International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/CSEIT2286140

Garbage Management System using Internet of Things (IOT)

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Article Info

Publication Issue :
Volume 8, Issue 6
November-December-2022

Page Number : 509-516

Article History
Accepted: 05 Dec 2022
Published: 20 Dec 2022

ABSTRACT

Any city can be considered to as a "smart city" Because of its orderly and tidy surroundings. Numerous challenges, including those related to smart grids, smart environments, smart living, and smart transport networks, are currently plaguing many modern cities. Today, cities and urban areas' top priority is proper waste management. Traditional waste management techniques are too simplistic to produce an effective and reliable waste management system. Any smart city must priorities smart waste management because it has a direct impact on people's way of life, health, and environment. This article deliberates a thorough analysis of various proposed methods for smart bin systems, such as smart waste collection, smart waste monitoring, and smart waste segregation. We also suggest a framework for a smart waste management system in addition to this survey. The decline in the cleanliness of the environment due to garbage management is one of the issues that most cities and towns are facing. The improper management of garbage collection is to blame for this. This poor management causes garbage to spread throughout the neighborhood, which in turn leads to unhealthy conditions in the immediate area. Additionally, it degrades the area's beauty and encourages the development of a number of serious diseases in those living nearby. The Garbage Monitoring System is designed to prevent improper garbage management and to enhance societal cleanliness.

Keywords : Internet of Things, Garbage Management System

I. INTRODUCTION

Monitoring System for Garbage: - Garbage may include the waste materials left behind in public spaces, society, school, home, etc. This undertaking is connected to the Internet of Things-based "Smart City" (IOT). So Cleanliness is necessary for a smart lifestyle, and cleanliness is starts with the garbage can. The problem with garbage disposal will be reduced or eliminated thanks to this project. The Internet of Things (IoT) is a recent communication paradigm that predicts a near future in which everyday objects will be fitted with microcontrollers, digital transceivers, and appropriate protocol stacks that will enable them to communicate with one another and with users, becoming an essential component of the Internet. Science and technology are advancing quickly, which could simplify all of our activities and human labor. Therefore, a network that anyone, anywhere, and at any time can access is required. Internet of Things is

one of them that fits those requirements (IoT).There have already been numerous studies that link the needs of daily life with such technology. As previously mentioned, the main goal of this research was to use IoT in the routine task of trash height monitoring. The MQTT

Protocol's performance in the system was also being evaluated for another reason. Delay, throughput, availability, and reliability were the test variables. IoT may become a daily dependency for people. Based on two earlier studies that have already been described, as well as an illustration from this study. The number of devices connected to the Internet was expected to reach 50 billion by the year 2020. In addition to smartphones and computers, the devices will also include items that were used on a regular basis in daily life. It was clear that a number of factors were compared, including delay, bandwidth use, and PDR. To determine the reliability of MQTT based on the interval of message delivery time to the MQTT broker, which was seen from the value of availability and reliability, this study concentrated on the MQTT performance with the existing scenarios, namely changing in the number of nodes and changement in message delivery time. The technical

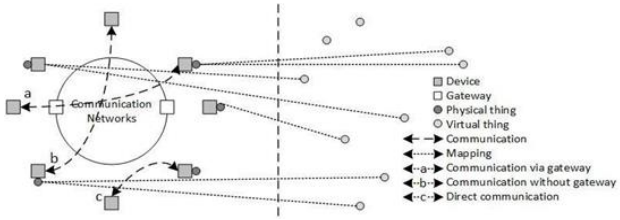

Fig. 1. Technical Description of The System of IoT

Description of the Internet of Things system, which is more specifically defined as device-to-device (D2D) and machine- to-machine (M2M) communication, is illustrated in Figure 1. Consequently, the implementation of IoT could be seen as M2M communication. The technical system on block (a) of Fig. 1 uses a gateway and a telecommunications network, in this case the internet, to link one device with another. Free Wi-Fi served as a gateway in the interim.

