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IMPLEMENTATION OF MUNICIPAL SOLID LIQUID BASED SMART WASTE MANAGEMENT SYSTEM- ZERO WASTE USING INTERNET OF THING

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ABSTRACT

Rapid increase in population, has led to the improper waste management in cities resulting in increased pests and spreading of diseases. Nowadays, the Garbage Collecting Vehicle (GCV) collects the waste twice or thrice in a week. So, the problem is over flowing of wastages on the roads. Hence, to overcome this limitation, in this paper a scheme on smart waste management using Wireless Sensor Networks (WSN) and IoT (Internet of Things) is proposed. The garbage bins are deployed with sensors and are networked together using WSN. The sensors deployed in the garbage bins collect the data for every determined interval. Once the threshold is reached, it raises a request to the GCA (Garbage Collector Agent). This agent collects the requests of all the filled vehicles and communicate using IoT framework. The experimental simulation is done in proteus tool. A hardware prototype is developed for the proposed framework. Analysis of the proposed scheme provides better results in waste management.

"Cleanliness is next to godliness" is said and believed from the centuries. "In the approach of the smart cities mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment with the application of smart solutions". Smart cities don't only mean smart buildings and smart parking areas but smarter waste management system is also a major issue to be addressed in developing a smart city. The smart waste management system which is proposed herein uses smart sensors to gather fill-level data from containers and garbage bins, and send it to an authorized number in real time. The authorized phone number which is situated in Waste Management Centre gather fill-level information sent from multiple containers which are situated throughout a city/locality. In this system, even the society president will come to know that whether the society's dustbin is emptied by drivers or not. Whenever the dustbin gets empty the message will be forwarded to society president and then he can even give feedback to their respective society truck drivers.

Keywords: Solid Waste Management, Garbage, Municipal Corporation, Internet of Things, Wifi, Zero Waste

I. INRTODUCTION

"Cleanliness is next to godliness" is said and believed from the centuries. "In the approach of the smart cities mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment with the application of smart solutions". Smart cities don't only mean smart buildings and smart parking areas but smarter waste management system is also a major issue to be addressed in developing a smart city. The smart waste management system which is proposed herein uses smart sensors to gather fill-level data from containers and garbage bins, and send it to an authorized number in real time. The authorized phone number which is situated in Waste Management Centre gather fill-level information sent from multiple containers which are situated throughout a city/locality. In this system, even the society president will come to know that whether the society's dustbin is emptied by drivers or not. Whenever the dustbin gets empty the message will be forwarded to society president and then he can even give feedback to their respective society truck drivers.

Convectional waste management systems which are currently employed in India have static routes and schedules where garbage from containers are collected on fixed schedules, regardless if they are full or not. Unaddressed filled dustbin with garbage on open streets. This type of situation is often seen where dustbin is not addressed even if it is filled and garbage is spread on open streets. This severely affects the health and hygiene of the people.

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To promote health and hygiene, the Govt. of India under the leadership of Prime Minister, Narendra Modi initiated swachh bharat campaign and introduced the concept of smart cities.

Secondly most of the times people end-up throwing garbage on open streets, which affect hygiene of city/locality. In order to prevent this dustbin is provided with a sensor and a siren. If the garbage is thrown around the dustbin instead of in the dustbin, the sensor senses it and the siren starts blowing until the garbage is put into the dustbin. This prevents the condition of not addressing the dustbin. Many a times, even if the dustbin is not full, it starts stinking resulting in extremely rotten smell. This is mainly due to the wet waste present in the bin. If the bin is not addressed until it is filled, this stinking smell may last for many days and this may severely affect the society. As a prevention to this, a Wet sensor is provided in the bin. This sensor collects the information about the wet waste present in the bin and if the value is greater than the threshold level, the message is sent to WMC to address the dustbin. In this, various society president are even included in which they will get the message whenever the dustbins of their society are cleaned so that they will know when and at what time their society dustbins are cleaned.

