



SMART WASTE MANAGEMENT SYSTEM

Md.Mahir Hasan (1712314042)
Tahmina Afroz Prima (1631761042)
Anika Tahsin (1712118042)

Supervisor
Dr. Md. Mahfuzur Rahman

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Department of Electrical and Computer Engineering
North South University

Contents

1	Introduction	3
1.1	Motivation	3
2	Related Works	5
2.1	First Section	5
2.2	Second Section	6
2.3	Third Section	7
3	Solutions & Methods	9
3.1	System Overview	9
3.2	Design	11
3.3	Implementation	12
3.3.1	First Subsection	12
3.3.2	Second Subsection	12
4	Suggestions & Challenges	13
4.1	Difficulties	13
4.2	Challenges	13
4.3	Suggestions	13
5	Conclusion	15
	Bibliography	17

Chapter 1

Introduction

The objective of this project is to read the paper "Smart Waste Management Systems" and attempt at least one test present in the paper to see if the research is still valid today. The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. In the field of IoT, the objects communicate and exchange information to provide advanced intelligent services for users. Today big cities around the world are facing a common problem, managing the city waste effectively without making city unclean. Today's waste management systems involve a large number of employees being appointed to attend a certain number of dumpsters this is done every day periodically. This leads to a very inefficient and unclean system in which some dumpsters will be overflowing some dumpsters might not be even half full. This is caused by variation in population density in the city or some other random factor this makes it impossible to determine which part needs immediate attention. Here a waste management system is introduced in which each dumpster is embedded in a monitoring system which will notify the corresponding personal if the dumpster is full. In this system, it is also possible to separate wet and dry waste into two separate containers. This system allows the user to know the fill level of each garbage bin in a locality or city at all time, to give a cost effective and time saving route to the truck drivers. This system provides an effective solution to waste management problem.

1.1 Motivation

In our city DNCC DSAC both are trying consistently to make the place clean and clear everywhere as much as possible. They are working at midnight very early in the morning. Still, we are not having a clear city just only because of ourselves.

If we use a proper dustbin system everywhere, and clean the dustbin on a regular basis. Only then can we expect a proper clean healthy city for every creature.

From these types of examples, we are motivated to work on a project like "Smart Waste Management System". This digitalization system can easily solve this problem. Just need that keep the city clean willing from each of us.

Chapter 2

Related Works

1. Our work is related to the work Smart Garbage Monitoring System using Internet of Things (IoT) (see Figure 2.3) presented in the [1].

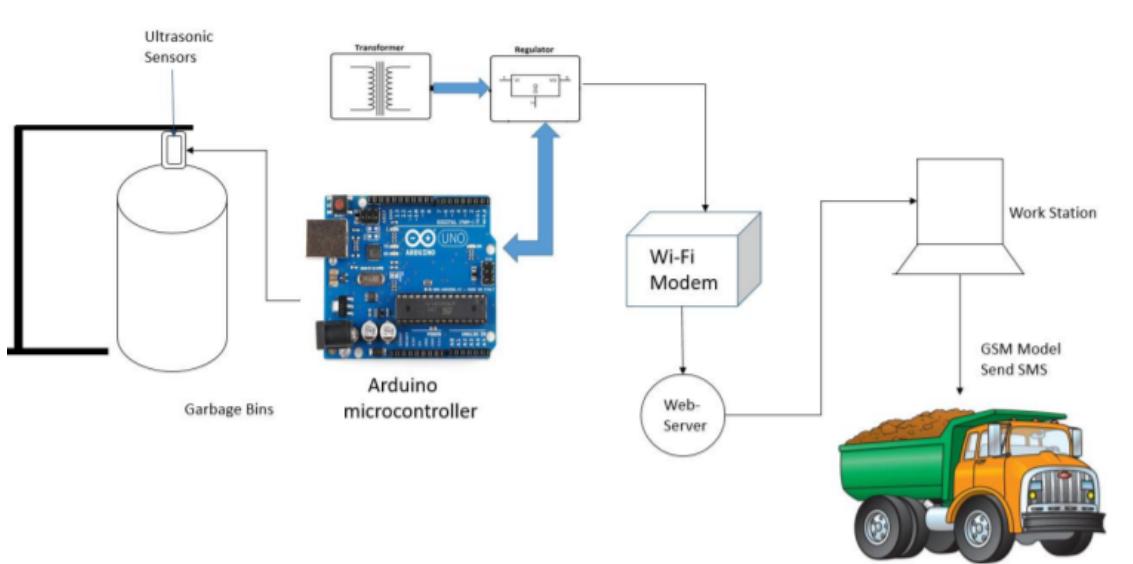


Figure: System Architecture Diagram

Figure 2.1: System Architecture Diagram

2.1 First Section

The IoT Garbage Monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The system makes use of Arduino family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level of garbage collected in the bins. Whereas a web page is built to show the status to the user monitoring it. The web page gives a graphical view of the garbage bins and highlights the garbage collected in colour in order to show the level of garbage

