



# E-TRACKING SYSETEM FOR MUNICIPAL SOLID WASTE MANAGEMENT USING RFID TECHNOLOGY

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**Abstract:** With the increase of population of a country, proper management of cumulative of Municipal Solid Waste (MSW) becomes more acute for maintaining green environment. In conventional approach a number of trucks collect the MSW and then transport and transfer these MSW in a pre-specified location, but all the above jobs are not properly monitored. It is very important to monitor the trucks and record the information related to the collecting time and area from a central location to ensure the job well done. This project exploits the tremendous power of RFID technology and presents the development of an electronic monitoring (e-monitoring) system to overcome the above problem in the conventional approach. The proposed e-monitoring system is an embedded system that consists of RFID technology interfaced with PIC micro-controller and a web based computerized software. A web based GUI so that the system can be accessed from anywhere and information can be viewed by different group of people. The GUI will have the facility for the citizens to put their complaints and comments on the service. It has been tested in the laboratory environment as well as in the field environment. The test results show that the system functions properly and is working real time. Municipal authority can monitor the SW collecting status through the system and can generate different reports to improve the performance of their service.

**Keywords:** E-Tracking, RFID, PIC microcontroller, GSM/GPRS, IR sensor.

## 1. Introduction

Generally solid waste is defined from the household refusal. The non-hazardous solid wastes are from industries, institutions such as hospitals, markets and streets. All these types of solid waste are a problem to environment. In developing countries, waste management is becoming a social issue due to unmonitored act. A significant amount of solid waste generated in country are not collected and managed properly. Wastes are either burned openly in the streets or end up with empty land, rivers and thereby creating a serious health issue to public.

In the conventional approach, a number of trucks from the municipal authority are sent to the waste bins to collect the solid waste (SW). The wastes are loaded in the truck and then transported and transferred to the pre-specified locations. However the category of the people involved in collecting and transporting the wastes are usually not responsible enough to make the job well done. Very often the wastes are not collected from each and every waste bin properly due to driver's attitude.

The conventional waste collection and management approach has the following problems:

- Lack of information about the collecting time and area.
- Lack of proper monitoring system for tracking all activities related to solid waste management.
- Lack of monitoring of the status of the bin.



## 2. Terminologies

### 2.1 RFID

Radio-frequency Identification (RFID) uses wireless radio communication technology to uniquely identify tagged objects.

*RFID Tag:* A tag (aka transponder) is composed of a semiconductor chip, an antenna, and sometimes a battery. Basic function of an RFID tag is to store data and transmit data to the interrogator. A tag consists of an electronic chip and an antenna encapsulated in a package to form a usable tag, such as a packing label that might be attached to a box. Generally, the chip contains memory where data can be stored. One can read that written data. Some tags contain batteries.



### 2.2 GSM/GPRS

General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM) protocol. GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. SIM900 GSM module is used in this system.

### 2.3 Micro-controller

A micro-controller is a computer-on-a-chip, containing a processor, memory, and input/output functions. It is a microprocessor emphasizing high integration, in contrast to a general-purpose microprocessor (the kind used in a PC).

### 2.4 Infra-red Sensor:

Infra-red sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor.

## 3. System analysis

### 3.1 Existing System

In the past there is no information about the collecting time and area. Lack of proper monitoring system for tracking all activities related to solid waste management makes the society polluted. The performance of the drivers are not notified so that there is no quick response to urgent cases There is no quick way to response to client's complaints about uncollected waste.

### 3.2 Proposed System

In proposed system, continuous monitoring about the status of the waste collection is done. The e-monitoring system can respond to any abnormal situation. Customers can easily send their complain using the complain form of the web site. The system will have the facility to send SMS to the workers and supervisors. If the waste bin is collected late or skipped it is notified to the supervisors and the drivers. A database is provided to check the collection process time and performance.



## 4. System model

### 4.1 Concept

The e-monitoring system has two parts:

- One is Vehicle unit
- Another is Control system

- 1) **Vehicle unit:** It consists of an RFID reader, a micro-controller, a Liquid Crystal Display (LCD) and a RF transmitter. The reader senses the tag and sends the notification to the controller. The tag unique id is displayed in the LCD screen. The information about the system is sent through the RF transmitter.