Figure1: Waste Management Hierarchy

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 of sustainable urban development plans. Smart waste management system is a system that gives prior information of the status of the bin to the municipality so that they can clean the bin on time and safeguard the environment. To avoid all such situations we intend to propose a solution for this problem "Zero Waste", which will alarm and inform the authorized person when the garbage bin is about to fill. Then message will be send to the authorized person to collect the garbage from the particular area. The authorized person will sends the message from his web application to the garbage collectors by sending a SMS. This system maintain a dry waste and a wet waste separately. This will help to reduce the overflow of the garbage bin and thus keeping the environment clean.

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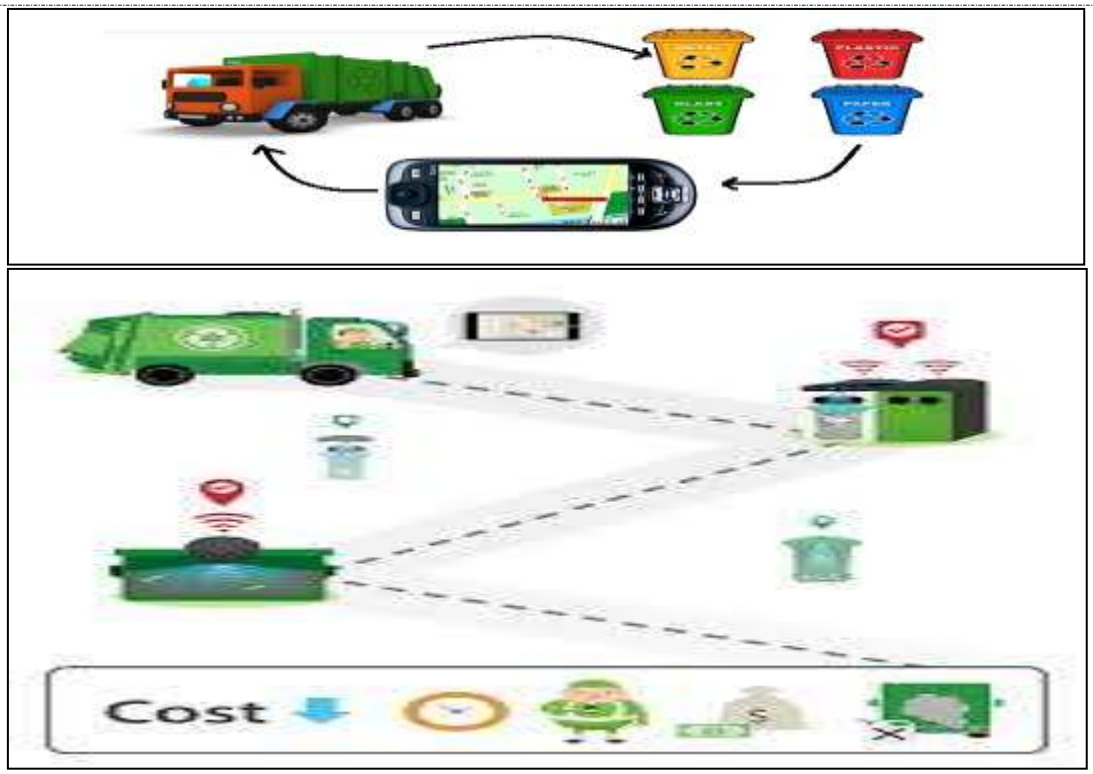

Figure 2: Architecture of Zero Waste

II. LITERATURE SURVEY

The garbage management in cities has to be effectively and efficiently implemented. The various proposals were put forward and some of them already implemented. But it cannot be considered as an effective one. So a survey was done among different proposals and this survey paper includes survey among different methods for smart garbage management in cities using IoT.