II. SYSTEM ARCHITECTURE

The IOT Garbage Monitoring system is an extremely creative system that will aid in maintaining clean cities. This system keeps an eye on the trash cans and provides information via a web page about the amount of trash being collected in the cans. The system does this by detecting the garbage level and comparing it to the depth of the garbage bins using ultrasonic sensors placed over the bins. The system utilises an ESP12-E Wi-Fi module for data transmission to a server, an HC-SR04 ultrasonic sensor for garbage measurement, and a 9V battery for power.

A web page, however, is created so that the user who is monitoring it can see the status. The website displays a graphic of the trash cans and highlights the garbage that has been collected in color to show how much garbage has been gathered.

Thus, by providing a graphical image of the bins via a web page and providing information about the garbage levels in the bins, this system aids in keeping the city clean. Page. A self- contained SOC with an integrated TCP/IP protocol stack, the ESP12E Wi-Fi Module allows any microcontroller to connect to your Wi-Fi network. Either an application can be hosted on the ESP12E, or all Wi-Fi networking tasks can be delegated to another application processor. An AT command set firmware is preprogrammed into each ESP12E module. The ESP12E module is a very affordable board with a sizable and expanding community.

III. METHODOLOGY

The ESP-12E, a small Wi-Fi module available on the market, is used in the proposed system to connect a micro- controller or processor to a wireless network and to connect an ultrasonic sensor to measure the

distance between the top of the lid and the top of the garbage can. and we use the schematic diagram provided below to connect all of the following components.

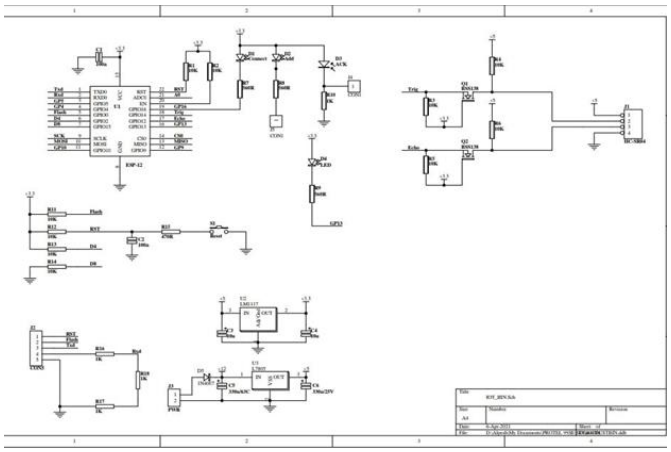

Fig. 2. Schematic diagram of the system

A. ESP12-E Wi-FI Module:

The ESP-12E is a small Wi-Fi module that is available on the market and is used to connect a microcontroller or Processor to a wireless network. The ESP-12E, a high integration Wireless SoC, is the device's brain (System on Chip). It has the ability to run as a standalone application or to integrate Wi-Fi capabilities into systems. It is a low-cost method of creating Internet of Things applications. The ESP-12E belongs to the

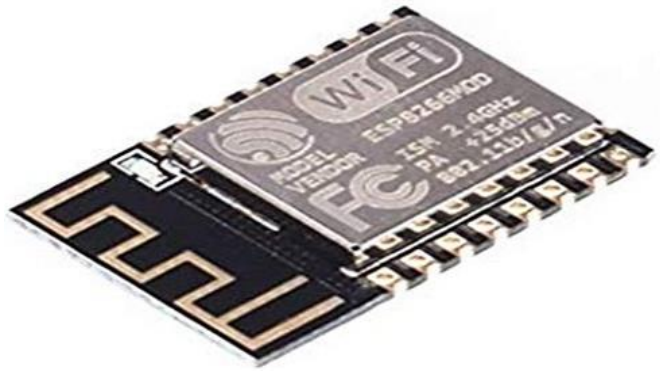

Fig. 3. ESP12-E Wi-FI Module

ESP-XX series. ESP8266 SoC serves as the common platform for all of them, but they vary in terms of output pins, flash memory, and antenna type. These modules, which range in number from ESP-01 to ESP-15, offer the best performance and value. These modules are frequently used by engineers to set up wireless communication between two applications. These modules are excellent for IoT and data sharing.

