

# SMART WASTE DISPOSAL SYSTEM

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## Abstract

The Smart Cities concept requires a marked improvement in Solid Waste Management (SWM) to provide a clean and hygienic environment to city residents. The system is designed to cover all the aspects of the waste management lifecycle and play an important role from the Smart City point of view. With rapid increase in population, the issues related to sanitation with respect to garbage management are degrading immensely. It creates unhygienic conditions for the citizens in the nearby surrounding, leading to the spread of infectious diseases and illness. To avoid this problem, IoT based "Smart Waste Disposal System" is the best and trending solution. This proposed system gives prior information of the status of the bin, so that the bin can be cleaned on time and safeguard the environment. "This paper proposes an advanced waste management system with smart bins that alerts the authorised collector by sending alert messages for efficient garbage collection in Cities."

## Keywords

*Arduino uno 3, Ultrasonic sensor, Smart Bins(SB), Esp8266 wifi module, Server for database, GSM Module, Web application*

## I. INTRODUCTION

The present smart waste management system is not as optimised as required. As of now we regularly see that the dustbins are placed on the roadside and dustbin is overflowing. This overflow of dustbin is due to the increase in the population and the wastage from hotels, industries etc. This overflow of dustbin will make our environment ugly and cause many diseases to the public. To avoid this situation we planned to design "Waste Disposal System Using IOT."

A big challenge in the urban cities is that of waste management as there is a rapid growth in the rate of urbanization and thus there is a need for sustainable urban development plans. To avoid all such situations we intend to propose a solution for this problem "Smart waste disposal system", which will alarm and inform the authorized person when the garbage bin is about to fill. Then a message will be sent to the authorized person to collect the garbage from the particular area. The authorized person will send the message from his android application to the garbage collectors by notifying him the route where bin is about to fill. This will help to reduce the overflow of the garbage bin and thus keeping the environment clean.

## II. COMPONENTS

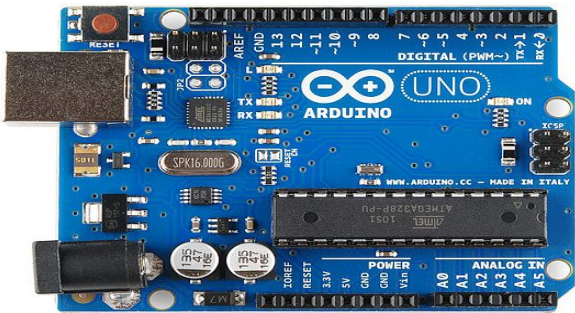
### A. Ultrasonic sensor:

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.



### B. Arduino microcontroller

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. Secondly, Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Furthermore, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.



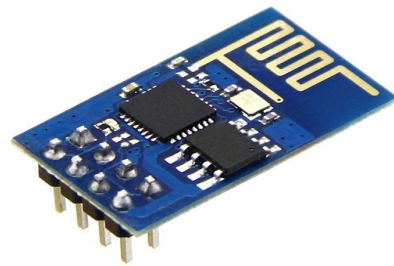
### C. Breadboard and Jumper wires:

A breadboard is a construction base for prototyping of electronics. "Breadboard" is also a synonym for "prototype". Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs). In our scenario we have used a breadboard for connecting wires. We have used jumper wires also called jumper wires. In our system, Jumper wires are used for making connections between items on your breadboard and Arduino header pins.



### E. Serial wifi wireless transceiver module:

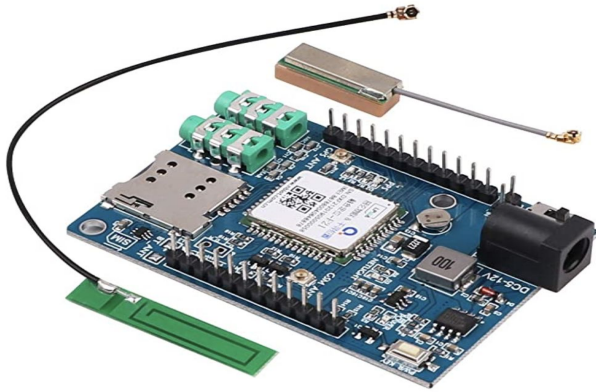
ESP8266 is a chip which is a wireless network microcontroller module. It will be a system-on-a-chip (SoC) with capabilities for 2.4 GHz Wi-Fi, general-purpose input/output etc.



