 %	2.77%
15	Do you recommend this system to your friends or family members, who are mostly out at work or vacation?	77.77 %	8.33%	13.88 %	N/A

Table 5.1: List of Questions

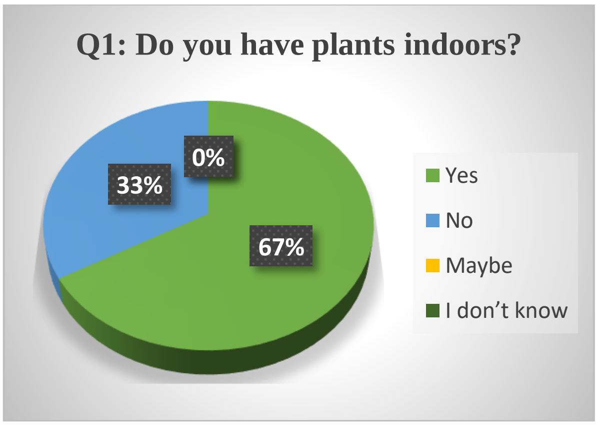


Figure 5:1: Q1 Response

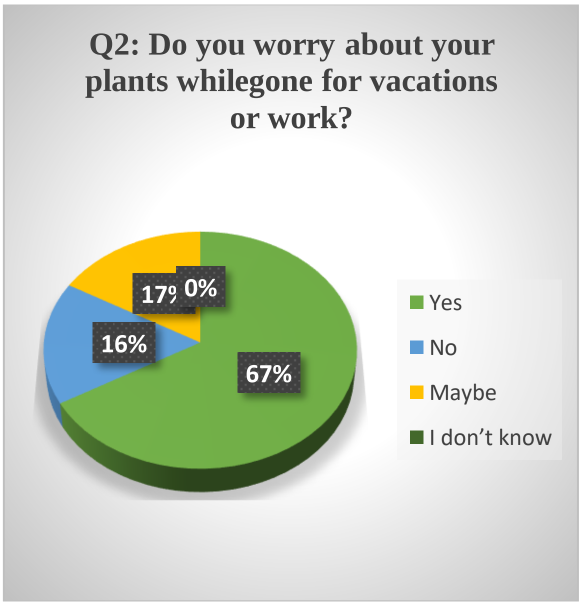


Figure 5:2: Q2 Response

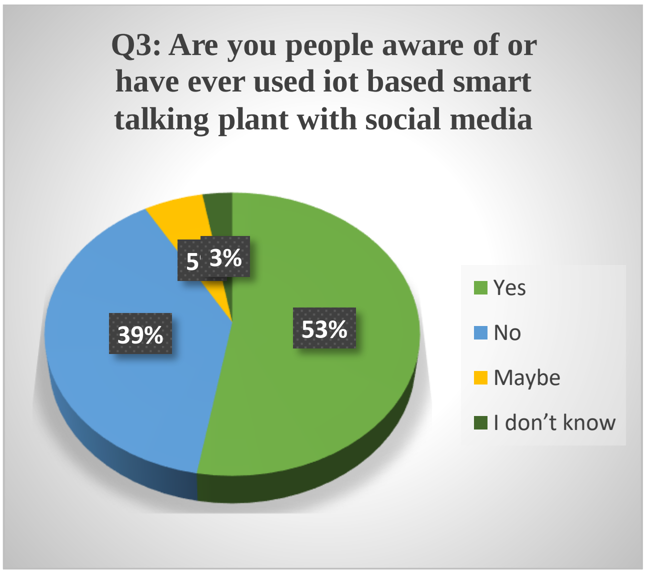


Figure 5:3: Q3 Response

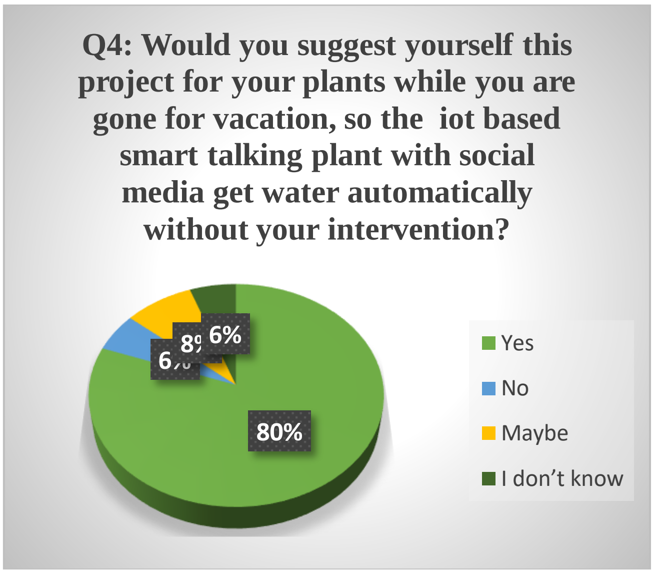


Figure 5:4: Q4 Response

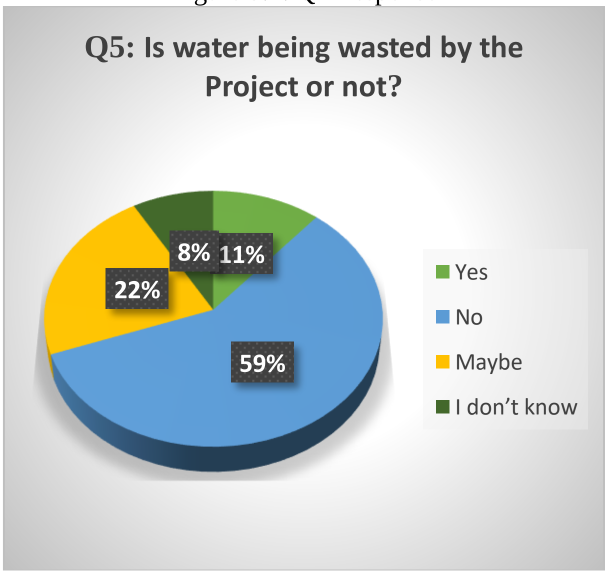


Figure 5:5: Q5 Response

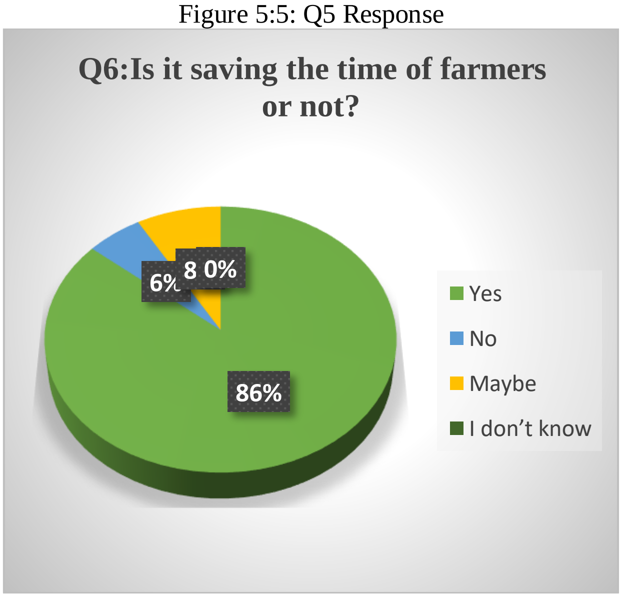


Figure 5:6: Q6 Response

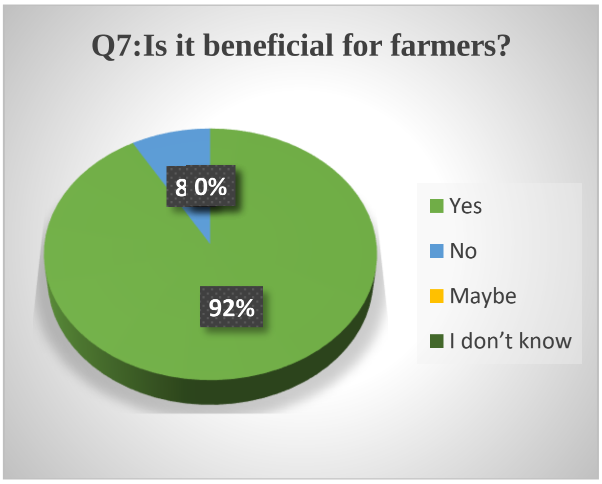


Figure 5:7: Q6 Response

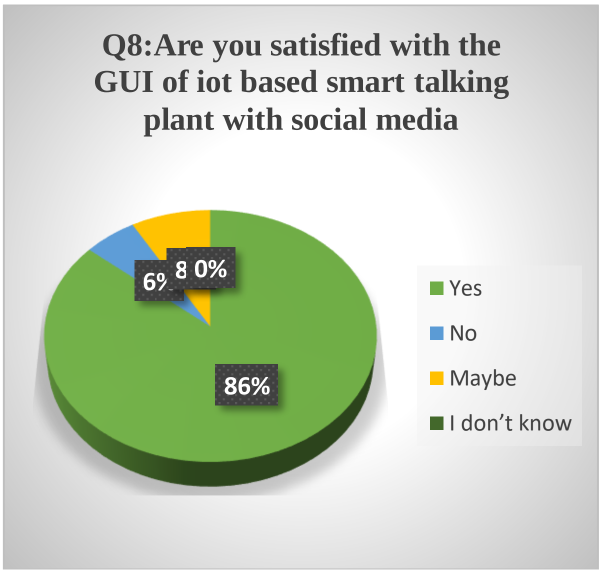


Figure 5:8: Q8 Response