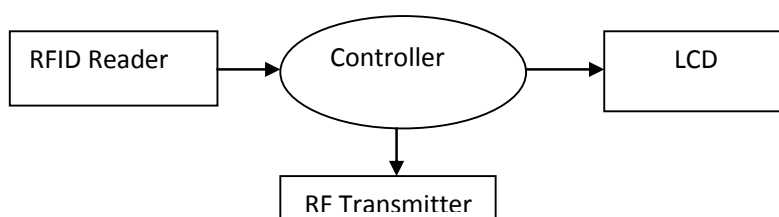


Figure 2 Functional block diagram of the vehicle unit

- 2) **Control System:**

It consists of a RF receiver, microcontroller and a Central Server..The central server has the time of collection of each bin. The data is received using RF receiver and the information about the bin are stored in the system.

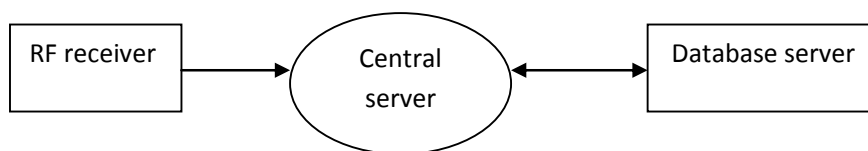
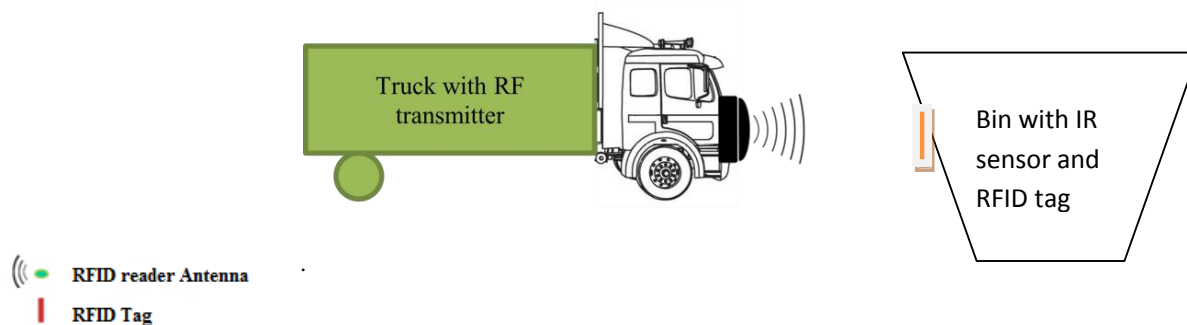


Figure3Functional block diagram of control system

### 4.2 Embedded Hardware Implementation

The main concept of the system is shown in figure 1 and the data flow model of the system is shown in figure. The system components used in this project are described in the following section.



- 1) **RFID Reader:**

RFID reader is to read data from RFID Tag. It is an intelligent module providing RF and control functions to read and program TIRIS transponders. Using attached antenna RFID reader sends data to



detect RFID tags in its frequency range. When any tag comes to the range of the RFID reader it reads data from RFID tag. After reading data it sends data to the micro-controller connected to it.



## 2) *Micro-controller:*

A Microchip PIC16F887A has been used in this project. For ease of use, a development board has been selected. The controller receives data from the RFID reader and decodes it. After matching the data with known lookup table, it discards non-acceptable data and processes only valid data. After filtering the data it arranges the data in a specific format. Then it sends the data to the web based software system for farther processing via the GPRS module. The data is also displayed on the LCD screen via another port for checking purpose.

After formatting the data into a specific format the controller sends the information to the remote central server through this GPRS module. Controller sends data to a specific mobile number as an SMS. A GPRS module is connected with a remote server that receives the SMS that was sent from the controller.