B. HC-SR04 Ultrasonic Sensor

The HC-SR04 is an ultrasonic sensor that measures the space between the top of the garbage can lid and the top of the can. The four pins on the HC-SR04 Ultrasonic (US) sensor are labelled Vcc, Trigger, Echo, and Ground, respectively. This sensor is very common and is used in many applications where sensing objects or measuring distance is necessary. The ultrasonic transmitter and receiver are formed by two projects that resemble eyes on the front of the module. The sensor operates using a straightforward high school formula that

Distance = Speed × Time

An ultrasonic wave is transmitted by the ultrasonic

Transmitter, travels through the air, and is picked up by objects that reflect the wave back toward the sensor and the ultrasonic receiver module. Now, we need to know the speed and the time in order to calculate the distance using the formulas above. Since we are using an ultrasonic wave, we are aware of its 330 m/s room-temperature universal speed. The circuitry built into the module will determine how long it will take for the US wave to return and will turn the echo pin high for that exact amount of time so that we can also determine how long it will take.

C. Printed circuit board

In electrical and electronic engineering, a printed circuit board (PCB, also known as a printed wiring board or PWB) is a medium used to carefully connect electronic components to one another. It has the appearance of a laminated sandwich structure with conductive and insulating layers.

Fig. 4. HC-SR04 Ultrasonic Sensor

The conductive layers having a pattern of traces, planes, and other features (like wires on a flat surface) etched from one or more copper sheet layers laminated onto and/or between sheet layers of a non-conductive substrate. Electrical components can be mechanically and electrically connected to conductive pads on the outer layers in the shape intended to accept the component's terminals by soldering them to them. Via plated- through holes are added as part of another manufacturing process to enable interconnections between layers. Nearly all.

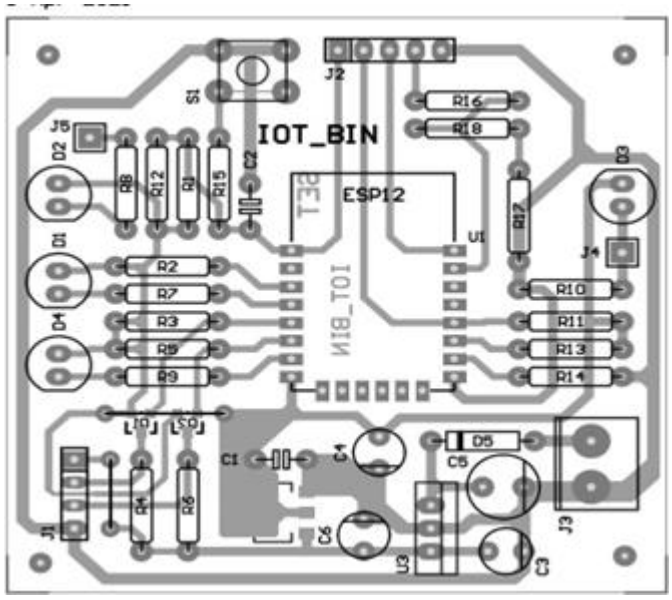

Fig. 5. Printed Circuit Board

Electronic products use printed circuit boards. Point-to-point construction and wire wrapping are two PCB alternatives that were once commonplace but are now infrequently used. Circuit layout on PCBs necessitates more design work, but manufacturing and assembly can be automated. Software is available to automate much of the layout work in electronic design. With PCBs, circuits can be produced in large quantities more quickly and affordably than with other wiring techniques because components are mounted and wired all at once. Large quantities of PCBs can be manufactured simultaneously, and the layout only needs to be done once. PCBs can also be produced manually, but the advantages are less.

