Smart Mini Plant Pot

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ABSTRACT

Air pollution and global warming are problems that happened in Thailand since the past to nowadays. People are becoming more interested in planting trees. But most people have an obligation to do, such as go out for business trip that spend a long time so this problem make people does not have time to look after to their tress to the full capacity and the tree might die faster than normal. So, researchers decided to produce the small tree pot that can convenience users and prove their problem. It consists of ESP-32, soil moisture sensor, temperature sensor and small water pump. It can measure and show soil moisture value and temperature via the mobile application that modified from MIT app inventor2. Users can check moisture value and temperature on the application. If moisture value is lower than standard the application will send users notification and users can command water pump to work via the application too and size of pot is 10*10*10.

Keywords: planting, soil moisture, temperature, IoTs, MIT app inventor2

INTRODUCTION

Nowadays, In Thailand has a problem about the weather and air pollution. Planting trees in house area is popular to people. They plant trees for natural treatment. But problems of planting trees are people usually forget to water sufficient amounts of water. The sys it sometimes they have their duties to do such as long business trip or working outside their home causing inconvenience in the care of trees effectively. Some people may have to pay extra to hire a gardener when they are not at home for many days. The usual method of watering plants is to use a water hose or watering can to pour water into the soil for each tree. This method may be a problem for elderly people who tend to like to plant a lot of trees. Exposing to the sun for a long hot day to water the plants as normal methods can negatively affect the physical condition of the elderly. For this reason, the researchers intend to develop a watering machine by applying ESP32 broad module and internet of things to controlling water and check the soil moisture with sensors. Users can stick the machine with pot that use to plant trees. There is also mobile application that users can command water pump working and show real time soil moisture value. It more convenience and reduce user anxiety when they have to leave home to do their duties for long times without worrying that

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the tree will not receive them is designed to pump water until the soil has sufficient moisture for the tree. The researchers apply soil moisture sensor to measure moisture value in soil. Users can check value in mobile application. System also designs to have notification via mobile application to warning users when soil moisture value is less than standard value. In part of water container, user can use anything that can enough contain water because the plants normally need a water 1 time a day, there is no problem with the water container so user can use anything that convenience for them. In this research paper, researchers divide the article structure into 5 parts. The second topic will explain the research related theory including related research. The third part will explain about design, development of project and mobile application. The fourth is result of experiment and conclusion of this research in the fifth topic.

LITERATURE REVIEW

Theory

Mini pot or intelligent plant pot is a building of a plant pot that has been used in science, information technology as a tool for convenience and ease of management. Which can be processed quickly and accurately resources is worthwhile. Increase the quantity and quality of products, help reduce production costs, safe for consumers and the environment leads to international competition making an intelligent plant pot is a plant-based planting with innovation. Which is very popular in foreign countries such as the United States and Australia and at present, it is widespread in Europe, Japan, Malaysia, and India etc. These countries are highly dependent on information technology systems, according to the article "Tomen: A plant monitoring and smart gardening system using IOT" shows the importance between IOT and crop planting Which has used technology to connect with various agricultural equipment To make those devices Able to manage plants effectively Using minimal labor, such as using sensors to measure various data Such as air sensors, ground sensors, etc. These sensors are used in wireless sensors networks. This mini pot technology uses sensor systems to analyze data that should have water how much at any time. Which technology is used in conjunction with MIT technology.

ESP module

ESP32 is a series of low cost, low power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations and includes in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process.

Figure 1 composition of ESP module

Soil moisture sensor

The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

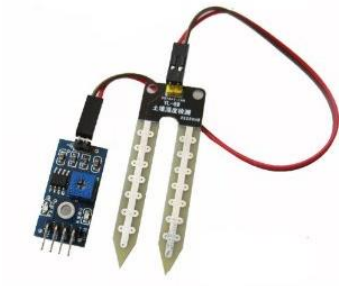

Figure 2 Soil moisture sensor

Temperature sensor

A temperature sensor detects the temperature of an object or of its environment and converts the reading into an electrical signal. Common types of temperature sensors include thermocouples, resistance temperature detectors (RTDs), thermistors, local temp sensor ICs, and remote thermal diode temperature sensor ICs. Thermocouples, RTDs, and thermistors are sensing elements with electrical properties that vary predictably with temperature. Local temperature sensor ICs utilizes the physical properties of transistors on the die as the sensing element. Clinical grade temp sensors meet the clinical thermometry specification of the ASTM E1112 for accuracy. Remote thermal diode temperature sensors employ an external bipolar transistor as the sensing element and include all the signal conditioning circuitry necessary to measure temperature using one or more external transistors.