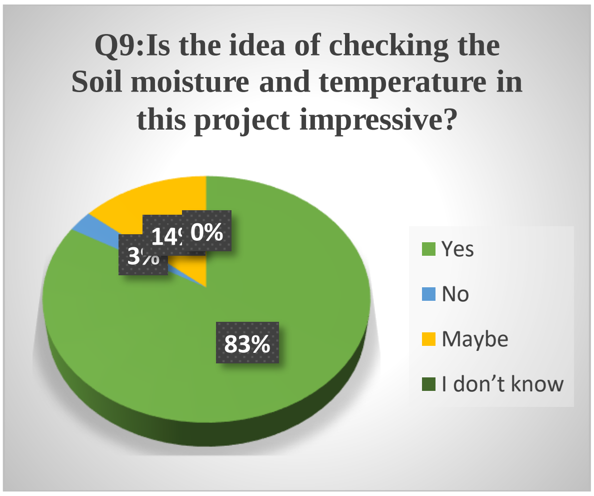


Figure 5:9: Q9 Response

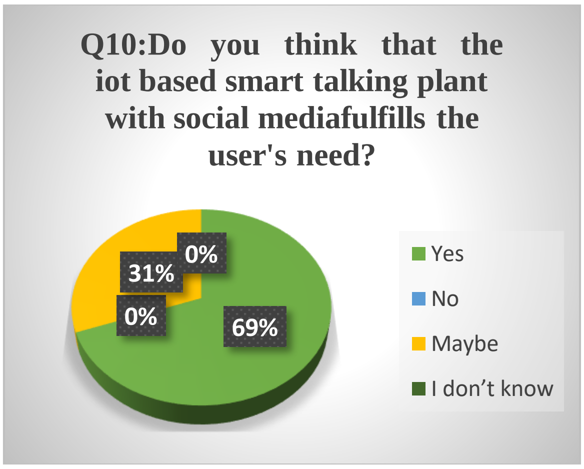


Figure 5:10: Q10 Response

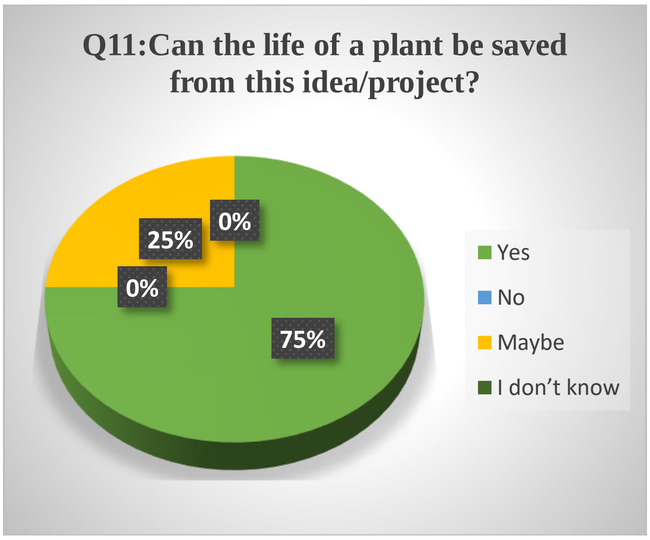


Figure 5:11: Q11 Response

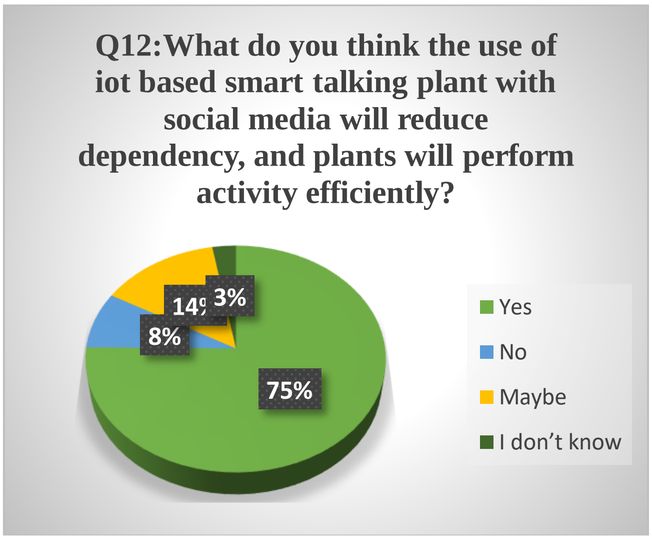


Figure 5:12: Q12 Response

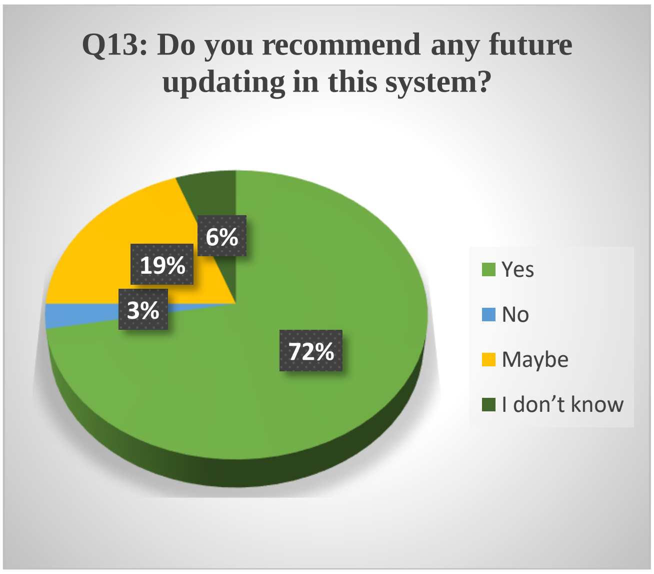


Figure 5:13: Q13 Response

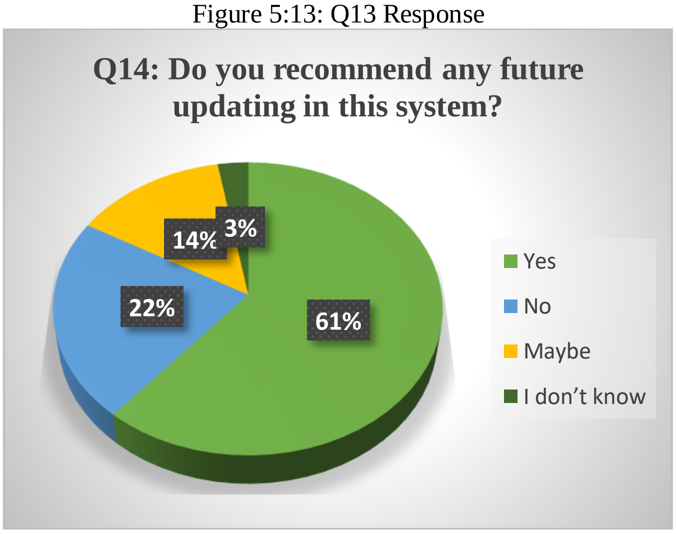


Figure 5:14: Q14 Response

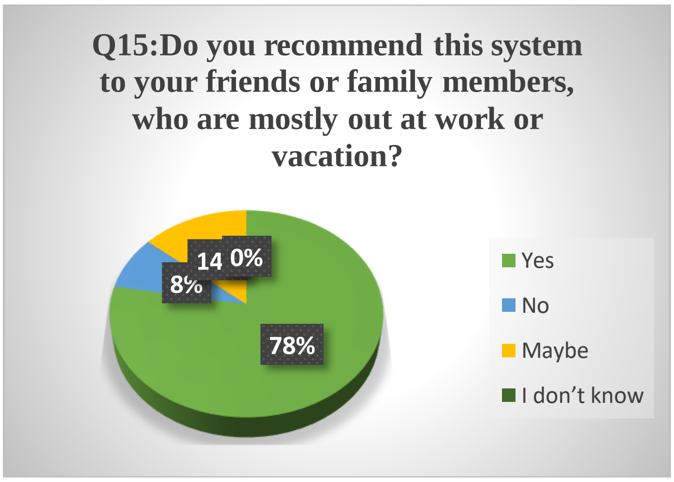


Figure 5:15: Q15 Response

5.1 UNIT TESTING

Unit Testing (5.4)

In this section, we show how the app displays the errors.

1. When the signup and sign-in fields are left blank, an error occurs, indicating that the required fields must be filled.

Figure 5.16: Field Required Error