collected. The LCD screen shows the status of the garbage level. The system puts on the buzzer when the level of garbage collected crosses the set limit. Thus this system helps to keep the city clean by informing about the garbage levels of the bins by providing graphical image of the bins via a webpage. The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

2. There is another work to related Waste Management Using Node MCU(see Figure 2.3) presented in the [2].

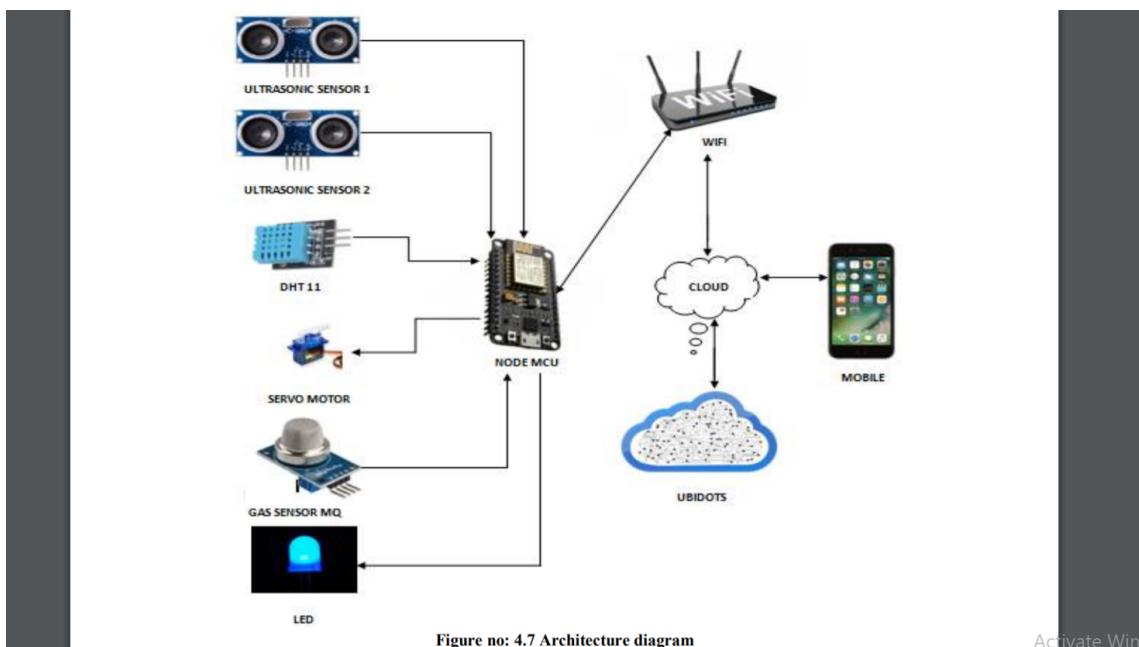


Figure 2.2: System Architecture Diagram

2.2 Second Section

In this system we are monitoring the level of bins and composition of waste using IoT and cloud. Our main goal of proposing this system is to remotely monitor the system and send quick notification to official which can reduce the overflow of bins. The level of bin is identified using ultrasonic sensor and its captured data are stored in cloud. If the bin level is filled it sends the notification from cloud to the official and the Red LED is on in the bin. If the bin is not filled, its available space is viewed using cloud and the Green LED is on in the bin. Then the waste is dumped in the main storage where it is decomposed. In the main storage, its level are analyzed using ultrasonic sensor and the sensed data are captured in cloud. The gas sensor are used to sense the gas level in the main storage if the gas level is high then the waste can be used has a fertilizer and the notification is send to official or it should be decomposed. All the data are sensed and send to cloud. The device in the bin uses Wi-Fi for sending the sensed parameters of bin level and presence of gas to the cloud. The humidity

and temperature of the bin are identified using the DHT 11 sensor and the data is sensed and send to cloud. Each city has a workstation located at the municipal office, which gathers the information from the bins in that particular city. The workstation maintains a cloud storage that will hold real-time values acquired from the bins. All the details of the bin and main storage are remotely accessed using the cloud server. The cloud server will have a web interface from which we can access visualization and reports