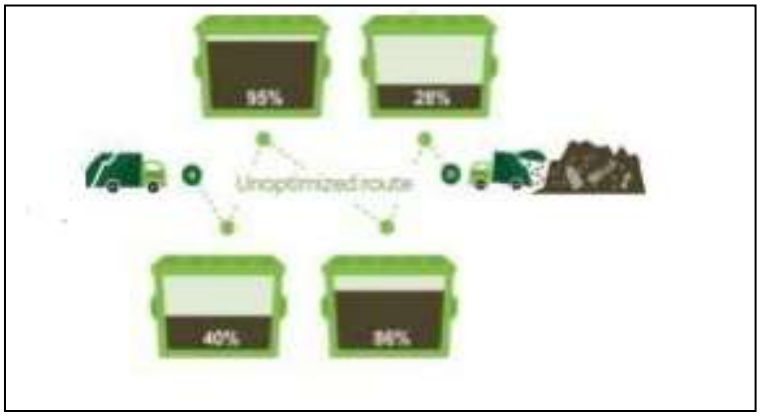

Figure 3: Existing Scenario

In [1], Smart Garbage Management in Smart Cities using IoT proposed a method as follows. The level of garbage in the dustbins is detected with the help of ultrasonic sensors system, and communicated to the authorized control room through GSM system. Arduino microcontroller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently. Level detector consists of IR sensors which is used to detect the level of the garbage in the dustbin. The output of level detector is given to microcontroller. Four IR sensors are used to indicate the different levels of the amount of the garbage collected in the dustbin which is placed in public area. When the dustbin is filled up to the highest level, the output of fourth IR receiver becomes

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active low. This output is given to microcontroller to send the message to the Control room via GSM module. At receiver, control room is present where all the activities are managing. At receiver, control room is present where all the activities are managing. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduce the total number of trips of garbage collection vehicle and hence reduce the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient.

In [2], a dustbin is interfaced with microcontroller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser with html page by Wi-Fi. Hence the status will be updated on to the html page. There by to reduce human resources and efforts along with the enhancement of a smart city vision. Considering the need of modern technology, the smart garbage bin can expensive but considering the amount of dustbin needed in India, there for they used based sensors to reduce its cost and also make it efficient in applications. And at the sender side they used only a Wi-Fi module to send and receive data. But because of the use of weight sensor for detection of amount of garbage in dustbin. It will only detect the weight of waste; not how much level it is of. The message can be sent directly to the cleaning vehicle instead of the contractor's office. Thus garbage bins are managed.

In[3], a Geographical Information System (GIS) transportation model for solid waste collection that elaborates plans for waste storage, collection and disposal has been proposed in [3] for the city of Asansol in India. An enhanced routing and scheduling waste collection model is proposed for the Eastern Finland, featuring the usage of a guided variable neighbourhood thresholding Meta heuristic. The aim of the research was to develop an optimal schedule for trucks on defined collection routes. The data from the bins are processed in the DSS and if it is correct it is sent to organizers of waste collection in this particular place and to the road police. The truck driver doesn't waste time for waiting, he/she goes to the next point and the route is dynamically recounted. When the problem is solved the system recounts the route for one of the available trucks and the waste from unlocked bin is collected. It is combined with dynamic routing algorithms to maximize the efficiency of waste collection.

In [4],it reviews the researches done on waste collection in developing countries from 2005 to 2011 and considers challenges for developing countries in waste collection sphere. The research focuses on determination the stakeholders actions/behavior and evaluation of influential factors defining their role in waste collection process. The models in the survey were tested on real data. Considering system approaches for solid waste collection in developing countries is presented. The research compares the history and the current practices, presented from 1960s to 2013. The output of the survey is drawing a conclusion that developing and implementing solid waste collection approaches in developing countries are of a great importance. The main issue is that waste collection does not include innovation that IoT can provide. Models do not use real time information of the waste collection, although some approaches use advanced scheduling and routing via exploiting modern ICT algorithms. Information about bins status was not considered as part of waste collection. All the reviewed surveys do not propose a model that will use IoT technology for Smart Cities, though they consider different approaches for waste collection.

In [5], the paper proposed an advanced Decision Support System (DSS) for efficient waste collection in Smart Cities. The system incorporates a model for data sharing between truck drivers on real time in order to perform waste collection and dynamic route optimization. The system handles the case of ineffective waste collection in inaccessible areas within the Smart City. Surveillance cameras are incorporated for capturing the problematic areas and provide evidence to the authorities. The waste collection system aims to provide high quality of service to the citizens of a Smart City. System architecture aims to suit two main targets. First target is providing software as-a-service (SaaS) products for customers. Mainly, these customers are private companies that are involved in waste collection, owning waste trucks, organize work of drivers, get contracts from municipalities and pass wastes to recycling organizations or city dumps. Second main target is developing a system, which makes possible mutually beneficial communication between all the stakeholders involved in the chain of supplying goods and utilizing solid waste in smart city. This paper presented a novel cloud-based system for waste collection in smart cities. The system aims to provide services for different kind of stakeholders involved in this area - from city administrations to citizens. Still, the design focuses mostly on providing SaaS services to commercial waste management companies.

