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Smart Trashcan Using IOT System

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Abstract: The development of Internet of Things (IoT) nowadays is essential to better electronics and electrical appliances usage. The Smart Trash Can using IoT System is a way to improve the management of our daily waste in everyday life. Having a trashcan in houses is practically an essential to every person. The management of trash by people differs individually as they have their own ways to throw out the trash. A pile of trash in the trash can will causes a bad odour to house and even workspace. A trashcan that is not manage properly will cause the trash can to be full and overflowing. This will affect the cleanliness and the view of house or the workplace. To manage the situation and properly have a efficient management of trash disposing system in a workplace our home, the Smart Trash Can using IoT System is introduced. This project will develop a system that can detect the level inside of the trash that can alert users. The ultrasonic sensor in the Trash Can will detect the distance of the trash inside the trashcan when the trash reaches the threshold value. The NodeMCU which is the ESP8266 controls the system which can link to any cloud platform and in this project, it is connected to the Telegram Messenger application. Users will be able to receive notifications on their smartphones or computers as Telegram can be accessed in all platforms. In conclusion the uses of Smart Trash Can using IoT system helps reducing time to manage trash disposing in a hectic schedule faced by everyone.

Keywords: IoT, NodeMCU, Ultrasonic Sensor

1. Introduction

As the population of citizens in Malaysia increases [1], the number of residential areas and industrial areas in the country increases. With the increasing number of developments this will lead to an increasing number of wastes disposed of by each sector. The inefficient management of trash will affect the longevity of the country. Inefficient trash management is due to the busyness of individuals with hectic schedules and the lack of development by authorities to efficiently manage waste disposal. A better waste management system for residents will help the amount of garbage in that area to be reduced. With that, an idea to develop a smart trashcan is proposed which will help users with their trash. This

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automated trashcan will be helpful with the usage of IoT and sensor-based circuitry. Our normal trashcan needs to be checked regularly so the trash will not pile up. However, it is not a practiced routine by everyone. With the development of this system, it will help users in taking care of their trash. This system is basically a setup that uses an Ultrasonic Sensor, a Wi-Fi module. Once it exceeds the threshold, with the help of IoT it will notify users through a text message so users can take out the trash. This trashcan will be suitable to users that will be needing the system to ease their trash disposal management either in their home or personal workspace.

The use of the Internet of Things (IoT) in this age helps users to transfer data through the network without the involvement of human interactions. This technology, which can be used with wireless transmitting devices, helps users in transferring data to the cloud. The uses of Internet of Things in modern days helps in everyday routine without we know the importance of IoT [2]

With the help of the IoT in the said project, users will apply the functionality of the Internet of Things to their daily routine. Research done by [3] show that the management of the disposal system in a particular area is not done efficiently which cause the pile of garbage in the housing area. The disposal of waste by residents and companies from their respective buildings is not conducted properly thus the lumping amount of trash and garbage in a waste disposal. This project will help users to manage their waste and ease them with disposing trash.

2. Materials and Methods

2.1 List of Hardware and Software

Table 1: List of Hardware and Software

Hardware/Software	Details
NodeMCU ESP8266	NodeMCU ESP8266 is an open-source software and hardware development environment constructed on the ESP8266, a low-cost System-on-a-Chip (SoC).
Ultrasonic Sensor HC-SR04	An Ultrasonic Sensor HC-SR04 is a equipment that uses ultrasonic sound waves to determine the distance of an object.
Arduino IDE	An official software introduced by Arduino.cc that is mainly used for writing, compiling, and uploading the code in almost all Arduino modules/boards.
Telegram Messenger	Telegram Messenger is a globally accessible freemium, cross-platform, encrypted, cloud-based and centralized instant messaging (IM) service

2.2 Block diagram of project

The design and structure of the system are shown using a block diagram. The project's design will be discussed. The project's block diagram is shown in Figure 1.

The system is divided into inputs, controller, and output. The input part is simply consisting of the Ultrasonic Sensor that will detect the volume of the trash in the trash can. The sensor will receive the reading of the volume inside the trash can. The controller will receive data from sensor which is powered by the regulator