### F. GSM Module:

GSM Module is a SIM 900a module built with dual band GSM/GPRS. It works on frequencies ranging from 900/1800 MHz. The frequency bands can be set by AT commands. The baud rate is configurable from 1200-115200 through AT commands. The GSM/GPRS

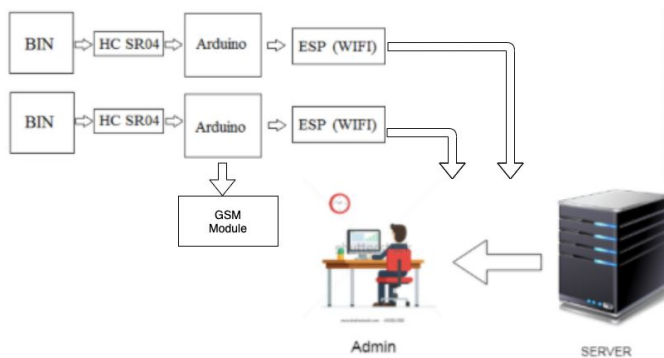
module has an internal TCP/IP stack to enable you to connect and communicate with the internet via GPRS which helps in sending SMS or make calls.



### III. ARCHITECTURE

To achieve a smart waste system, we have used components such as ultrasonic sensors, microcontrollers, as explained above which are capable of notifying waste level status. In our system the sensors placed in the bin sense the level of the garbage in that bin. On reaching the threshold a command is generated through which the authorized person will come to know about the location where the bin is about to fill. The authorized person conveys this notification to the garbage collectors with the help of an android application. The architecture can be clearly understood with the help of the below figure.

According to the figure, the Ultrasonic sensors attached in the bins send the level of trash in their respective bins to the arduino board. This data is then used to calculate the optimized path for the trucks to follow. This Data is sent to the trucks via the system admin.



In the cloud, the real time analysis has to be carried out to generate various reports like- area generating maximum waste, seasonal or function reports on waste, segregation reports etc. which can help the authority with better strategies for waste management. The proposed architecture assumes a backup server be provided by the cloud service provider. Along with the real time analysis, the optimized route for collecting the garbage will be found using Google maps. This will provide the advantage of saving fuel costs. The authority would view all the reports, optimized routes and all the data related to the garbage bins. The person accordingly will direct the garbage collectors for the collection of garbage and make efficient plans for the garbage management.

### IV. IMPLEMENTATION METHODOLOGY:

#### A. Hardware components implementation

In this scenario, Every bin will be given a unique id. A database will be maintained containing the information about which dustbin to be placed in which area by their corresponding ids. The bin will have an ultrasonic sensor from which the level of garbage can be detected. In detail, Ultrasonic sensors are used to detect the level of the bin. An ultrasonic sensor is installed in the waste bin and detects the fill level regardless of what has been deposited inside. As we studied the definition of ultrasonic sensor earlier we know that Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. In this case, the object is the waste and the sensor is used for measuring the level of bins. The level of garbage will be depicted in terms of distance between the sensor and garbage in the dustbin.

In our system, the arduino is the microcontroller which will be programmed in such a way that it would control the power from being wasted. In detail, monitoring the bin at every interval will lead to wastage of power and energy through sensors. Therefore, the sensors will be activated only after certain intervals of time so that the power could be saved. The information collected by the sensor will be processed by an arduino

microcontroller. Hence saving energy and power is the main work of an arduino microcontroller.

### B. Admin Implementation

From the collected data, the admin will get to know about real-time garbage level, and he will be able to monitor the trucks and their operations on collecting waste from the locations. Admin has responsibility to add any new bin locations and any new truck information which is used to run and maintain this system efficiently.

For this admin there is a web portal in which admin has access to information about the level of trash in all the bins and the updation of all the bin information and truck information is done using this web portal.