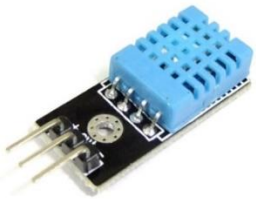

Figure 3 Temperature sensor

Mini pump

Mini pump is a low cost mini submersible type water pump that works on 3-6V DC. It is extremely simple and easy to use. Just immerse the pump in water, connect a suitable pipe to the outlet and power the motor with 3-6V to start pumping water. Great for building science projects, fire-extinguishers, firefighting robots, fountains, waterfalls, plant watering systems etc. This motor is small, compact and light. It can be controlled from a micro controller/Arduino using our DC Motor Drivers or one of our Relay Boards. You may use our 5V SMPS Power Supply

Adapter to run this pump. You may also use our 6V Solar Panel to run the pump with appropriate a 6V voltage regulator.

Note: Do not run the pump dry (without putting it in water) and do not use it to pump flammable liquids.

Figure 4 Mini pump

One Channel Relay Module

A relay is an electrically operated device. It has a control system and controlled system. It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal. The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume. It is widely adopted in devices of power protection, automation technology, sport, remote control, reconnaissance and communication, as well as in devices of electro mechanics and power electronics. Generally speaking, a relay contains an induction part which can reflect input variable like current, voltage, power, resistance, frequency, temperature, pressure, speed and light etc. It also contains an actuator module (output) which can energize or de-energize the connection of controlled circuit. There is an intermediary part between input part and output part that is used to coupling and isolate input current, as well as actuate the output. When the rated value of input (voltage, current and temperature etc.) is above the critical value, the controlled output circuit of relay will be energized or de-energized.

Figure 5 One-Channel Relay module

MIT App Inventor 2

MIT App Inventor is an intuitive, visual programming environment that allows everyone – even children – to build fully functional apps for smartphones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks-based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments. The MIT App Inventor project seeks to democratize software

development by empowering all people, especially young people, to move from technology consumption to technology creation.

Figure 6 Part of MIT App Inventor 2

Related Work

- **Digital Pot:** Junyi Heo creat project about the pet plant name ‘ Digital Pot ’.The Digital Pot is the tamgotchi of the plant world. It is your plant’s spokesperson as it “speaks” what the plant exactly needs: more or less water, higher or lower temperature, better soil conditions, more or less humidity. The Pot calculates those variables based on the need of the plant, and expresses its condition via a series of pictograms on an LCD display.

Figure 7 Digital Pot model

- **Xiaomi HHCC Ropot Smart Flower Pot:** Xiaomi HHCC Ropot Smart Flower Pot or smart plant pot from Xiaomi is tool that can help users can understand their plants or flowers more. It can check moisture, soil of plants in the pot. User can see the information of plant in the application real time. This invention is a bit different from our project. It cannot water by itself but our project adds this function to make users more convenient.

Figure 8 Xiaomi HHCC Ropot Smart Flower Pot model

- **Parrot Pot:** The Parrot Pot is autonomous, wireless and runs on 4AA batteries. This pot watered plants by itself and sunlight, fertilizer level, temperature and soil moisture monitoring in the application. The application of this invention is a bit different from our project. In the application of our project, there is notification to warning user when moisture of soil is less than plants need or it's time to water but the application of parrot pot just monitor the value. There is no warning to users.

Figure 9 Parrot Pot model

METHODOLOGY

The Project has 2 parts: software and hardware that show system diagram on Figure 10. In part of software, the application was design for user need to login before using. User information is stored in database. Users have to fill the information of plants in the application. ESP32 will check data of soil moisture, if soil moisture is low then the application will be warning, in which the gauge will point to red and buzzer will alarm. If there is nothing happen after 5 minutes, the pot will be watered plants by itself. In part of hardware, we have use ESP32 to connect soil moisture sensor and temperature sensor together. We write down commands on ESP32 to make sensors work. The function of pot in this project is check value of moisture in soil and temperature in the air the show the value in the application. When soil moisture is low, the pot will get command from application first.