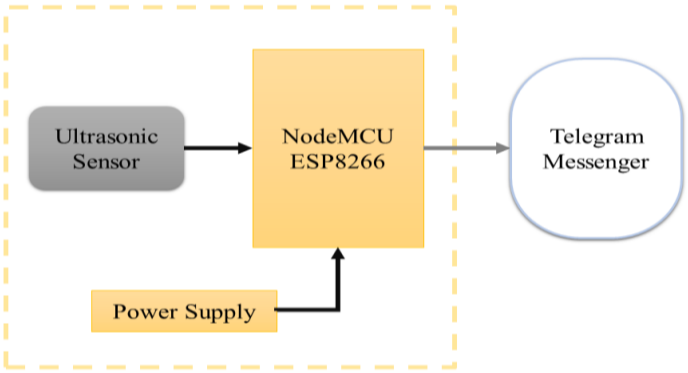

Figure 1: The block diagram of the project

2.3 System Flowchart

The flowchart of the system starts with the system is initialize and the ESP8266 is powered by a USB to micro-USB cable. Then the Ultrasonic sensor is initialized to the Wi-Fi module. The Baud rate for the Arduino IDE is set to 115200 bps for the system. The Velocity of sound and the distance metrics is defined in the program. The connection of ESP8266 Wi-Fi is initiate with setting up the password and SSID of the Wi-Fi. Then the TelegramBot is initiate after getting the token and user ID from the API.

The IDE is then connected to Wi-fi and telegram. The trigPin of ultrasonic sensor is set as the Output while the echoPin is set as Input. The trigPin is set on high state for 10 microseconds. Then the sound wave triggered by the Trig Pin will move from the sensor to an object and bounce back to the sensor which the echoPin is set to read the time of sound wave travel. To find the distance of the object from the sensor, the distance is calculated by using the formula

$$Distance = (Duration\ of\ sound\ wave\ travel * Velocity\ of\ Sound)/2$$

The system program will read the value of the distance. If the distance of the object is less than 5 cm, then the TelegramBot is initiate to send messages to the TelegramBot. If the statement is false then the program will return to read the distance of object in front of the Ultrasonic Sensor. When the statement Distance of object is less than the threshold which is 5 cm then TelegramBot will send a message “Trash Can is Full!!” to users