3. Another work to related IoT based Garbage Monitoring Using Arduino(see Figure 2.3) presented in the [3].

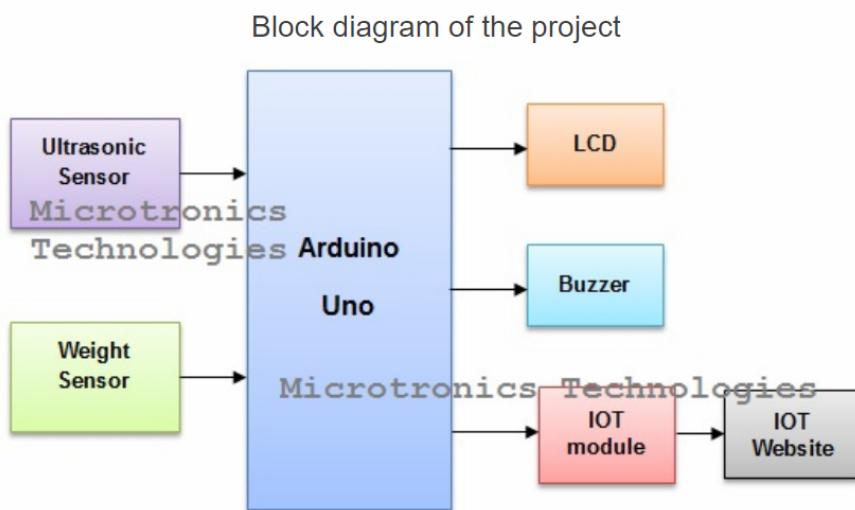


Figure 2.3: System Architecture Diagram

2.3 Third Section

Due to an increase in population, there is an increase in the demand for food, daily essentials and basic resources in the household. This, in turn, has significantly increased the amount of waste. Accumulated waste causes air pollution and also causes many diseases. Hence, it is very important to avoid accumulation and spillage of the waste from the dustbins installed in public places. IoT and Arduino based Garbage and Waste collection bins overflow indicator is a system that would notify the waste collecting team when a garbage bin is full and needs to be emptied. IoT and Arduino based Garbage waste collection bins overflow indicator project uses a sensor, microcontroller, and IoT module to name the important components. We have used a weight sensor that needs to be placed under the dustbin. The weight reading from the sensor is sent to the microcontroller. The microcontroller is programmed to send notifications to the website using an IoT module (ESP8266) when the weight reaches the threshold value. ESP8266 is a chip used for connecting micro-controllers to the Wi-Fi network and make TCP/IP connections. On receiving the notification over the website, the department can send the waste collection team to collect the waste from the dustbins. There is a pre-requisite for using this IoT and Arduino based vehicle fuel theft detection system that the Wi-Fi module should be connected to a Wi-Fi network or a hotspot. We have developed this project with the GSM module in place of the IoT module.

Chapter 3

Solutions & Methods

3.1 System Overview

The project name is "Smart Waste Management System". Here we are having SMS alert when our garbage basket is full. The SMS will be sent to the waste cleaner