D. LM7805 voltage regulator IC

Electronic circuits frequently use voltage regulators. In exchange for a variable input voltage, they offer a constant output voltage. In our situation, the 7805 IC is a well-known regulator IC that is used in most projects. The letters "78" and "05" in the name 7805 stand for a positive voltage regulator and a device that outputs 5 volts, respectively. So, a +5V output voltage will be provided by our 7805. This IC's output current is up to 1.5A. However, the IC loses a lot of heat, so projects that use more current are advised to use a heat sink. For instance, if you are using 1A and the input voltage is 12V, then (12-5) * 1 = 7W. This is an example of a 7805 IC application circuit. To get this IC working, we simply need two capacitors with values of 33uF and 0.1uF. Both the input capacitor (0.33uF), which addresses the issue of input inductance, and the output capacitor (0.1uF), which increases the stability of the circuit, are ceramic capacitors. To function properly, these capacitors must be placed close to the terminals. Additionally, they ought to be of the ceramic variety because these are faster than electrolytic capacitors.

E. LM117 Linear Voltage Regulator

The well-known LM317 and 7805 are examples of linear voltage regulators, as is the LM1117. Due to the fact that it is offered as a DCY Package, it is renowned for its small form factor (SMD Component). The LM1117 comes in a variety of forms. The fixed types offer fixed output voltages of 1.8V, 2.5V, 3.3V, or 5V, while the variable voltage regulators allow for variable voltages between 1.25V and 13.8V. The LM1117 is essentially simple to use. If the voltage regulator is fixed, power it by connecting the Vin pin, and the Vout pin will then receive the regulated output. In this scenario, the Adj/Ground pin is grounded and only functions as a ground pin. To further reduce noise, a capacitor can be added to the output side.

F. MQTT Protocol

The TCP/IP protocol is used by the Message Queue

Telemetry Transport (MQTT) protocol. MQTT was renowned for its small packet size, minimal power requirements, and publish / subscribe system working principle. REST and Web Socket are two additional protocols for M2M communication that are widely used globally. They were both HTTP. This study also discussed the contrast between HTTP and MQTT. As was previously mentioned, MQTT is a protocol with small packet sizes and minimal resource requirements. However, MQTT required less bandwidth because of its small packet size. If only there were more connected devices, MQTT would use less bandwidth than HTTP. As was previously mentioned, MQTT is appropriate for a system with limited resources. It took place as a result of MQTT's publish/subscribe method, which eliminates the need for clients or subscribers to manually update data on a regular basis because each one automatically receives the most recent information related to the subscribed topic, thereby conserving resources due to a reduction in computing activity.

MQTT does have these benefits, but it also has drawbacks. On the MQTT protocol, there are three Quality of Service (QoS) levels:

a) QoS level 0: "A maximum of one delivery" At this level, the message was only sent once without the sender's confirmation, so it might arrive just once or not at all. To put it another way, it made it possible for the message to be sent.

b) QoS level 1: "Delivery at least once" At this point, the client would at least once receive the message. The sender will resend the message with the DUP bit if the client did not receive it the first time. In this instance, though, it permitted the sending of the duplicate message.

c) QoS level 2: "Each delivery is exact." The message will only be received exactly once at this level, without any errors or duplicate messages.

G. MQTT publish/ subscribe architecture

An alternative to the conventional client-server architecture is the MQTT publish/subscribe pattern (also referred to as pub/sub). In the client-server model, a client speaks with an endpoint directly. The publisher client is separated from the client or clients that receive messages by using the pub/sub model (the subscribers). There is never any direct Communication between publishers and subscribers. They don't even know the other exists, in fact. A third element manages the linkage between them (the broker). The broker's responsibility is to properly distribute all incoming messages to subscribers after filtering them all. We'll discuss MQTT specifics in a moment, but for now, let's focus on some of the general aspects of pub/sub. The separation of the message's publisher and

