IoT-BASED SMART WASTE MANAGEMENT SYSTEM

Abstract:

This paper proposes an Internet of Things (IoT)-based smart trash cans observing the system, which can detect the current trash receptivity. The main goal of this project is to develop a smart garbage cleanup that helps to keep our environment clean and gives a distinctive impression to the senses. Unconscious trash cans lead to unhygienic environments and pollution. These smart trash cans have been designed by using ARDUINO UNO with ultrasonic sensors, servo motors, and battery jumper cables. There all hardware and software connections have already been completed and the smart trash clean-up program has been driven properly. The trash can cover waits for the user to put down the garbage can and when someone goes away from it then it will be closed. From an environmental point of view, it contributes to green and hygiene, from a business point of view, we try to originate it reasonably for as most of people as possible.

Introduction:

In the pursuit of a healthy and captivating environment, cities across the globe are embracing innovative technologies to enhance their aesthetics and quality of life. As our world rapidly urbanizes, the need for sustainable solutions to address environmental challenges becomes more pressing. One of the most extensive issues faced by modern cities is the accumulation of dust, which not only mars the beauty of the cityscape but also poses significant health risks to its inhabitants. Solid waste management is a large challenge for the environment in smart areas across the universe[1]. On the streets of urban cities, hundreds of people are passing the same location for around one minute[6]. Around 95% [7] of people are carrying food covers, polythene bags, and plastic bottles. If they dispose of all of them at once, the bins will be filled in several minutes. In order, to maintain a beautiful and healthy green environment, there is a need for an efficient waste management solution. The solution will include all the activities essential for monitoring the waste from its inner level outside the garbage bin to the collection of garbage. In paper [11] the main aim of this text is to give an image of the Web of Things and its edges, even associated with the sector of energy. System [12] proposed a

university has its special atmosphere of waste, particularly the specific classes of waste and also the unnatural production of waste at a special time. According to the system [9] Smart Cities are being designed and designed for comfortable human residency. Among courtesies that good Cities can deliver is the environmentally friendly waste assortment and process. During this paper, we have a preference to inspire and propose an Internet of Things (IoT) allowed system design to achieve dynamic waste assortment. According to the system [10] Collecting urban knowledge on an incredibly citywide scale plays a primary role in the analysis, development, and implementation of smart cities. This demo presents Cruisers, an associate automotive sensing platform for smart cities. In [13-16], researchers assume capacity, weight, temperature, humidity, and chemical sensors for solid garbage collection. Specifically, in [13], the authors propose a municipal solid waste platform exploiting recycling collection information based on IoT Technology. The paper displays a model for waste collection, transportation, and reusing. In [19] authors have considered two garbage bins, for waste segregation, and detectors are connected to bins for waste data collection to avoid overfilling. The proposed system [18] uses ultrasonic sensors to collect real-time waste levels which take the waste readings every time the lid of the bin is opened and closed. The paper [22] focuses on the real-time garbage level and the level of toxicity attending in it and uses the air quality sensor CCS811 for measuring the toxicity level. The routes are generated using Dijkstra's algorithm. The system of [17] uses real-time waste data and calculates the shortest path using Google API. The elementary components of IoT are accompanied by Intelligent Transportation Systems and surveillance systems which improve the Quality of Service in garbage collection. It has proposed an advanced Decision Support System model in the paper [21]. In the system of [20] Waste collection routing problem is included in a mixed-integer nonlinear programming model after which waste is unloaded to find out the optimal route for all the garbage trucks. An Android app is implemented in order for the drivers to have a user-friendly GUI interface with the IOT system [25]. A city service that acts as a countermeasure to environmental pollution within the Smart City is IoT-enabled garbage collection. Related research in the literature addresses the treatment of waste collection as an essential municipal service [24], [23].In recent times followed mechanisms include the garbage collector departing through particular dust bin zones and checking for

waste. The trash vans/trucks follow a denotes path for collecting the trash from bins. This traditional process of identification, monitoring, and collection of trash is complex, difficult, and involves a lot of manual effort and cost. About 5,000 tonnes of waste is being generated in Dhaka city every day[2]. Only half of that amount is properly collected and dumped, while the other half remains untreated. More than 2.01 billion tonnes of waste are produced globally, maybe a third is not even maintained in a hygienic safe manner[3]. Hence it is necessary to manage these wastes quickly and efficiently. It has become the need of the hour to overcome this situation by taking proper decisions and crucial actions. A garbage collection management system can prove beneficial to obstacle the issue of the extensive rise in waste over the period. Researchers are deeply trying to respond to a cost-effective method for waste management in different countries. Some of the mechanisms are already in practice as per allocated by the respective authorities. Majority of the countries stick to a curbside disposal mechanism where garbage is collected over definite periodic intervals by garbage collection trucks and is dumped at the disposal yards [3].