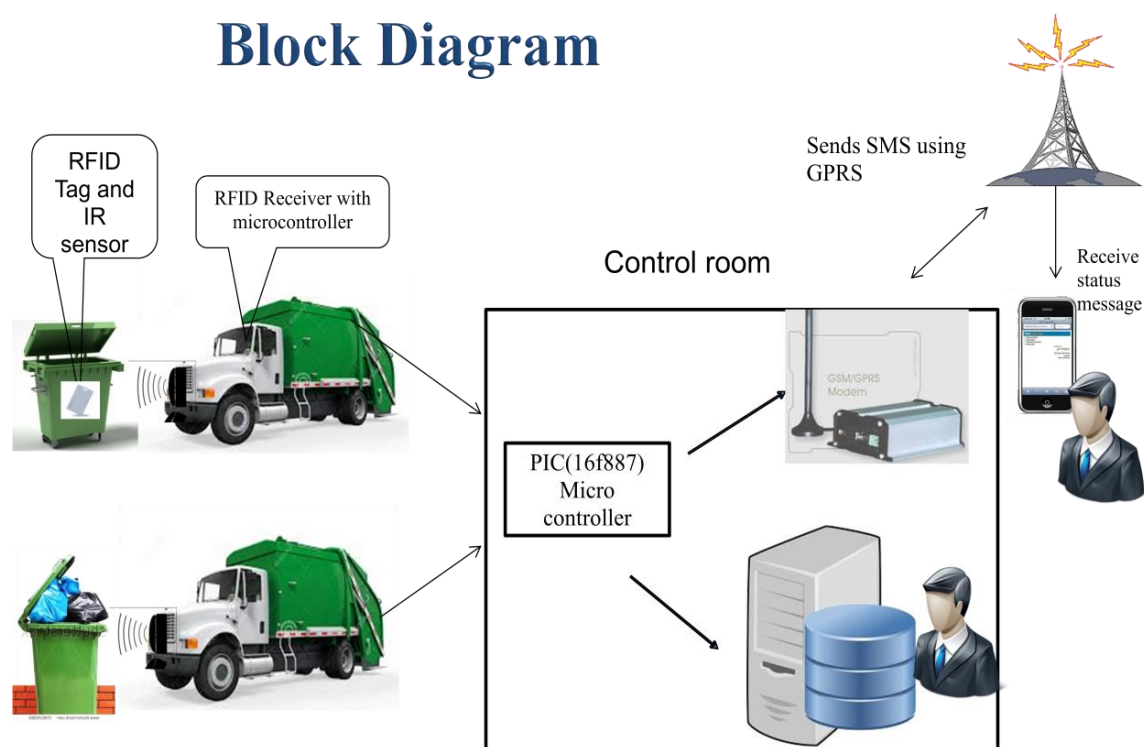


## 5. Working:

RFID reader sends signals to detect the RFID Tag in its frequency range. When any Tag comes to the range of RFID reader it automatically reads data from the RFID Tag and the status of the bin's waste collection using IR sensor. Then the controller collects data from the RFID reader, filters collected data and arranges the data into specific format. In SMS receiving part the GPRS module will receive only the formatted SMS. After formatting the data, the controller sends the formatted data to the central server. After fetching and verifying the data, central server sends the information to web server and also to authorized persons mobile phone.



## Block Diagram



### 5.1 Operation of the embedded system:

Figure shows that a waste bin is mounted with an RFID tag and IR sensor and the container carrying truck is equipped with the proposed embedded system. When the truck comes to the signal range of the RFID Tag then the RFID reader of the embedded system starts reading data from the RFID Tag and sends the captured data to the controller. The controller filters the data received from the RFID reader and arranges the data in a pre-specified format. Then the controller sends this data to the central server via RF Transmitter. The controller program has been written in C programming language. The flowchart of the program is shown in Figure 11. The system is initiated by switching on the start button of the embedded system. Whenever any municipal vehicle equipped with the embedded system comes to the frequency range of RFID tag mounted with the waste collecting container, the embedded system sends a request signal to the tag. Then the tag responds and data is read by the embedded system through the RFID reader. And the status of the bin is collected from by sensing. After reading the data controller verifies it for further processing. If data is valid then the embedded system converts the data into specific format, otherwise it discard the data. After arranging the data in specific format, it sends the data to the GPS module of central server as SMS. Central server verifies the SMS. If the system finds the SMS is in proper format then it updates the database server with the content of the SMS.

## 6. Result:

The E-tracking system for municipal solid waste contains the central servers with database. The database contains the time of collection to each bin. If the time was late or the bin is missed a notification is send to the supervisor through SMS.