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- The term "smart city" first appeared in 1998 and has been increasing popular in the recent years.
- Giffinger et al. defines the smart city as "a city well performing in a forward- looking way, built on the smart combination of endowments and activities of self-decisive, in dependent and aware citizens" and identifies six application domains (economy, people, governance, mobility, environment and living).

- smart cities are not only about automating routine functions, but also monitoring, understanding, analyzing and planning the city and processes within.
- Smart cities empower data-driven decision making processes ,which in-turn can improve efficiency, equity and quality of life for the smart city's citizens, in real time.
- Widespread and inexpensive availability of cloud computing services, rapid penetration of smart phones in urban populations as well as the rise of Internet of Things (IoT) in the form of deployment of a variety of sensors drive smart city technologies that offer new application domains in city planning and operations.

III. OUR WORK

SMART AND WIRELESS WASTE MANAGEMENT AN INNOVATIVE WAY TO MANAGE WASTE

This model helps to identify the level of garbage using ultrasonic sensors which will be interfaced with ultrasonic conditioning chip and it will be located on the top of dustbin. 4 load cells were used in case if ultrasonic sensor fails to give input. Input from sensors will be processed by the microcontroller using signal processing algorithms and the processed input will be sent municipal office through SMS using a GSM modem so they will get SMS to pick up the waste. GPS module is installed to detect the location of dustbin.

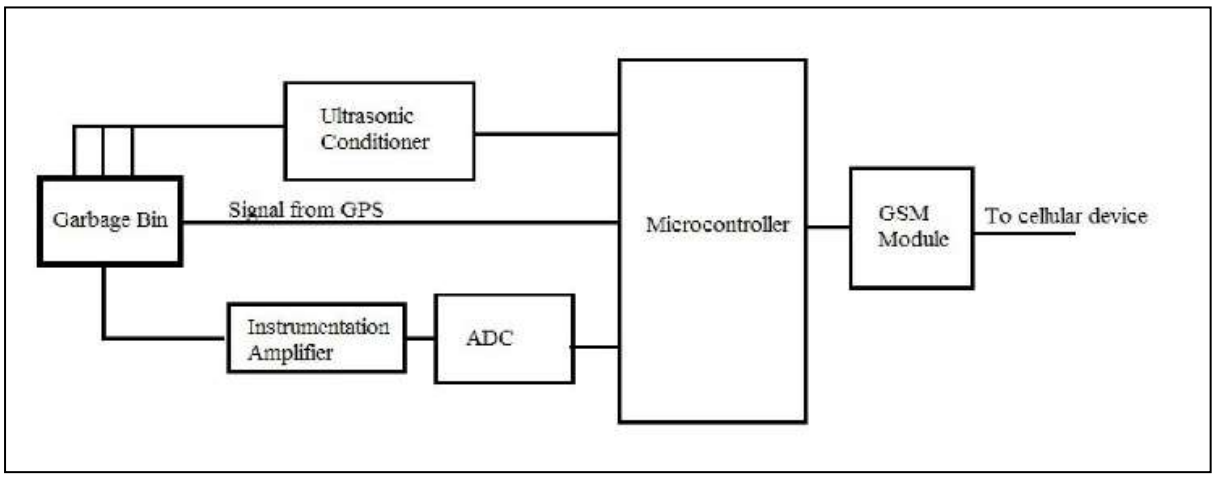

Figure 4: Block Diagram for Smart Garbage Bin

The bins installed with sensor unit send the information to the server through wireless communication using Wi-Fi module ESP 8266 which needs Wi-Fi connection that provides peer to peer connection. The proposed system is divided into two sections: an administration section and a service section. In the service section, residents throw away the waste in a bin and that information with the sensors is collected and transferred to the administration section. The web Server displays the details of sensor value, at real time. The same information is transferred to concerned authority so that accordingly the filled bins are timely evacuated. The priority algorithm is also used for making the system more result oriented.

