



# IoT Based Garbage and Street Light Monitoring System

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## Abstract:

Now-a-days we observe garbage bins being overflow and all the garbage spills out resulting in pollution. Garbage may consist of the unwanted material left over from manufacturing process like industrial, commercial, mining or agricultural operations or from community and household activities. This project is related to the “Smart City” which uses the concept of “Internet of Things” (IOT). IoT Based Garbage and Street Light Monitoring System is a very innovative system which helps to make the cities smart by monitoring the garbage bins. The information regarding the weight and volume of garbage collected in the garbage bins is sent to the Amazon cloud and is monitored by Admin. The Admin is responsible to send the information to the garbage collecting vehicle if the garbage bins are full, the vehicle can then go to a particular area where the bin is located and collects the garbage. Hence our problem statement is to design a system based on Renesas microcontroller for collecting the garbage from particular area whose public garbage bins are overflowing with prior concern. This project also includes Street light monitoring system which avoids accidents during night. To overcome the manual operation for street light monitoring, we have designed an automatic street light control system using a sensor called Light Dependent Resistor (LDR). Hence this reduces power consumption and manpower.

**Keywords:** Renesas Microcontroller, Ultrasonic sensor, Force sensor, DC Motor, Light Dependant Resistor(LDR), LED's, UART Module, GSM,GPRS.

## I. INTRODUCTION

### OVERVIEW

Garbage Monitoring System: “Swachha Bharat Abhiyan”, an Indian central government ambitious project to make India a clean country, aims to teach citizens to reduce and even clean their own garbage waste. Garbage may consists of the unwanted material left over from manufacturing process like industrial, commercial, mining or agricultural operations or from community and household activities. India generates about 60 million tons of trash every year. 10 million tons of garbage is generated in just the metropolitan cities like Delhi, Mumbai, Chennai, Hyderabad, Bangalore, and Kolkata. This project is related to the “Smart City” and based on “Internet of Things” (IOT). So for smart lifestyle, cleanliness is needed, and cleanliness is begins with Garbage Bin. This concept will help's to eradicate or minimize the garbage disposal problem. Street Light Monitoring System: In today's busy life, no one bothers to switch off/on the street lights when not required. Street light are the major requirement in today's life of transportation for safety purposes and avoiding accidents during night. In this paper, we have designed an automatic street light control system using a simple light dependent resistor (LDR). This automatic street light control system provides human safety, urban beautification, and road safety. This project gives solution to minimize power consumption and manpower.

### 1.1 Problem Statement

The main goal of this paper is to design a system for collecting garbage from particular area whose garbage bins are overflowing with prior concern and to automate the street light system.

## II. SYSTEM ANALYSIS

### 2.1 Existing System:

With increase in population, the scenario of cleanliness with respect to waste management is degrading tremendously. The overflow of garbage in public areas creates the unhygienic condition in the nearby surrounding. It may provoke several serious diseases amongst the nearby people. It also degrades the valuation of the area. Street light are the major requirement in today's life of transportation for safety purposes and avoiding accidents during night. Despite that, in today's busy life, no one bothers to switch it off/on when not required.

### 2.2 Proposed System:

In this paper, an efficient method to dispose this waste has been designed with Wireless Sensor Networks (WSN) used. The microcontroller automatically reads the present conditions of the dustbin and street light through sensors and updates that information to the Amazon web page with the help of GPRS. The need for manual operation of the street lights is completely eliminated and much energy is saved that would have been otherwise wasted if the user were to forget to power “OFF” the light at any point in time. This work was successfully designed, implemented and commissioned for use.

### Benefits of Proposed System:

- Monitoring and maintaining the present dustbin level, weather it is filled or not, if it is filled then update that information to the Amazon web page.
- Automatically turns on and off the street light based on the sun-light intensity without human interaction and thus reduces power consumption.