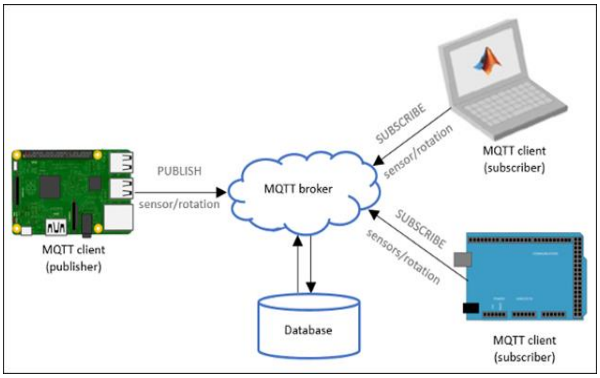

Fig. 6. MQTT pub /sub architecture

Recipient is the most crucial aspect of pub/sub (subscriber). There are several dimensions to this decoupling: Publisher and subscriber do not have to be acquainted through space decoupling (for example, no exchange of IP address and port). Publisher and subscriber don't have to operate simultaneously thanks to time decoupling. Synchronization decoupling: Neither component's operations need to be suspended during sending or receiving. The MQTT pub/sub model, in short, eliminates direct communication between the messages publisher and the recipient or subscriber. It is possible to regulate which client/subscriber receives which message thanks to the broker's filtering activity. Space, time, and synchronization are the three dimensions of the decoupling.

IV. ADVANTAGES

- Very simple circuit to implement.
- The HC-04 sensor is very rugged.
- Monitors the garbage bins and informs about the level of garbage collected in bins.
- Uses very small amount of electricity.
- Ultimately helps is better planning of garbage pickups.
- Can help in reducing overflowing bins.
- Reduces trips to the areas where the bin still have a lot of capacity.

V. DRAWBACKS

- Cannot detect liquid waste.
- Only detects the top of the garbage level.
- It would not realize if the space is left
- The sensor will not work properly on irregular surfaces.

VI. CONCLUSION

The IOT-Garbage Monitoring System contributes significantly to the creation of a clean, disinfected, and pollution- free environment. There should be appropriate awareness and alertness among the public prior to the operation of this technology because it is new in India. Otherwise, users' rough behavior could damage delicate devices like sensors. It is an automatic system that keeps track of dust bins in order to gauge their overall health. Finally, this technique contributes to environmental preservation. As a result, trash collection is improved in terms of efficiency, effectiveness, and operation. People who are willing to go the extra mile to improve the cleanliness in their respective areas can use the system as a benchmark. This system uses an ultrasonic sensor to measure the amount of trash in the trash cans, but in the future, various other types of sensors could be combined with the ultrasonic sensor to provide more precise results and advance the system. Currently, this system can be used in a few locations, but once it establishes its reliability, it will be usable in all the major locations. Certain modifications can be made to the system to advance it and make it more beneficial for the users and employees given that it also reduces manual work. In the future, a team could be formed to manage and maintain the system as well as to handle any maintenance needs.

VII. FUTURE SCOPE

- Solar panel can be used on top of bin which converts solar energy into electrical energy to be stored in the battery for situations when there is no sunlight.

- We can use GPS and software applications to guide trucks to choose the shortest path based on fill level of wastes.
- Smart mobility vehicles can be connected with smart dustbins using Wi-Fi/cellular connectivity over internet.
- We can use devices such as smart dustbins to robotic road cleaners coupled with smart transportation vehicles to clean up the collected and compressed wastes.

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Cite this article as :

Vedanti Patne, Chetan Garje, Saurabh Khobragade, Radha Mankar, Prof. Ranjana Shende, "Music Emotion Recognition", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 8 Issue 6, pp. 505-508, November-December 2022. Available at doi : https://doi.org/10.32628/CSEIT2286140
Journal URL : https://ijsrcseit.com/CSEIT228640