Plant Monitoring with Artificial Intelligence Chatbot

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***Abstract* – This paper is about an IoT system with AI chatting bot for plant monitoring which can monitor the level of soil moisture, light, temperature and fertility of our plant anywhere and anytime. As we know, plant is a living nature that really close to our life thanks to their beauty and the benefits that they provide to us and to the surrounding as well. People like to grow their favorite plants. Some of them even setup a small garden in their house to make their house restful and calm. However somehow they do not have enough time to watch after their plant. They simply water the plant once a day without even knowing what the plant actually needs. In this project, we implement a chatting bot to help us update the status of the plant while we were outside the house. The chatting bot will inform the owner about the current condition of the plant and its current need. In addition, the project collects and records the soil moisture, temperature, light of the surrounding, and also the plant's fertility. By monitoring these environmental variables continuously, it gives us an information of which factor affects growth of the plant. User can analyze the graph and determine the cause of the plant getting withered or the leaves getting dry and brown.**

***Keywords*—Raspberry Pi, Artificial Intelligence, IoT, Plant Monitoring.**

I. INTRODUCTION

Plant monitoring nowadays is seen to be one of the most important task and feature in any farming or agriculture- based environment. With the inception of Ambient Intelligent systems, there have been a rise in ambient intelligent based devices – Smart Homes [1] and other similar technologies involving RFID has evolved over the past few years [2]. With the presence technology and intelligent system in this agriculture field, makes plant monitoring easier. The most important factor for the productivity and quality of plant growth are humidity, temperature, light and conductivity of the plant. The more conductivity, the more fertile the plant. By monitoring these environmental variables continuously, it gives information how each factor affects plant growth and how to maximize it. However, the previous work focused on only getting the reading of soil moisture level, temperature of the environment and light conditions in and around the plant.

Plant monitoring with AI ChatBot is developed based on the concept of IoT. This implementation works along with a cloud-based server and mobile based device which helps the user to see the analysis of their plant from time to time and also the real-time status of the plant which is being monitored by the hardware device. A comprehensive sensor is installed at the plant. This sensor detects changes in the moisture, light and temperature of the surrounding and one additional sensor which is to see the fertility of the plant. This curation also integrated with Thingspeak software which to take data and analyzed in graph format. For user-based curation, the mobile device provides user an Artificial Intelligence ChatBot to communicate with the user. User can make a conversation to ask the real-time condition of their plant. Through the conversation, the ChatBot will give recommendation on what should be done or what their plant needs.

II. RELATED WORK

The authors [3] has done a similar project with smart garden monitoring system using IoT. The smart garden consists of NodeMCU connected to Arduino microcontroller as a hub to connect to different types of sensors such as humidity sensor, ultrasonic sensor, moisture sensor and temperature sensor. The ultrasonic sensor is connected to a water tank which indicate the level of the water tank. The other sensors connected to their respective positions and send their collected data to the NodeMCU. This project use Firebase as a database which real-time values of the sensor are updated every second.

They developed an Android application whereby this software is connected with the firebase that allow user to monitor the parameters from anywhere.

The plant monitoring and smart garden system using IoT was done by [4]. Tomen is a plant monitoring and smart gardening system with the help of a raspberry Pi

microcontroller. This project is to solve plants thrive by tracking the environmental conditions and monitoring them. The changing in soil moisture condition, weather and temperature will alert the user through their Android Smart phone. This system also includes an application which runs on android device and Microsoft Windows computer which help to monitor the plant condition. All the garden parameters like temperature, light intensity, humidity and soil moisture are tracked by the system and these data were uploaded in the database.

Plant communicator is a project experiment done by [5]. The purpose of this project is to protect plants and making sure they survive by monitoring moisture, temperature and light consumes by the plant. The sensors they are using in this experiment that connected to Arduino are TMP36 temperature sensor and phototransistor. To reduce the cost, they even created their own DIY moisture sensor. But unfortunately, this DIY moisture sensor was not accurate as sold in the marketplace. Furthermore, all data gathered by the sensors were uploaded to ThingSpeak software application to plot an analysis graph. The system also can send emails and graphs on a daily basis and notify user of its needs.

All in One Plant Monitoring System by [6] is a Bolt IoT project which monitor the soil moisture and sunlight level of a plant by sending SMS and E-mail of the current status of the plant to the user smartphone. This project also sends an alert message via SMS an E-mail to the user of any cause by anomaly or low level of soil moisture. This project use Bolt IoT Wi-Fi Module as the microcontroller. After data has been pulled out from the sensor, data will be uploaded to the Bolt Cloud to plot graph of the sunlight intensity. To send the status of the plant to the user's smartphone, this project uses two different software which is Twilio SMS to send SMS and Mailgun E-mail to send the status to user's E-mail.