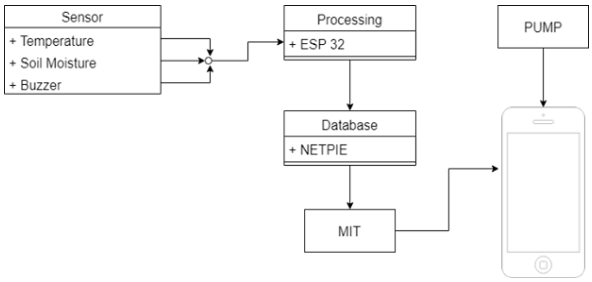

Figure 10 System diagram

Functionalities

- In part of application, users have to register to the application for login.
- In part of model, the pot has a mini water pump to pump the water into soil in the pot.
- Soil moisture sensor and temperature sensor used to detect moisture in soil and take the temperature in the air and show value in the application.

Block diagram

- **In part of application:** Sensor will send the data to ESP32 so; ESP32 will digitize all the data and then send to NETPIE. If the data more than or equal 70, MIT will show on green gauge and then if the data more than or equal 34 but less than 70, MIT will show on yellow gauge and if the data less than 34, MIT will show on red gauge.
- **In part of pot:** MIT will show the button that either press down or not press then MIT will send the data to NETPIE so, NETPIE will convert press down to 'on' and not press to 'off' and then NETPIE will send 'on' and 'off' to ESP32. If 'on' ESP32 will digitize all the data to 1, 'off' will change to 0. If the data is 1, pump will be watered but if the data is 0, pump will not be watered.

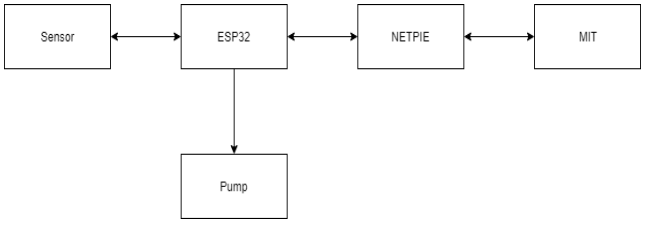

Figure 11 Block diagram

Flowchart

- **Pot Flowchart**

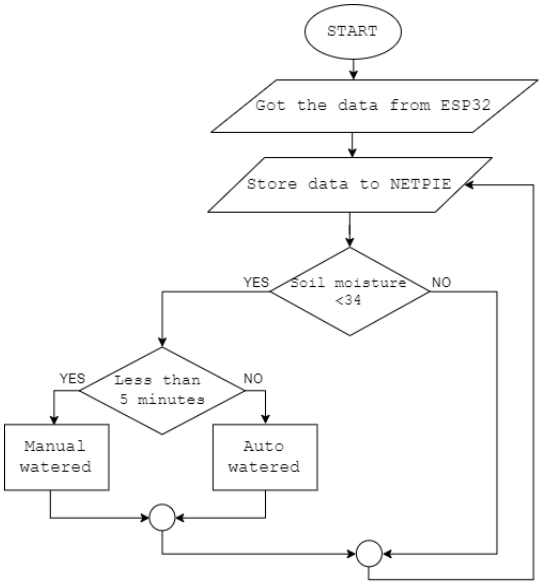

Figure 12 Pot Flowchart

From Figure 12 Pot Flowchart, the pot will receive the data from esp32 if the soil moisture is lower than 34 percent, the pot will timer for 5 minutes. Within 5 minutes the user watered by manual. The pot will get the data at Netpie and finish the operation, but if within 5 minutes, the user did not water and the pot will water automatically. Then the pot stores the data on Netpie and finish working