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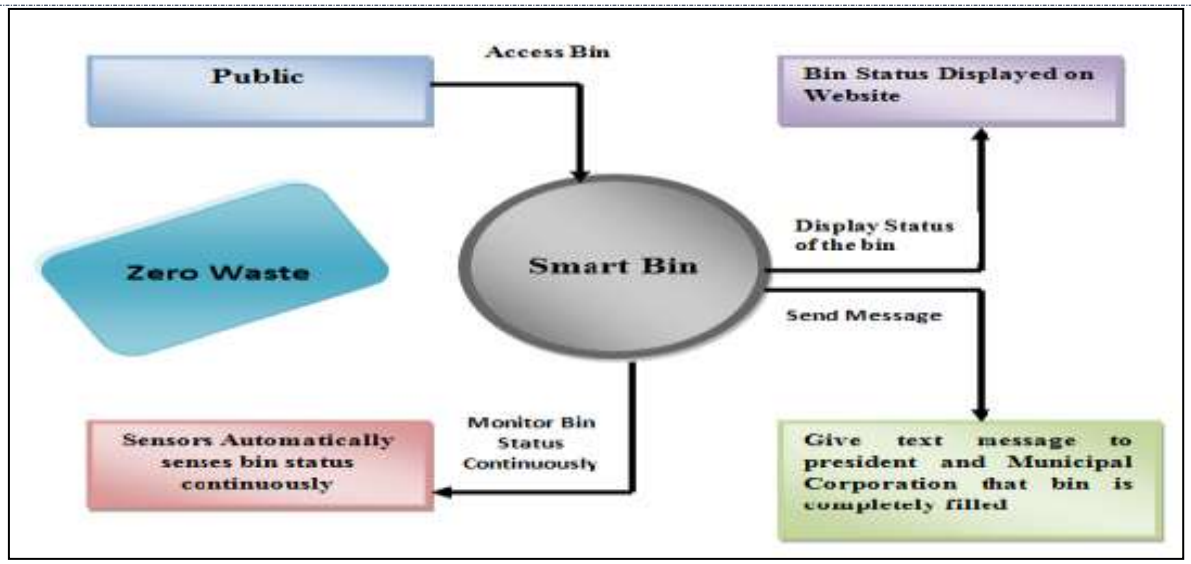