In response to this challenge, we present a groundbreaking conference paper that introduces an IoT-based innovative dust-cleaning system. IoT-based technologies play an important role in smart cities for the implementation of new services and redesigning existing services [4]. The new point of view of global IoT infrastructures gives us the possibility to collect data and, further, deal with common management issues more effectively[5]. According to the system [8] the Internet of Things (IoT), obviously infrastructure for the imagined idea of a good town, brings new potentialities for town management. The core principle of this system lies in harnessing the power of the Internet of Things(IoT) technology to automate and optimize the dust-cleaning process, thus offering a unique and comprehensive approach to transforming cities into breathtaking beautiful urban havens.

Our IoT-based trash cans help people dispose of their waste It’s easy and helps reduce phone calls and waiting for work Designated area cleaners and a healthier environment to live in, you are nothing. Diseases and people become healthier and less vulnerable to Diseases caused by these waste products. This system Ensures trash cans are cleaned as soon as they reach the trash level reach the maximum. It takes over power with the help of a battery. If you don’t clean the trash can within a certain amount of time, For

appropriate action to be taken, recordings might be transmitted to a sweeper or higher authority for affected contractors. Finally, keeping the environment clean and Waste management becomes much easier.

Proposed Methodology:

The proposed method involves monitoring and collecting solid dust from wet and dry garbage bins placed at different places in a particular area. The proposed system is implemented by considering the following:

The ultrasonic sensor is located on the front panel which has four pins labeled Vcc, GND, ECHO, and trig. The TRIG and ECHO pins are connected to digital pins two and three on the Arduino board. The servo motor has three pins named Vcc, GND, and the servo pin. The servo pin of the servo motor is connected to PIN nine on the Arduino board.