The work on "IoT Enabled Plant Monitoring" was done by [7], is a monitoring system which monitor the plant temperature using temperature sensor and send the data to the cloud. This temperature sensor is connected to the NodeMCU. Data that has been recorded is uploaded to cloud. In this project, ThingSpeak cloud is used to store and analyze the data. This project also gives the remote monitoring facility which will be helpful to analyze the plant and take actions. Buzzer and LED are connected to the other NodeMCU to give an alert signal when temperature of the plant is higher than the actual needs.

III. PROPOSED PROTOTYPE

This section shows the hardware needed for the project and the flowchart of the system.

A. Hardware

Below is the hardware used throughout the development of this project:

Figure 1: HHCC Flower Care Sens

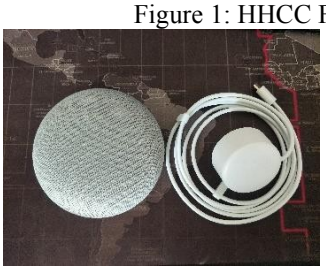

Figure 2: Google Home Mini

Figure 3: VGA Cable

Figure 4: Monitor

Figure 5: Power Adapter

Figure 6: Keyboard & Mouse

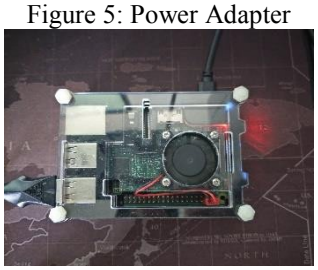

Figure 7: Raspberry Pi 3

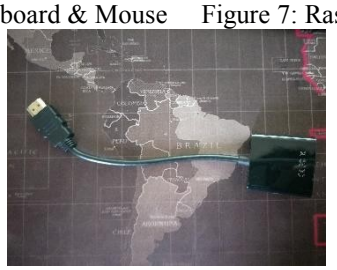

Figure 8: VGA to HDM Converter

B. Flowchart

The flowchart in Figure 9 shows the overall processes taking place for the system to run. The work details will be explained in the Methodology section.

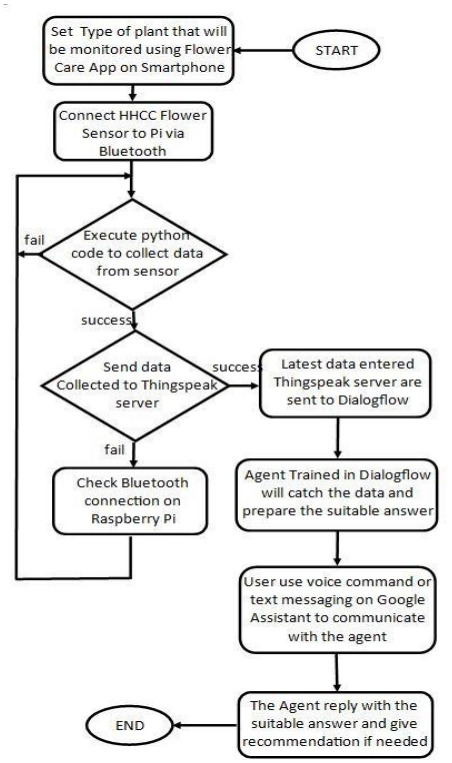

Figure 9: Flowchart of the project

IV. METHODOLOGY

SDLC methodology used in this project is Waterfall model. The model divides the project into five phases which are Requirement stage, Design stage, Implementation stage, Testing and Verification stage and the final phase is the Maintenance stage.

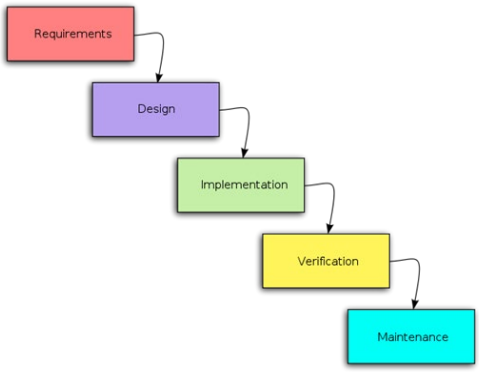

Figure 10: Waterfall Model

In Figure 10, the phases were executed in sequence one by one before proceeding to the next phase. Therefore, the developer can give an extra focus during each phase.

1. Requirements Analysis Phase

In this phase, all possible information and requirement is gathered and documented in a requirement specification document. Several methods can be used to gather this information such as by reading journals and article from the internet as well as observation and discussion with supervisor. Lecturer's advices are also sought after to determine whether the information collected are feasible enough to be made into this project.