Figure 5: Context Free Diagram

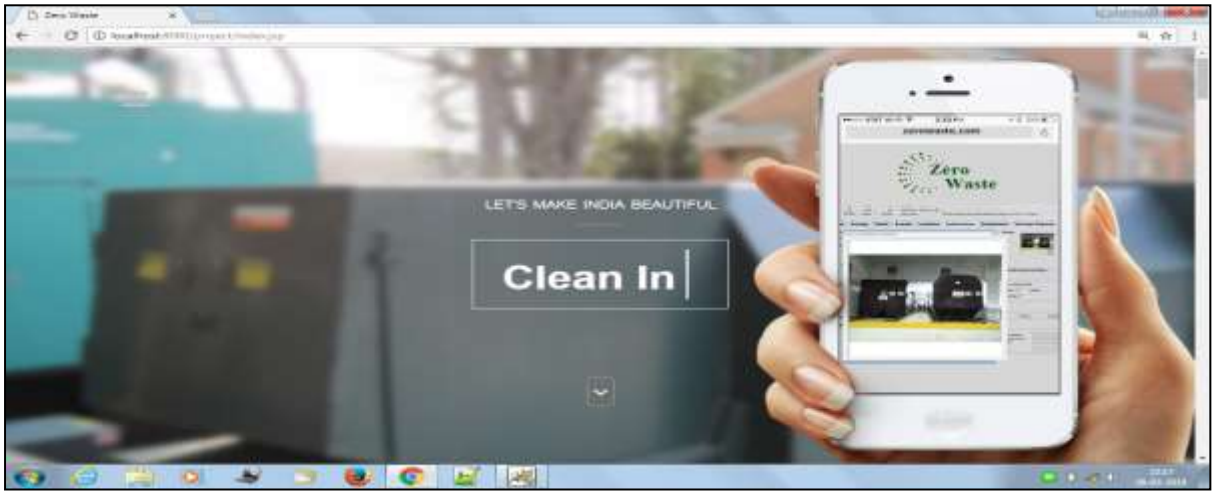

Figure 6: Main Page

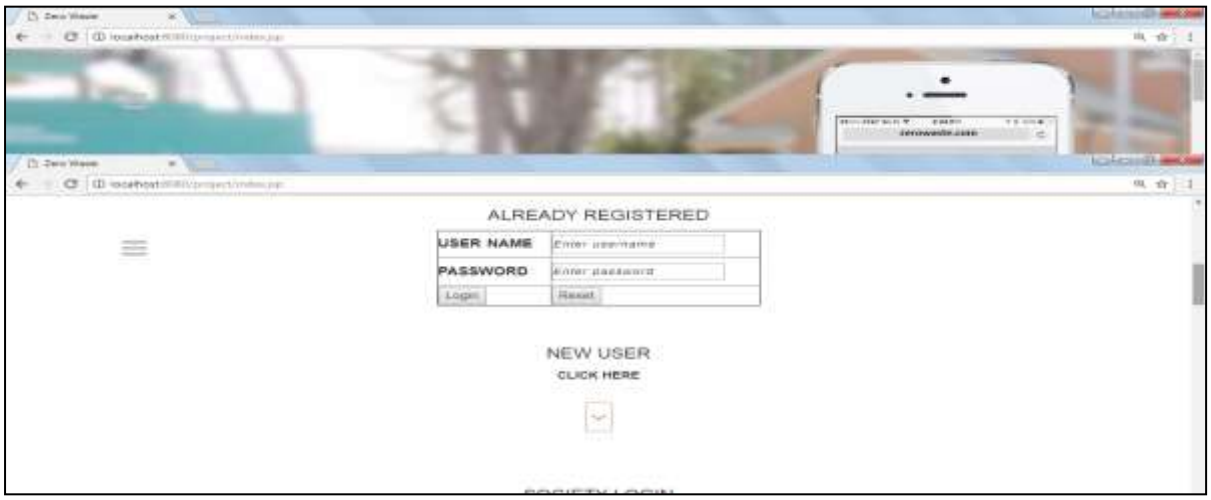

Figure 7: Login Page

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Figure 8: Driver Registration