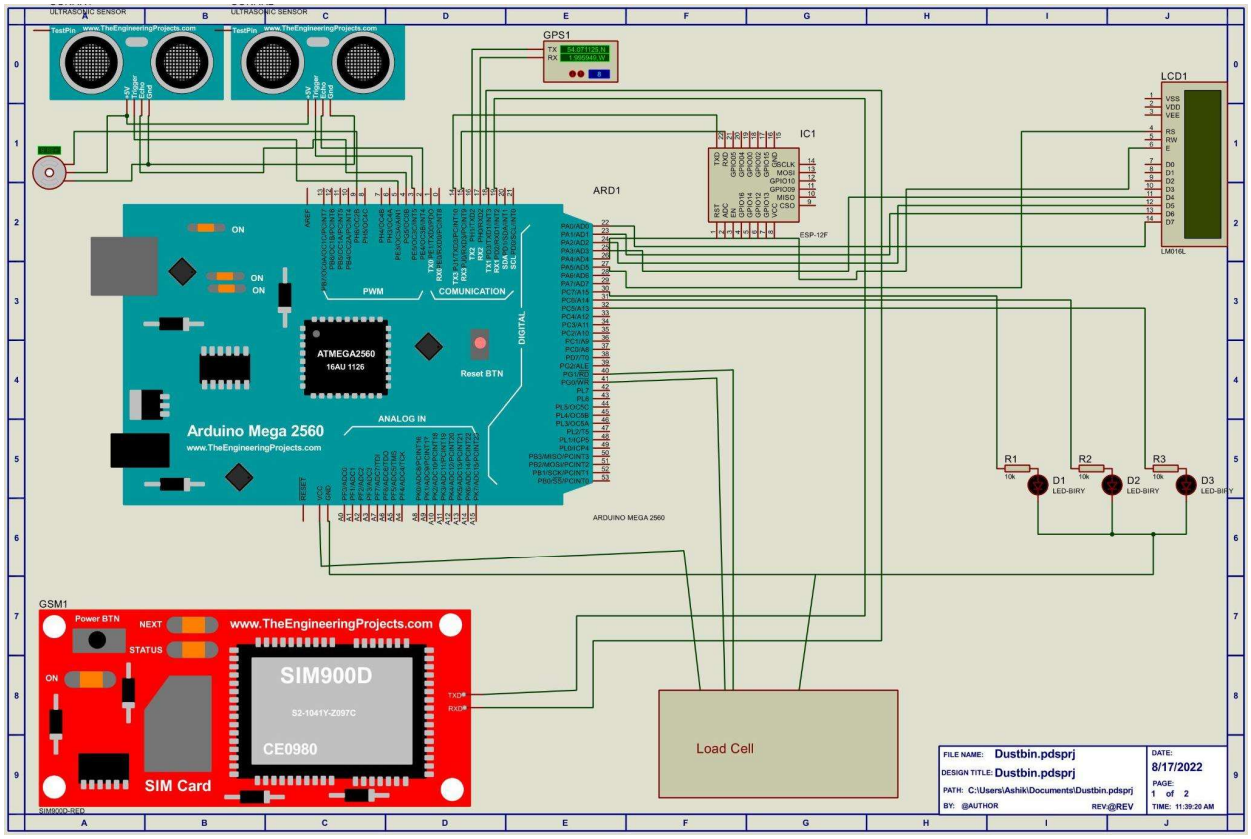

Figure 1: Circuit diagram of the proposed method

Once the connections are made, the Arduino is plugged into the system, and using the Arduino IDE, the code is injected inside the Arduino. This ends the connection and returns the code for the first part. The code for this project is divided into two parts. The header code indicates the operation of the recycle bin, i.e. mainly the operation of opening the lid of the trash can. The second part code indicates the portion of the message received on the mobile device using the Blynk app. The second part is structured as follows:
The ultrasonic sensor placed inside the tank also has the same four pins named Vcc, GND, ECHO, and TRIG. In Arduino IDE, the board should be changed from Arduino UNO to NodeMCU, if the board is not on the list, we need to install the board from the board manager. In this section, the TRIG and ECHO pins of the ultrasonic sensor are connected to the digital pins D5 and D6 of the NodeMCU. Vcc is connected to the Vin of NodeMCU and GND to the ground of NodeMCU. This requires login and now the code needs to be injected into the NodeMCU. Connect the Arduino's RX pin to the GSM module's TX pin and the Arduino's TX pin to the GSM module's RX pin. Connect the Arduino's GND to the module's ground. In addition, the GSM module needs an external 12v power supply.

Fig 2: Front part of the dustbin

Fig 3: Back part of the dustbin

Fig 4: Inside part of the dustbin

For developing a smart dustbin we need software and coding with hardware. Here, we implement hardware and attached their images, and also give the source code link which is built in C language.

We test the project in two phases: software and hardware. The hardware part should be physically tested, while the software part is meant to be tested via the Arduino IDE. I need to verify if the system is working properly. Check the distance indicated by the sensor to make sure the reading is correct. Put the trash in front of the ultrasonic sensor first, or the sensor will detect the trash and close the lid of the trash can Open and throw the trash in the trash can. This process repeats and continues like a cycle.