- **Sensor Flowchart**

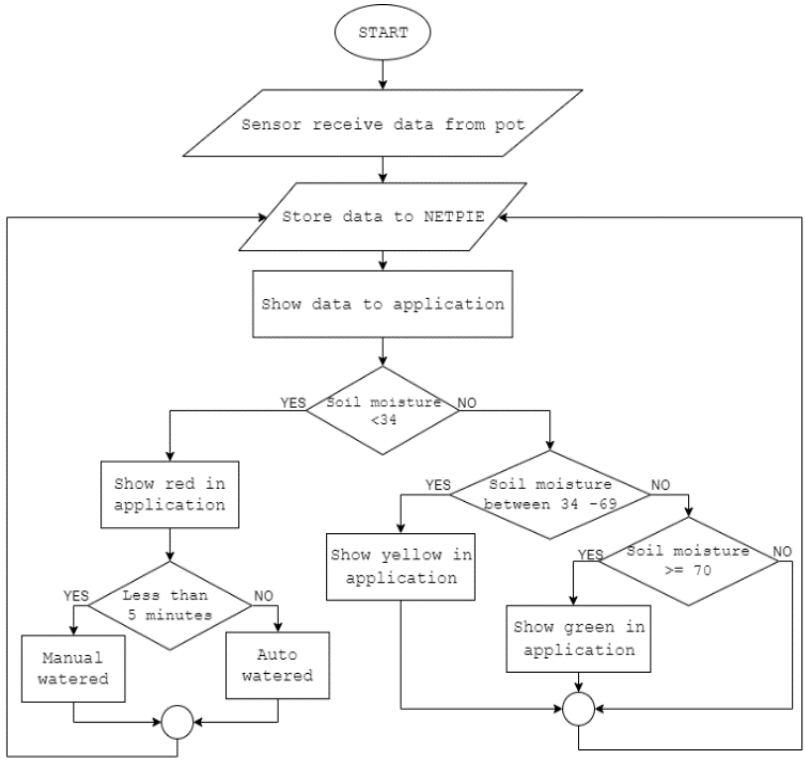

Figure 13 Sensor Flowchart

From Figure 13 Sensor Flowchart, the values stored on the Netpie that are display on the application. If the soil moisture sensor is less than 34, the gauge will show red that indicating danger on the application. The pot will automatically be watering the timer in 5 minutes. If the soil moisture sensor is between 34 to 69, the gauge will show yellow that indicating almost dangerous is shown on the application. And if the soil moisture sensor is more than or above 70, the gauge will show green color that indicating safe on the application. Then the data will be stored on the Netpie and finish the work.

- **User Flowchart**

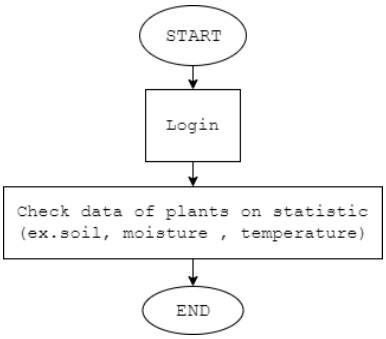

Figure 14 User Flowchart

From Figure 14 User Flowchart, users have to login to enter the application page. On the application, there is a function to press manual watering and can check soil moisture, humidity and temperature

- **Model**

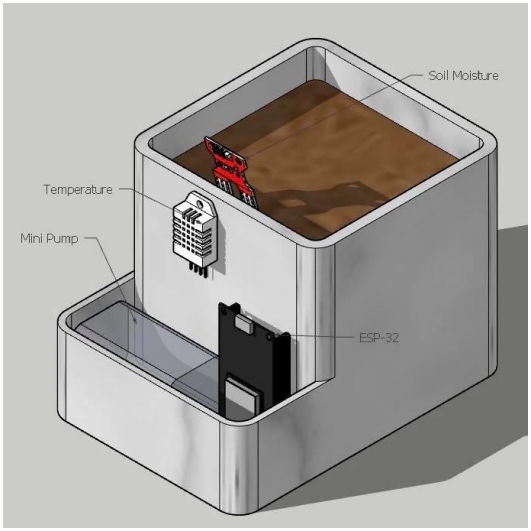

Figure 15 Pot Model

Use Case Diagram

This is use case diagrams that show user and app developer relationship with application. It shows ability that user and app developer can do in application.