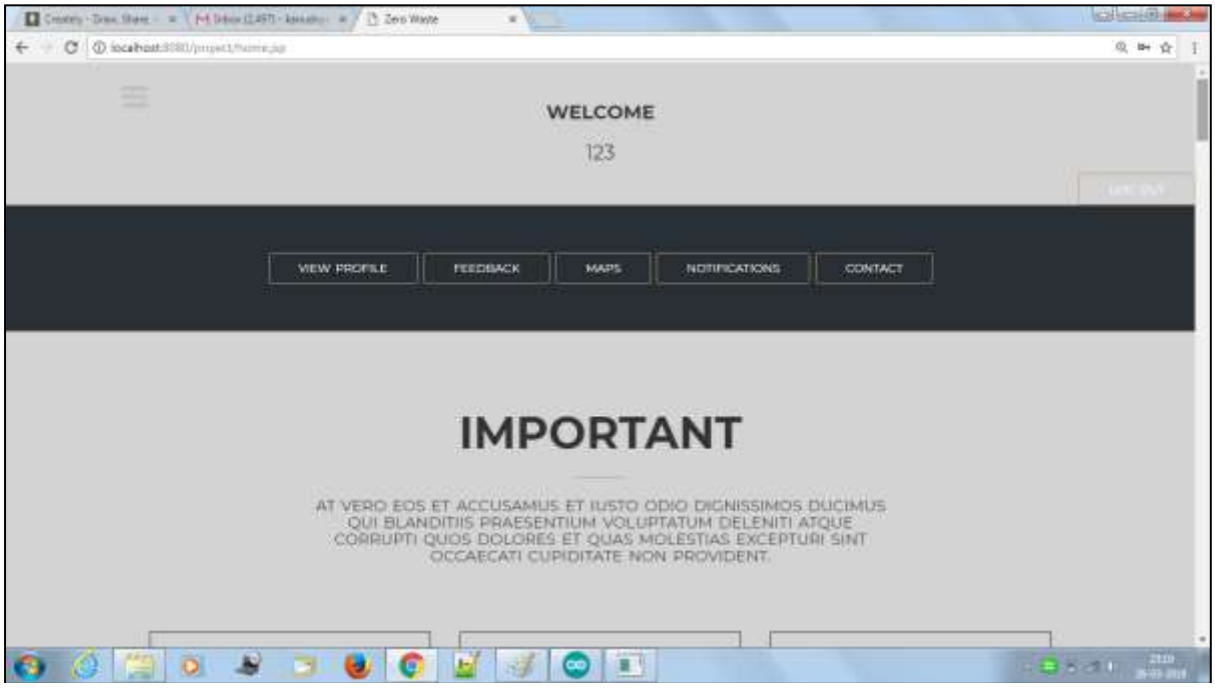

Figure 9: Driver Home Page

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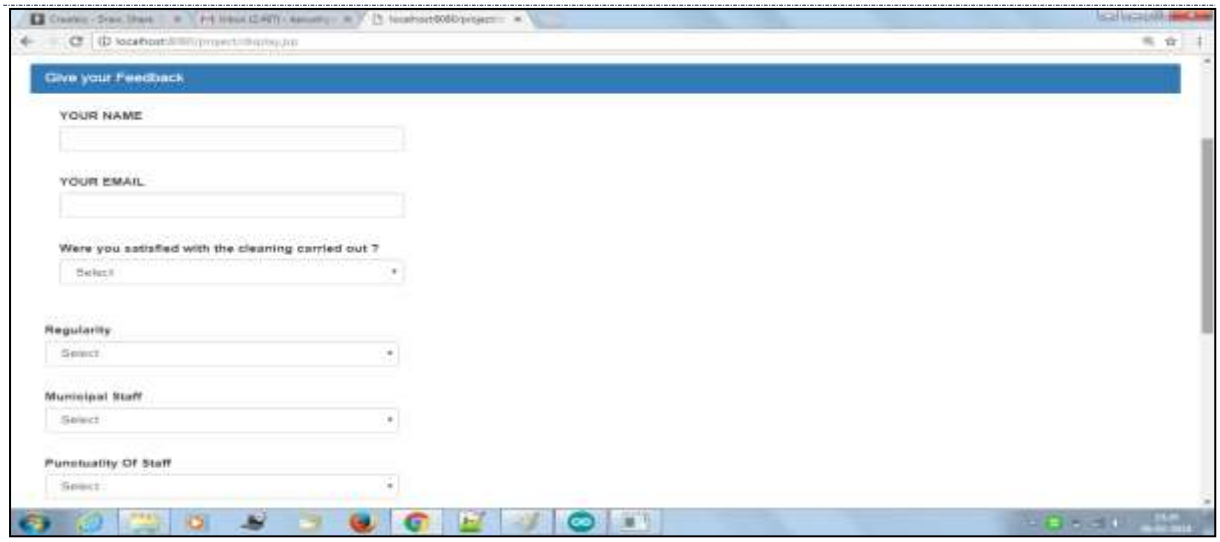