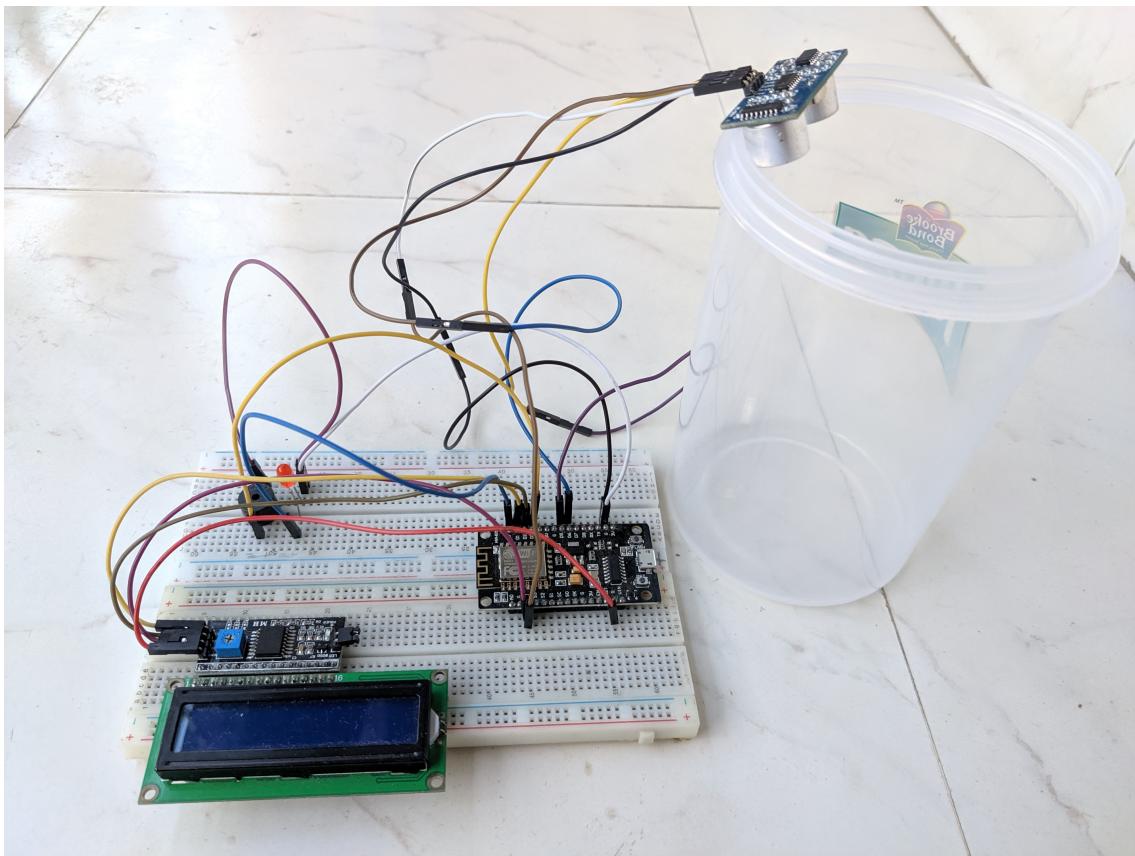


Figure 3.1: Smart Waste Management System.

of that area within few minutes he will clean up the basket. Firstly, the ultrasonic sensor will give a signal to NodeMcu esp8266 when the basket will be full. NodeMcu esp8266 will start to display that information in our 16*2 LCD display and start to

ring the buzzer as well. On the other side, the code will send the level of the waste in the website there will be a SMS sending option enable which will go to the nearby cleaner to clean up the dustbin within few minutes.

HARDWARE REQUIREMENTS: We will need the following hardware to accomplish our project.

- i) HC-SR04 ultrasonic sensor.
- ii) Buzzer.
- iii) 12C LCD Display(16x2).
- iv) Connecting wires.
- v) NodeMCU ESP8266.
- vi) RED LED (5mm).

1. HC-SR04 ultrasonic sensor: The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger,Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that Distance = Speed × Time The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

2. Buzzer: It is a mechanical, electromechanical, magnetic,electromagnetic, electro-acoustic or piezoelectric audiosignalling device. A piezo electric buzzer can be driven by an oscillating electronic circuit or other audio signal source. A click, beep or ring can indicate that a button has been pressed.

3. 12C LCD Display(16x2): It is an electronic display screen module. A LCD 16x2 display is a basic module. The modules have been chosen over seven segments and many multi segmented LEDs. There are economical and easy to program and have no limitations of displaying special as well as custom characters, animations and etc. A 16x2 LCD can display about sixteen characters per line. There are two such lines. Command and Data are the two registers of the LCD. 16x2 LCD has 2 horizontal line which comprising a space of 16 displaying character. It has two type of register inbuilt that is:

Command Register- Command register is used to insert a special command into the LCD.

Data Register- While Data register is used to insert data into LCD.

4. Connecting wire: In our project we use male-female male-male wires.

5. NodeMCU ESP8266: NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266WiFi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to

the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif NonOS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs. Node MCU provides a way to connect different sensors to their controllers wirelessly via wifi. Since, it is an improved version of the ESP8266 it has better and easier programming, with better voltage stability and more reliability.

6. Red LED(5mm): At the purpose once the pin is high in terms of value, the crystal rectifier is on, once the pin is low, it's off.

All the components in this IOT based project is inter-connected with each other. When our dustbin basket is getting full then the led will light up instantly and indicate that the dust is almost full which will be displayed in the 16*2 LCD display immediately as well. After that, when dustbin will be totally full the led will not remain on, it will be off instantly. On the other hand, buzzer will start to ringing loudly and "basket is full" this information will be displayed through 16*2 LCD display this information will be sent to one specific website and where the level of waste in the dustbin will be shown and there will one SMS enable option in which will be operating immediately to alert the nearby cleaner to clean the dustbin within few minutes.