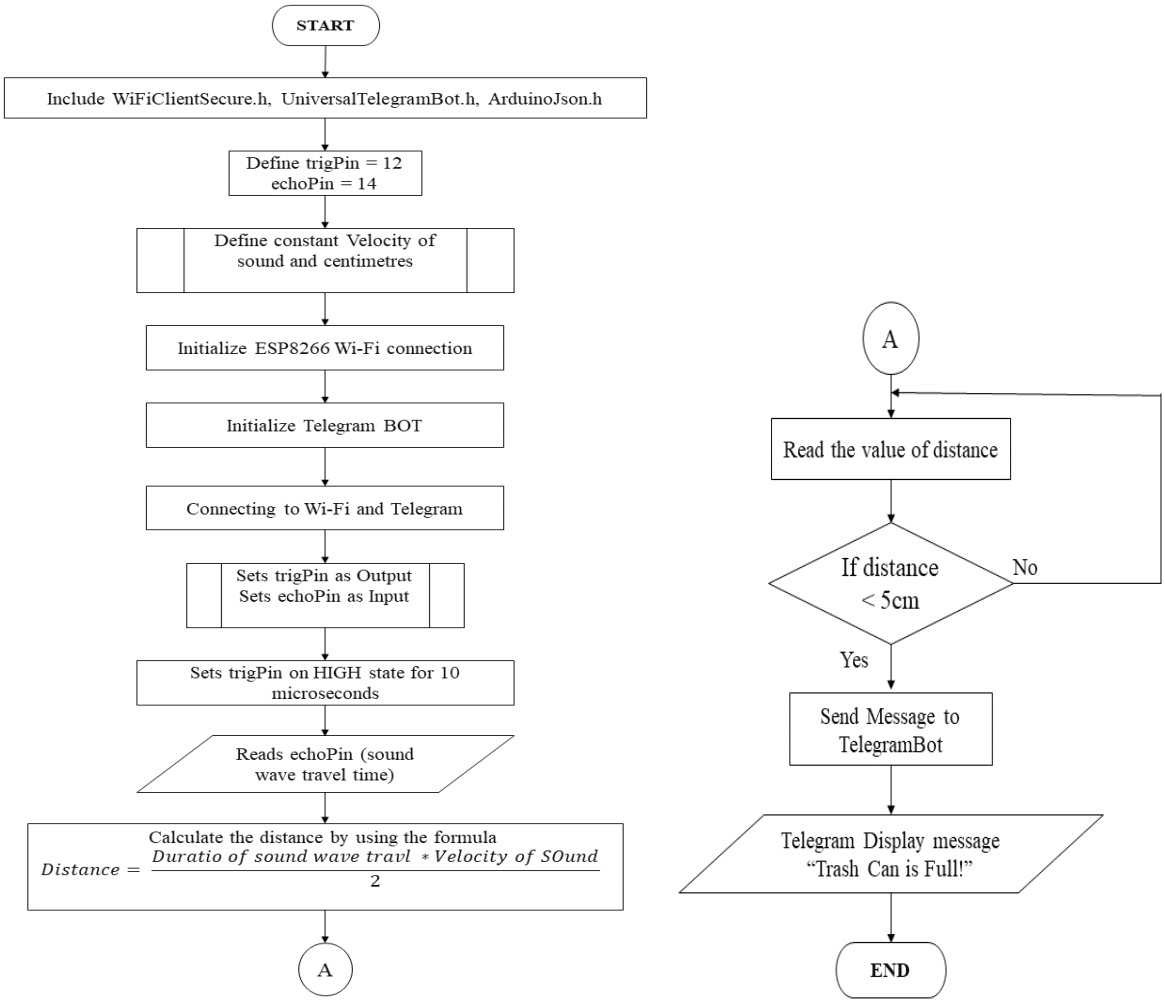

Figure 2: Flowchart of the system

2.4 Hardware Development and Circuit Diagram

This system uses an ultrasonic sensor and NodeMCU for the control system. The Ultrasonic sensor will detect the level of trash in the trashcan. The data of the sensor will be sent to the NodeMCU which is the main microcontroller in the system that is connected to power supply. The sensor will read the distance and detect a distance that is less than the value of threshold set in the system. The system will notify users through Telegram Bot and send users messages notifying about the state of trash can.

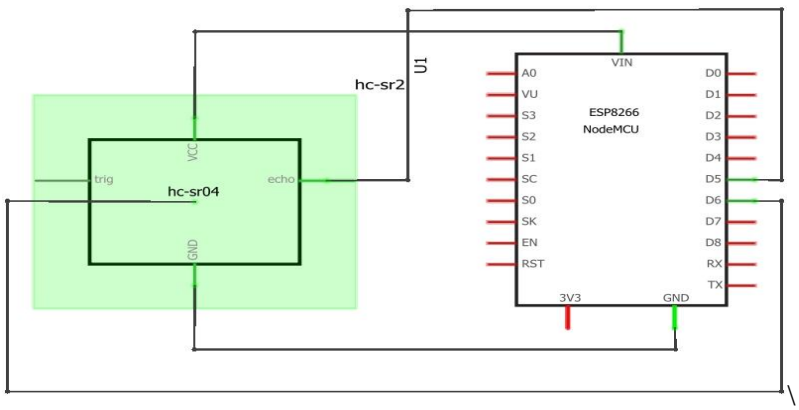

Figure 3: Circuit diagram of system

2.3 Interfacing between NodeMCU ESP8266 and Ultrasonic Sensors

The NodeMCU ESP8266 is connected to the Ultrasonic Sensors to develop the full system of this project. The NodeMCU is programmed to connect to the Wi-Fi by using the SSID and password of the Wi-Fi. It will receive information on the changes detected by the ultrasonic sensors. Figure 4 shows the connection of an ESP8266 and Ultrasonic Sensor

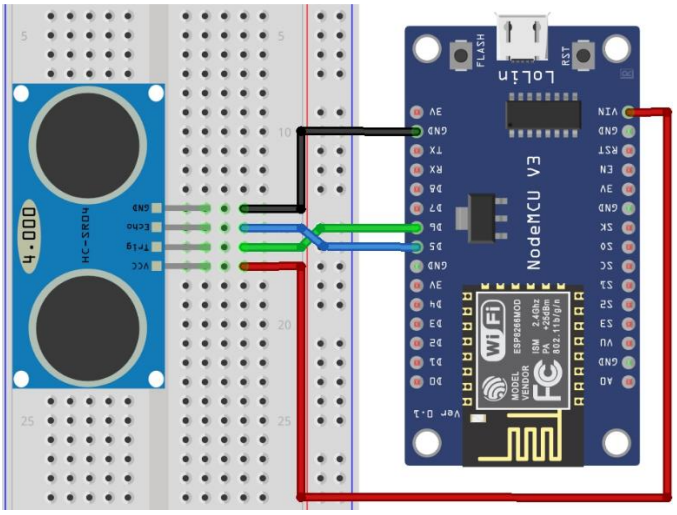

Figure 4: Connection of ESP8266 and Ultrasonic sensor

The NodeMCU ESP8266 is connected to the Ultrasonic Sensor by connecting the pins on the Wi-Fi module to the pin of sensor. The GPIO pins are connected to the Input and output pin of the sensor. The GPIO14(D5) is connected to the Echo pin while the Trigger Pin is connected to the GPIO12 (D6). The GND and Vin of the microcontroller is connected to the ground and VCC of the ultrasonic sensor respectively which allow full communication between the components. The power of the system will be provided by the USB port.