Fig 5: Garbage-loaded percentage

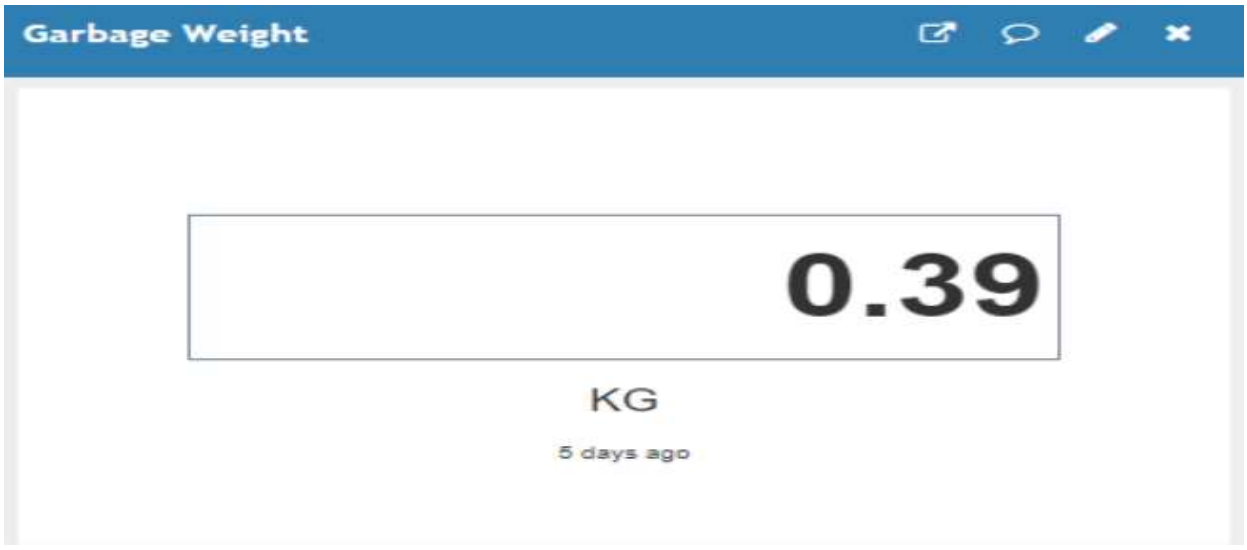

Fig 6: Garbage-loaded weight

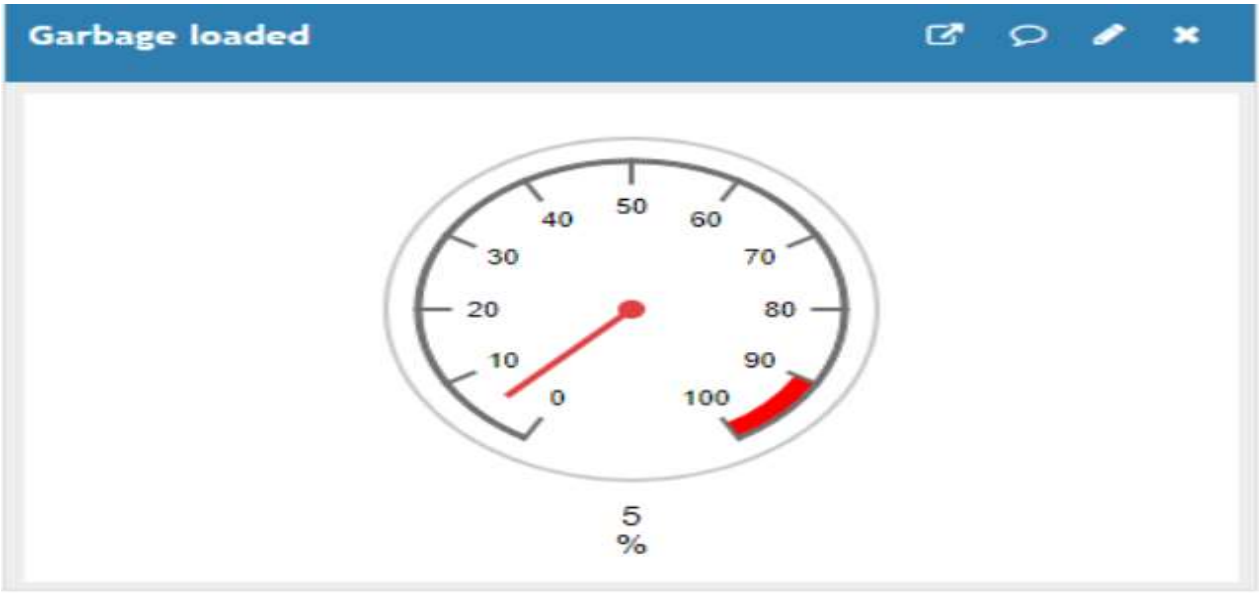

Fig 7: Garbage-loaded percentage

In this section, we do testing on hardware and software. After that, we added test results on how the smart dustbin reacts with the garbage. The testing procedure was also added to remember the steps of how it works. Lastly, the think speak gives us the real situation of a smart dustbin that we build.

Result and Discussion:

The hardware part should be physically tested, while the software part is desired to be tested via the Arduino IDE. I need to verify if the system is working correctly. Check the distance indicated by the sensor to make sure the reading is accurate. Put the trash in front of the ultrasonic sensor first, or the sensor will detect the garbage and close the lid of the trash can open, and throw the trash in the trash can.

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the trash level reach the maximum. It takes over power with the help of a battery. If you don't clean the trash can within a certain amount of time, For appropriate action to be taken, recordings might be transmitted to a sweeper or higher authority for affected contractors. Finally, keeping the environment clean and Waste management becomes much easier. From an environmental point of view, it contributes to green and hygiene, from a business point of view, we try to originate it reasonably for as most of people as possible.

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