2. System Design Phase

Figure 11 shows that the block diagram of the project. In the figure, the HHCC flower care sensor is connected to the soil of the plant. It is wirelessly connected to the Raspberry Pi to send the data via Bluetooth. Raspberry Pi is powered up by a 5V power supply. In the Raspberry Pi, all the codes are to pull out data from sensor and to upload it into ThingSpeak server is implemented and executed. Once the data has been uploaded to ThingSpeak server, Dialogflow will read the latest data entered in each field in the ThingSpeak channel. Next, agent in Dialogflow, will learn and ready to be asked by user and give recommendation as feedback. The user can communicate with the agent through Google Assistant application either using application on their smartphone or using Google Home which has built-in Google Assistant in it.

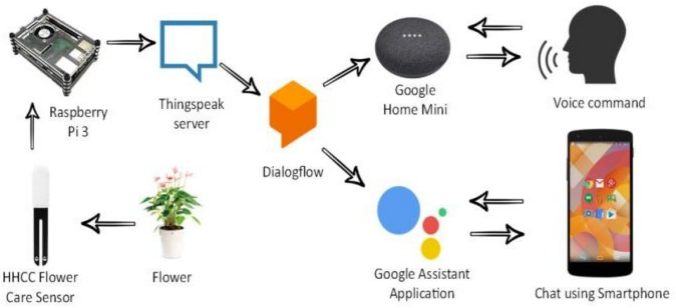

Figure 11: End-to-end Diagram

3. Implementation Phase

After completed the system design, hardware and software installation and configuration take places. All the units are tested for its functionality. Any troubleshooting process was carried out during this stage, so that the project is ready to run smoothly in the next phase. Data that have been pulled out from the sensor is uploaded to the cloud storage through Raspberry Pi as data hub. Then, this data will be sent to the ChatBot service and user can make the conversation with the ChatBot.

4. Testing and Verification Phase

In this phase, the HHCC Flower Care sensor is tested whether the sensor reading can be captured or not. The connectivity between this sensor and Raspberry Pi is also tested. Actually, the best thing about the HHCC Flower sensor is that it comes with a free Android application called "The Flower Care App". In Figure 12, the application shows that the system has successfully captured the reading of each sensor. Then, the results are taken and analyzed daily to confirm that the project objective which is to capture the reading of soil moisture, light, temperature and fertility of the plant is accurate and justified.

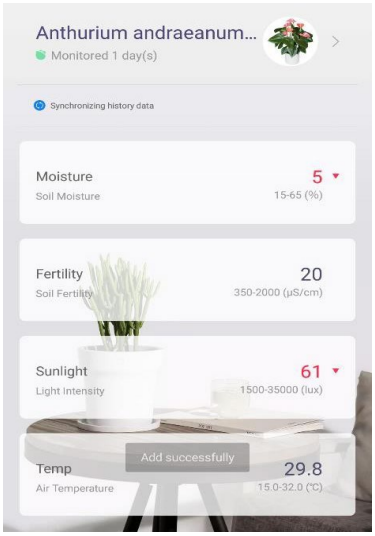

Figure 12: The current sensor reading

Furthermore, the agent in Dialogflow also needs to be tested frequently to make the agent smarter. The agent needs to be trained with lots of similar words that has possibility to be asked by the user. Some of the question samples the developer conversed with the agent are shown in Figure 13.

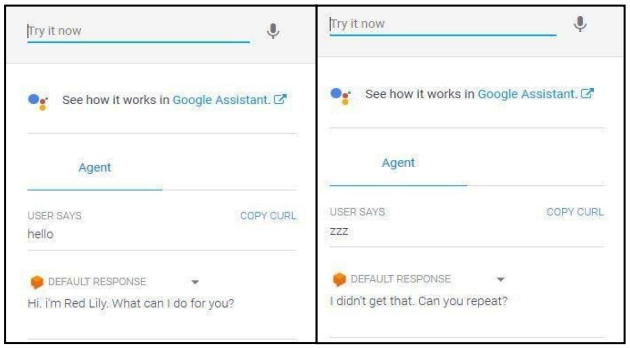

Figure 13: Example of conversation

It is important to create intent for the agent. Intent is basically like a topic. Intent is created so that the agent can communicate with the user based on topics declared in the intent section. This intent will train the agent to give feedback and recommendation based on the parameters asked by the user. The parameters here are the temperature, the light intensity, the soil moisture level and the soil fertility. Figure 14 shows some of phrases that are declared under the temperature parameter. By creating more intents, it can make this AI agent to be more human like.