From the connection, the Ultrasonic sensor will measure the distance between the sensor and object in front of them. The ultrasonic sensor will keep sending measurements as the coding for the sensor is not program to notify users In this case, the ultrasonic sensors which act as a level sensor will detect the level of the trash in the trash can. The sensor will transmit information to the NodeMCU ESP8266 as the level of trash increase. The NodeMCU will not be transmitting any messages or information to the TelegramBot as the level of the trash does not reach the threshold. As the level of trash reaches a certain distance from the ultrasonic sensor, the threshold is reached and the TelegramBot is notified thus sending notifications to the user Telegram messenger. In this project, the TelegramBot created is SmrtTrshCnBot.

2.5 Application of ESP8266 on Arduino IDE

The latest version of the Arduino IDE is installed which is the 1.8.13 version. In the Arduino IDE, the libraries for the NodeMCU are added by selecting the Preferences as shown in the figure. In the Additional Board Manager URLs field, the URL *http://arduino.esp8266.com/stable/package_esp8266com_index.json* is pasted to install the ESP8266 add-ons which is shown in Figure 3.6. To add the ESP8266 board to the Arduino IDE, the Boards

Manager from the Tools tab is selected in the Arduino IDE and the right module of the NodeMCU is selected which is the NodeMCU 1.0 (ESP-12E Module) as shown in Figure 5.