Figure 10: Feedback Page

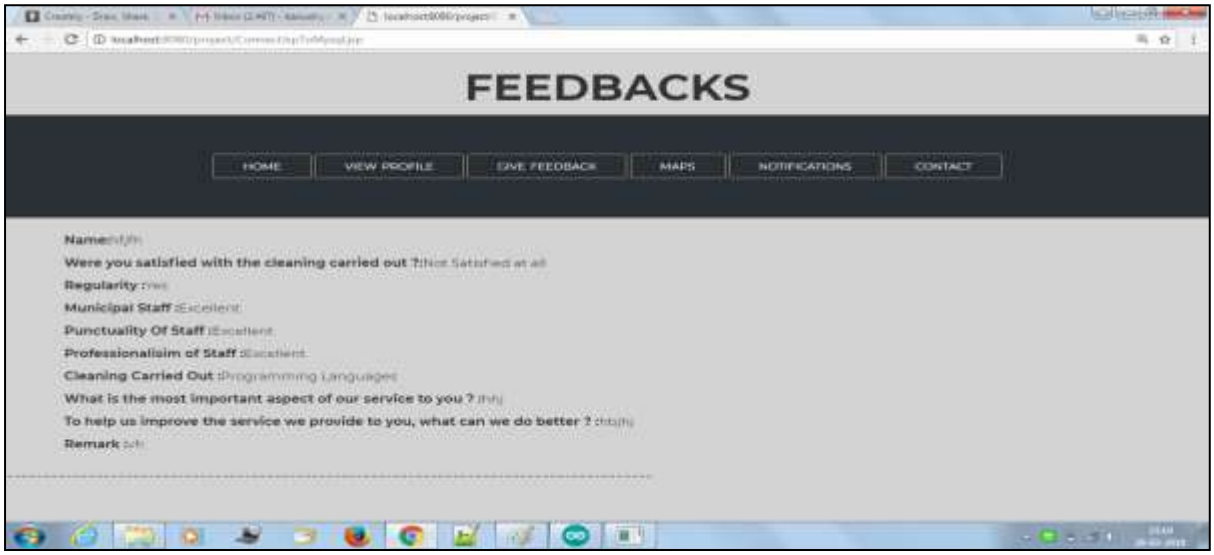

Figure 11: View Feedback

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Figure 12: Society Registration

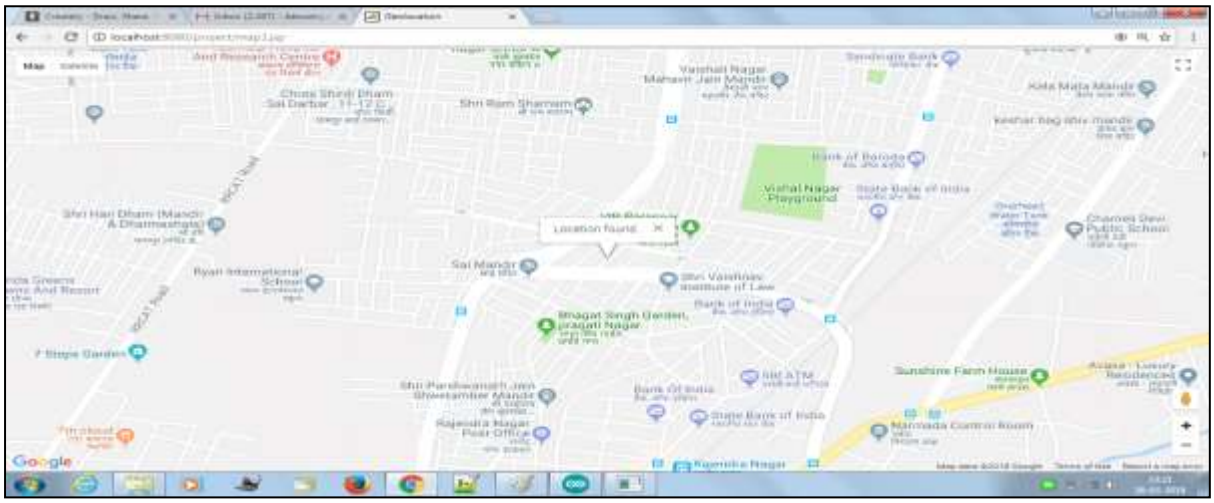

Figure 13: Map

IV. CONCLUSION

- Only registered users are provided with all the features of the website.
- The user should have internet to run website.

There are several future works and improvements for the proposed system,

- Having a case study or data analytics on the type and times the waste is collected on the type of days or season making the bin filling predictable and removing the dependency on electronic components and fixing the coordinates.
- Improving graphical interfaces for the Server and complete Android applications has possibility of extending the system adding other use cases and applications for smart cities.
- Moreover, the proposed solution is flexible and decoupled with respect to the determination of optimal number of bins and vehicles or to the algorithm that define the best route for vehicles.

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