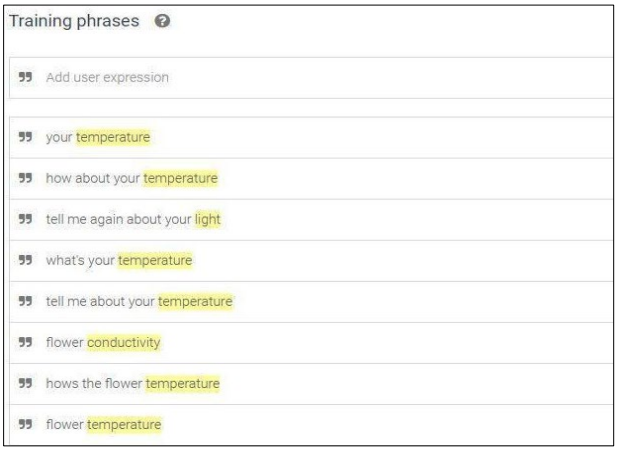

Figure 14: Training phrases

5. Maintenance Phase

In this last phase, any issues that appears in the customer or client environment are to be fixed and patched. Moreover, to enhance this product, a better version is to release to meet the client demand. Maintenance phase basically is done after delivering changes in the customer requirement.

V. RESULT AND DISCUSSIONS

In this project, Google Assistant is chosen as the medium of communication between user and the Artificial Intelligence agent. The reason Google Assistant is chosen is because Google Assistant has already installed on almost all of the Android smartphone nowadays. The user does not need to download additional application on their smartphone. Moreover, Google Assistant can accept two kind of input which is by voice command or by text messaging. This is a big advantage where user does not need to type to communicate with the agent. They can simply use their voice to ask. This makes the agent looks like human as the agent also will respond using voice.

After the AI agent has successfully developed, user can directly talk or texting with the agent using Google Assistant application on user's smartphone or through the Google Home mini to ask about their plant and to receive recommendation as well. The result of the chatting between user and Google Assistant can be seen in Figure 15.

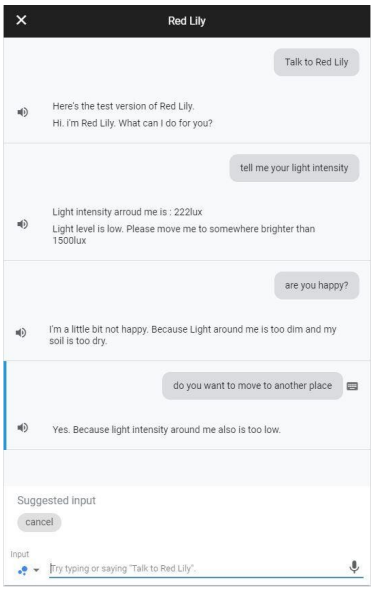

Figure 15: Result of chatting with the AI agent

VI. CONCLUSION

In brief, this project is developed to help the user in the process of taking care of their plant. User can directly ask Google Home Mini to know about the plant's current temperature, soil moisture reading, plant's fertility and sunlight exposure. User can ask the condition of their plant and receive recommendation on what their plant actually need. In addition, user can use the function of Google Home mini to set alarm to water their plant at certain time, and user also can ask about their plant's description and biology.

From the implementation and development of this project, it can be concluded that objectives of this project have been achieved. The prototype can run successfully whereby the user can chat verbally or typing message to their plant, receive feedbacks from their plants and receive recommendations about the plant health status from anywhere and at anytime.

REFERENCES

[1] C. Kidd *et al.*, *The Aware Home: A Living Laboratory for Ubiquitous Computing Research.* 1999.

[2] A. J. Jara, M. A. Zamora, and A. F. G. Skarmeta, "An internet of things–based personal device for diabetes therapy management in ambient assisted living (AAL)," *Pers. Ubiquitous Comput.*, vol. 15, no. 4, pp. 431–440, 2011.

[3] T. Thamaraimanalan, S. P. Vivekk, G. Satheeshkumar, and P. Saravanan, "Smart Garden Monitoring System Using IOT," 2018.

[4] R. Elangovan, N. Santhannakrishnan, R. Rozario, and A. Banu, "Tomen:A Plant monitoring and smart gardening system using IoT," *Int. J. Pure Appl. Math.*, vol. Volume 119, Mar. 2018.

[5] Arduino_Genuino, "Plant Communicator - Hackster.io," 2017. https://www.hackster.io/arduino/plant-communicator-7ea06f (accessed Mar. 01, 2020).

[6] Siddhant Poojary, "All In One Plant Monitoring System - Hackster.io," 2019. https://www.hackster.io/siddhantp0/all-in-one-plant-monitoring-system-dc6b02 (accessed Jan. 01, 2020).

[7] Sysenso, "IoT Enabled Plant Monitoring," 2018. https://sysenso.com/blog/f/iot-enabled-plant-monitoring (accessed Feb. 14, 2020).