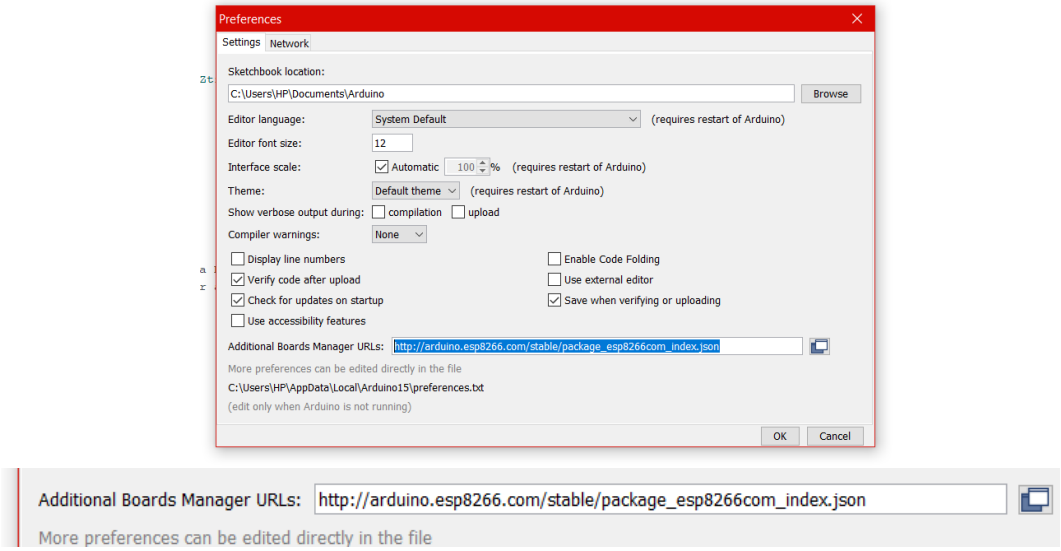

Figure 5: To install ESP8266 add-ons

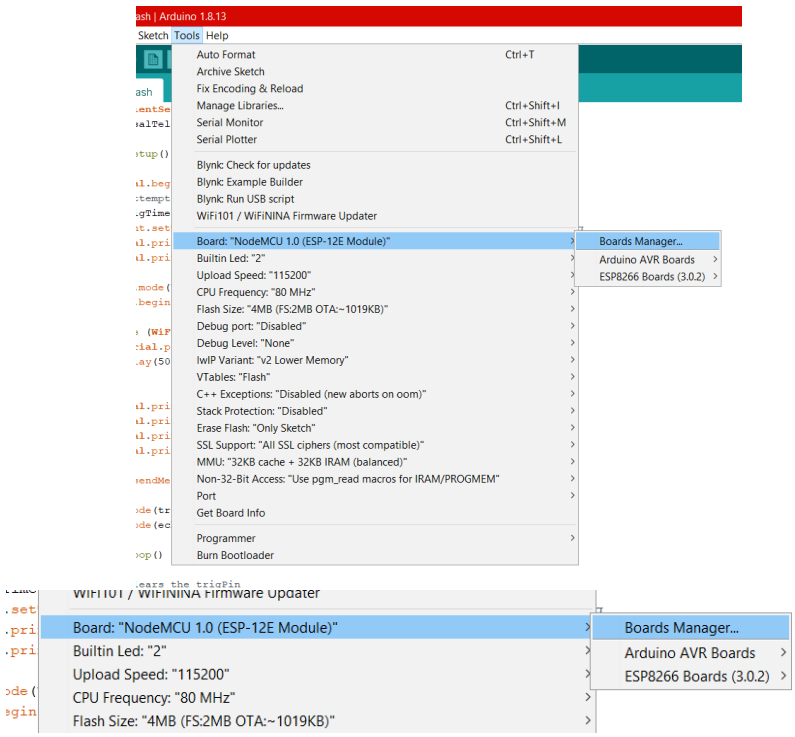

Figure 6: Adding ESP8266 board to Arduino IDE

The next step is to write the coding for the ESP8266. A basic code is selected from the Examples in the Arduino Ide. Before uploading the code to the NodeMCU, from Tools, select the port: COM based on where the ESP8266 is connected to the computer ports as shown in the Figure 6.

3. Results and Discussion

Following the completion of the hardware and software implementation to the project system, the results are obtained and collected. The results are thoroughly checked to observe the overall outcomes from the project system. After conducting the prototype testing, ultrasonic sensor can detect the level of the trash inside the trash can. Firstly, the system is placed in the trashcan with no trash thus the ultrasonic sensor does not send any information to the TelegramBot as it was program to notify users when the level of trash is within the threshold range of the ultrasonic sensor and the object which is below 5 cm. The prototype height is 19 cm and the ultrasonic sensor will detect the changes of trash level inside the prototype. Table 2 shows the output when the level of the trash inside the trash changes and the messages sent by the TelegramBot named SmrtTrshCnBot.

Table 2: Response by The Trashcan

Distance between Sensor and trash	SmrtTrshCnBot responses
17 cm	No Messages
15 cm	No Messages
10 cm	No Messages
5 cm	The Trash Can is Full!

When the threshold is in range then the information from the ultrasonic sensor is forwarded to the TelegramBot then it will send a message to the users via the bot that the users created in Telegram Messenger. Figure 7 shows the trash at 5 from the sensor. Figure 8 and Figure 9 show the output from the serial monitor and the TelegramBot when the ultrasonic sensor detects trash within 5 cm of its range.

Figure 7: Trash at 5 cm from Ultrasonic Sensor

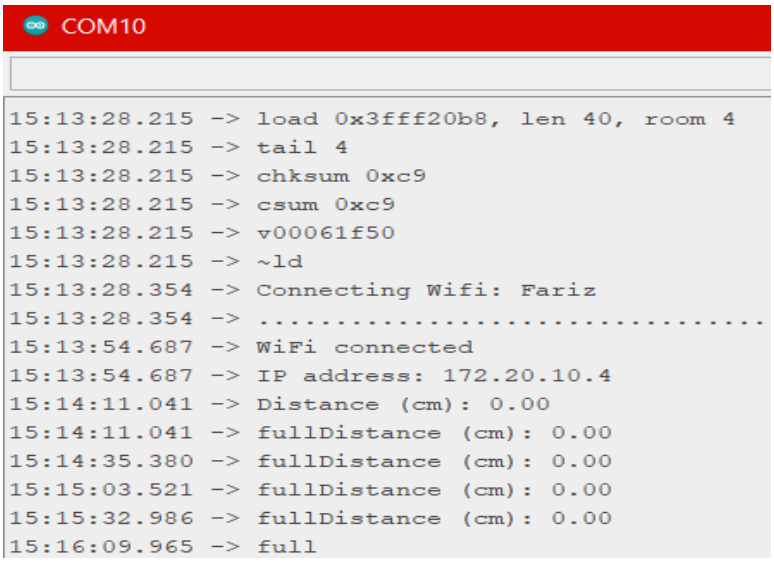

Figure 8: Output from Serial Monitor

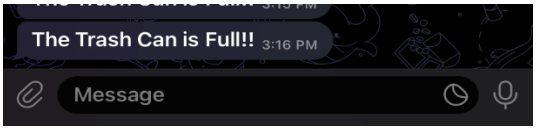

Figure 1: Notifications from TelegramBot

4. Conclusion

In conclusion, the Smart Trashcan using IoT system project is completed and successfully achieves the objectives of the project. This project can be a fix to the problems faced in managing trash in houses or workspace. The project will ease the users to clean or throw out their trash when it is time without

forgetting which will cause the trash can to be full. This project is mainly for the uses of personal which helps the users from disturbing their other chores.

Acknowledgement

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