2. In sign up and log in, if any user fills the incomplete information like incorrect mail or invalid password then error occurs and won't let you to log in

Figure 5.17: Sign-in Error

The primary goal of the proposed technique is to monitor the plants continuously as well as to develop a system that is capable of providing continuous information about the health of the plants by accessing live data from the various sensors, e.g., DHT11 (Temperature and Humidity Sensor), soil moisture sensor, LDR (Light Sensor), and water consumption. It is intended to make a talking plant synched with the Internet of Things (IoT)-based efficient system. ESP32 (Arduino) is an important part of the entire system that accesses the continuous live data from these sensors, evaluates the accessed data, and takes different decisions to perform the right action. ESP32 communicates with online platforms like Facebook and Twitter. An IoT technique is introduced into the system to make it more efficient and easily accessible across the globe. Furthermore, the mobile app makes it an option for the plant to create tweets, Facebook posts, and text messages that tell their owner how thirsty it is by just sending a tweet and, of course, sending the owner a thank-you reply after watering it or removing it from the heat of the sun. This system is quite helpful for the regular maintenance of the plants. Nature-loving people prefer to use such a system in order to take proper care of the plants.

6. CONCLUSION

As a result, this system is very helpful for people in terms of saving excess water use. This system is quite helpful for the regular maintenance of the plants. Nature-loving people prefer to use such a system in order to take proper care of the plants. This automatic system is generally used on a small scale, like plants inside houses or in backyard gardens, but it is possible to implement this project on a larger scale of agriculture where it can be made useful on a large scale, like farms and big gardens. In the future, it can be used with solar panels to provide electricity to the automatic system.

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