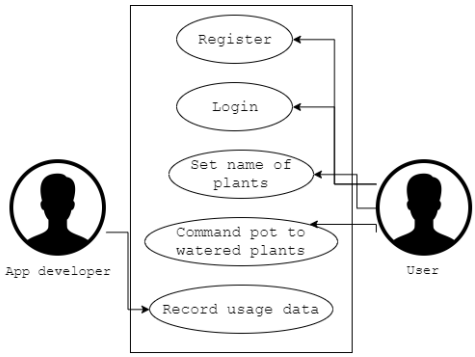

Figure 16 Use case diagram

Database and Web server

- **ER Diagram**

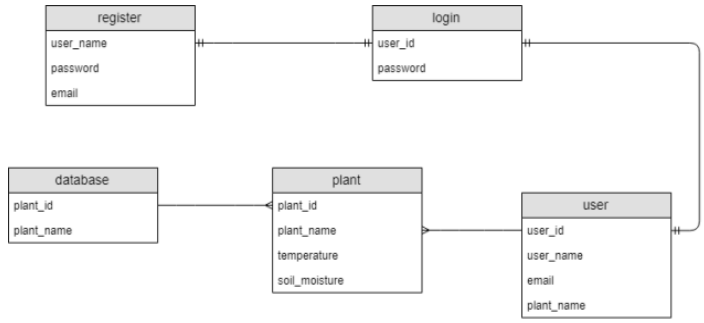

Figure 17 ER diagram of web application

Mobile Application

- **First page of application:** The first page will show logo “Mini Pot” that show on Figure 18.

Figure 18 First page of application

- **Login or register of application:** This page will show username and password for user login. The Figure 19 shows login or register.

Figure 19 Login of application

- **Gauge of application:** The gauge will show temperature data and soil moisture data of pot with gauge. The Figure 20 show gauge of application.

Figure 20 Gauge of application

- **Statistic of application:** The page will show statistic data that stored by sensor in pot. The Figure 21 show statistic of application

Figure 21 Statistic of application

RESULTS

Model

After we designed the model as shown in Figure 15, we have simulated a plant pot from flute board as show in figure 22 and figure 23.

Figure 22 Side view

Figure 23 Top view

If there are problems with circuit device inside, users can open the cover on top of plant pot to fix the components in pot.

Mobile application

In part of mobile application, we create log-in page as show in figure 24 first. Users have to login before enter to next page

Figure 24 Login

If users type wrong username or password so, the application will appear word “username and password is incorrect” then, users have to enter right one again. After users are logging in the next page will show soil moisture value, temperature and humidity value. Users can command pump to water plants in this page by using ON and OFF button. This page is show as figure 25.

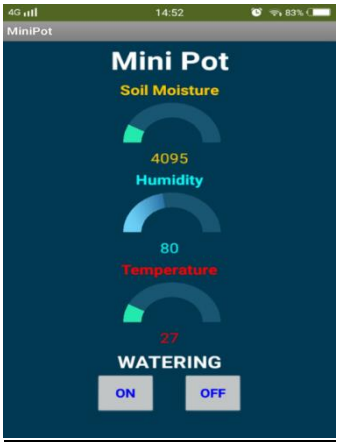

Figure 25 Graph that stored sensor values

The values of each sensor are recorded in Netpie as shown in figure 26. The stored values are displayed in a graph. It will record five minutes once.

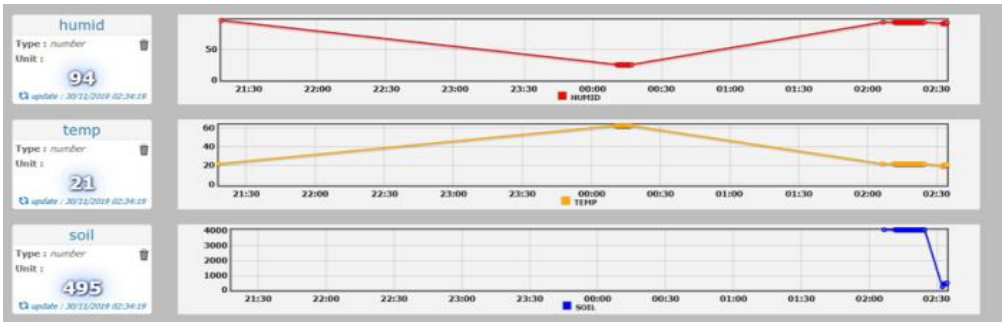

Figure 26 Command page

CONCLUSIONS

From the experimental results, the researcher concluded that 'Mini Pot' can use with small trees that plant in office. Soil moisture and temperature sensors can work well with mobile application. Users can command water pump to watering plants via mobile application. Mobile application can show temperature, soil moisture value includes to humidity value data in real-time. We have drilled a little hole in the bottom of 'Mini Pot' in order to drain the water too, because if not draining the water out it may cause the roots of the tree to rot.

However, the researchers recommend using 'Mini Pot' on small trees for accuracy of sensors that will show data on mobile application.

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