3.2 Design

Ultrasonic Sensor: An Ultrasonic Sensor is used for detecting whether the trash can is filled with garbage or not. Here Ultrasonic Sensor is installed at the top of Trash Can and will measure the distance of garbage from the top of Trash can and we can set a threshold value according to the size of trash can. If the distance will be less than this threshold value, means that the Trash can is full of garbage and we will print the message "Basket is Full" on the message and if the distance will be more than this threshold value, then we will print the distance remaining for the garbage vat to be full.

RED LED(5mm): The LED will light up at different levels, indicating the amount of dust bin filled up by garbage.

Buzzer: When the trash bin is filled up to 80 capacity, the buzzer will start ringing.

12c LCD Display: The LCD will display the capacity of the trash bin filled up by garbage.

Node Mcu ESP8266: A message, indicating that the trash bin is almost filled up, will be sent to the desired device using the wifi module Node Mcu.

We have face a couple of the challenges in our project. these are -

1. GSM module
2. GPS module

GSM module: First of all, we have brought 2 GSM module for our project. Those are SIM800L QuadBand GSM/GPRS Shield and SIM900AGSM/GPRSModule V4.0. But unfortunately we could not work any of those two. SIM800L only supports 2G sim, which is impossible to collect nowadays and the other one SIM900A module is a lock sim module. Though, we have tried a lot to execute SIM900A with 3G,4G sim but it was not functioning at all.

GPS module: As we can not to accumulate GSM module, we could not add this GPS Module NEO6MV2 with our project. In future, we want to accumulate GPS module with our project.

To solve this this problem we used Ubidots instead GSM module.Ubidots is an IoT platform empowering innovators and industries to prototype and scale IoT projects to production.Ubidots provides instant visualizations of data posted by our device to Ubidots. Using Ubidots we analyse the data and when the dustbin is full we send the message to the drivers via Ubidots API.

3.3 Implementation

3.3.1 First Subsection

Connections of the ultrasonic sensor with the NodeMcu are very simple. Connect the VCC and the ground of the ultrasonic sensor to the 5V and the ground of the .Node MCU is an open source IOT compose.In this system we are monitoring the level of bins and composition of waste using IoT and cloud. Our main goal of proposing this system is to remotely monitor the system and send quick notification to official which can reduce the overflow of bins. The level of bin is identified using ultrasonic sensor and its captured data are stored in cloud. If the bin level is filled it sends the notification from cloud to the official and the Red LED is on in the bin. If the bin is not filled, its available space is viewed using cloud and the Green LED is on in the bin. Then the waste is dumped in the main storage where it is decomposed. In the main storage, its level are analyzed using ultrasonic sensor and the sensed data are captured in cloud.All the data are sensed and send to cloud. The device in the bin uses Wi-Fi for sending the sensed parameters of bin level and presence of gas to the cloud. The humidity and temperature of the bin are identified using the DHT 11 sensor and the data is sensed and send to cloud. Each city has a workstation located at the municipal office, which gathers the information from the bins in that particular city. The workstation maintains a cloud storage that will hold real-time values acquired from the bins. All the details of the bin and main storage are remotely accessed using the cloud server. The cloud server will have a web interface from which we can access visualization and reports.

3.3.2 Second Subsection

We have add the website feature with our project. Through this website we can have the waste level information in our dustbin. Moreover, we have added the SMS sending option through one website.

I (Md. Mahir Hasan [1712314042]) and my another group mate (Tahmina Afrosz Prima [1631761042]) have done the work equally. Like- implementing the the hardware part and code properly in short the whole project. On the other hand, All the reports, I and Tahmina have given our 100 percent to make it proper informative and complete as well.To be more specific, I have done the hardware part (as I have the all hardwares) and half of the code part and Tahmina has done half of the code part. We both have done the report simentaniously.

Chapter 4

Suggestions & Challenges

4.1 Difficulties

To implement the message system we have some difficulties.

1. We have tried 2 GSM modules for our project.
2. GSM-800L. 800L supports 2G sim. But we cannot manage any 2G sim. So we tried another GSM module for that. GSM-900A. It is a default damage tool

4.2 Challenges

To overcome these difficulties we tried UBIOTS IoT platform. We send the messages to the truck-drivers via UBIDOTS IoT platform. When the bin is filled it will send information to the driver's cellphone.

4.3 Suggestions

We can improve our project using a GPS module. Using a GPS module we can find the exact location of the dustbin. It will save a lot of time for the drivers.

Chapter 5

Conclusion

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