These Figs shows the E-tracking system

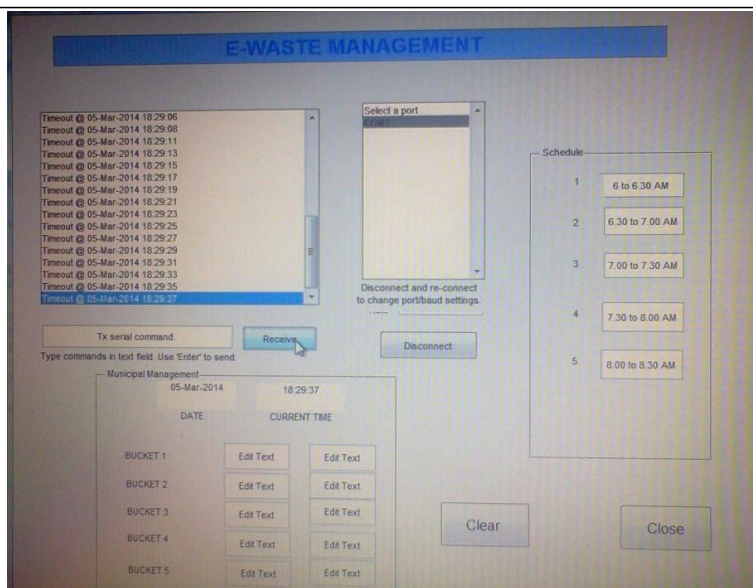


Fig-central server system

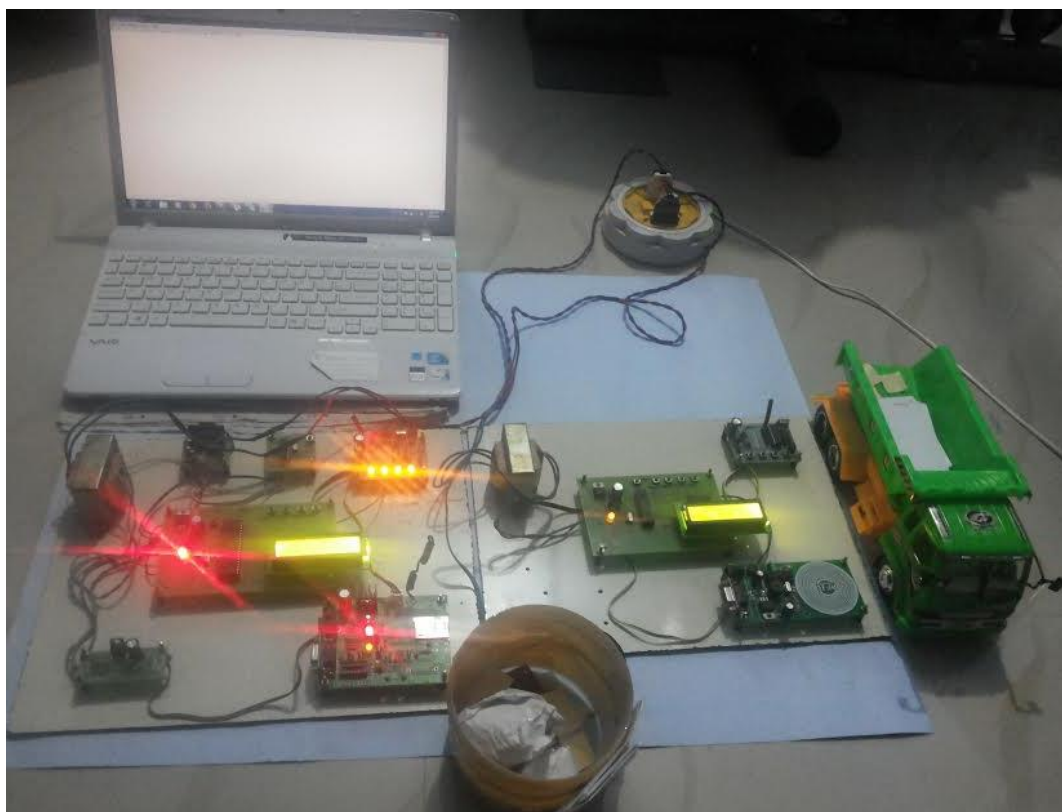


Fig-tracking system for municipal solid waste



## 7. Conclusion:

The objective of the project was to develop an tracking system for proper management of MSW. With the objective keeping in front, a micro-controller based embedded system integrated with RFID and GSM technology is developed in this project. Since it is a micro-controller based embedded system, it is portable and low cost. A municipal authority can use this type of system and monitor the waste collection status in real time and based on the recorded information they can prepare different reports and measure the performance of the team and thereby increase their productivity.

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Dr. S. Padmapriya received her BE (Electronics and Communication) from Madras University in the year 1991. And M.Tech (Information Technology) from Punjab University and M.E.(Embedded Systems) from Anna University, and Ph.D. (Computer Science) from Berhampur University . She has been the member for evaluation committee for projects and served has Resource coordinator for Bharathidasan University and IGNOU. She has published papers in many national level conferences on embedded systems. She is now presently heading over the Information Technology Department in Prathyusha Institute of Technology and Management.

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