This web portal is made using html, javascript, jquery and bootstrap for client side processing and php for server side processing. Database is implemented using mysql.

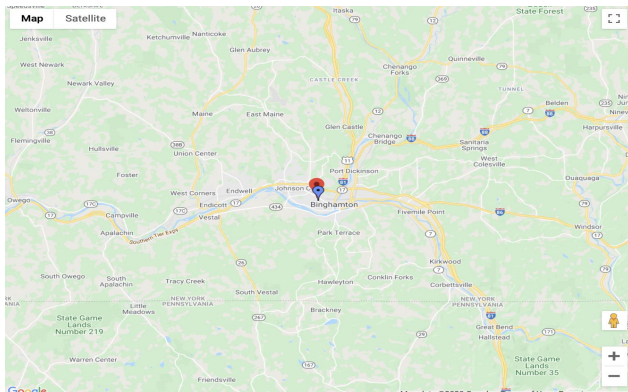
### C. Location Optimization

Google Apis are used in our application for Locator Optimisation.

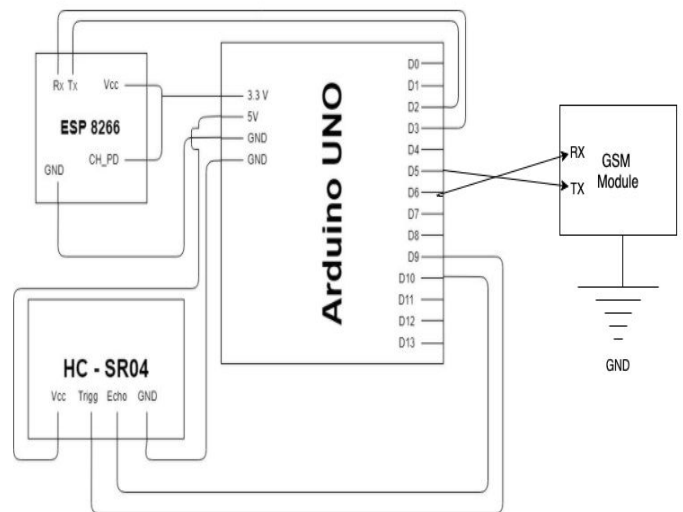
Locator Application is used for seeing the overview of all the bins and adding any new bins.

## V. IMAGES OF IMPLEMENTATION

Location Generation:



Circuit Diagram:



## VI. COST COMPARISON AND FEASIBILITY STUDY

Cost comparison on expenditure of three cities with respect to areas and population detailed below. Three cities are New York, Chicago, and Kansas

Population :

NYC -> 8.538 million

Chicago-> 8.426 million

Kansas -> 18.41 million

Area :

NYC -> 789 km<sup>2</sup>

Chicago-> 709 km<sup>2</sup>

Kansas -> 603 km<sup>2</sup>

Expense on Waste Management Annually:

NYC -> \$ 2200 Million

Chicago -> \$ 13 Million

Kansas -> \$ 40 Million

According to above statistics New York city spends 151% more on Waste Management than Chicago and spends 40% more than Kansas per square kilometer area.

For Development of our country there has to be more funds allocated and better techniques to manage waste. Our Proposed System would require funds to set up but would save cost on collection which would be better for long term. Also this system would result in a more efficient system which is required in our cities.

## VII. CONCLUSION

This paper shows the implementation of smart Trash management system using ultrasonic sensor, arduino microcontroller, and other required components. This system ensures that the garbage is cleared as soon as its garbage level reaches its maximum.

This Project aims for the betterment of smart city and technology solutions are provided to manage the waste in a cost effective manner by saving the fund for collection and transportation. The information is processed with very less human intervention, the collection of levels and storing and generation of routes is done automatically therefore there is less chance of error. Google provides the best algorithm for the route optimization and navigation for the truck drivers to follow.

Therefore our System improves the current waste collection and transportation to reduce costs and keep the environment cleaner and also our smart waste disposal system makes the garbage collection more efficient and hygienic.

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