### III. SYSTEM DESIGN AND SPECIFICATION

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of microcontroller, Ultrasonic sensor, force sensor, GPS, GPRS, LCD, Amazon cloud web server. The microcontroller located at the centre of the block diagram forms the control unit of the entire project. Embedded within the microcontroller is a program that helps the microcontroller to take action based on the inputs provided by the output of the sensors. We are using Ultrasonic sensor and force sensor to monitoring the waste in the dustbin. Level of waste in the dustbins is detected with the help of Ultrasonic sensor. Force sensor is used to measure the weight of the dust bin. Red and Green LEDs are used to indicate filled and empty level of dustbin respectively. When person comes near to dustbin to put garbage the door will be automatically opens, when person leaves the predefined area of dustbin the door will close automatically. When the measured value of sensors exceeds a certain threshold value, this information with GPS location where the dustbin is located will be updated directly to Amazon cloud web server through GPRS (IoT). Through Amazon cloud server, we can see in which area dustbin is located, by comparing coordinates of latitude and longitude and updates the location and inform the respective vehicle to collect the waste. Microcontroller is used to interface the sensor system with GSM system. This will help to manage the garbage collection efficiently. In automatic street light system, LDR is used. During the day, the LDR senses enough illumination and the street light goes OFF. And when darkness comes, resistance of the LDR increases tremendously and causes the light to come "ON". Also, a transistor switching Relay is deployed to provide the switching mechanism to activate the street lights.

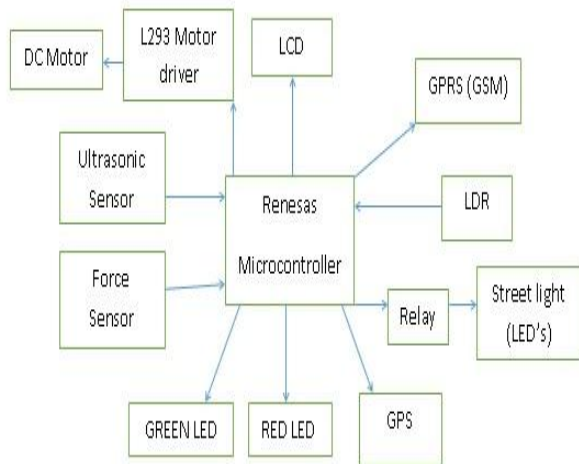


Figure.1. Block Diagram

#### 3.1 Hardware Used

##### Renesas Microcontroller:

R5F100LEA microcontroller from Renesas RL78 series which is a 16-bit microcontroller is used to implement this project. Microcontroller acts as the heart of this project, which controls

the whole system. It contains of Flash ROM 64KB, RAM 4KB and Data Flash 4KB, and it has High speed on-chip oscillator, Self-reprogrammable under software control, 58 GPIO's, 3 UART's, Simplified I2C, 10 bit resolution ADC, 28 Interrupt Sources, ISP programming support etc.

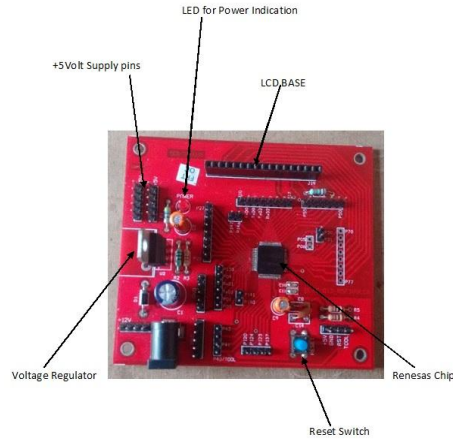


Figure.2. 64pin Renesas Microcontroller Board

##### Alpha Numeric LCD Display:

A **liquid crystal display (LCD)** is a flat panel electronic visual display, based on Liquid Crystal Technology. It consists of an array of tiny segments (called pixels) that can be manipulated to present information. Liquid crystals do not emit light directly instead they use light modulating techniques.

##### UART Module:

The Universal Asynchronous Receiver/Transmitter (UART) peripheral is based on the Industry standard TL16C550 asynchronous communications element, which in turn is a functional upgrade of the TL16C450. Functionally similar to the TL16C450 on power up (single character or TL16C450 mode), the UART can be placed in an alternate FIFO (TL16C550) mode. This relieves the CPU of excessive software overhead by buffering received and transmitted characters. The receiver and transmitter FIFOs store up to 16bytes including three additional bits of error status per byte for the receiver FIFO. The UART performs serial-to-parallel conversions on data received from a peripheral device and parallel-to-serial conversion on data received from the CPU. The CPU can read the UART status at any time. Processor interrupts system that can be tailored to minimize software management of the communications link.

##### Ultrasonic and Force Sensor:

Ultrasonic sensor is used to monitor the level of waste in dustbin. Force sensor is used to monitor the weight of dustbin.

##### DC Motor:

NR-DC-ECO is high quality low cost DC geared motor. It contains Brass gears and steel pinions to ensure longer life and better wear and tear properties. The gears are fixed on hardened steel spindles polished to a mirror finish. These spindles rotate between bronze plates which ensures silent running. The output shaft rotates in a sintered bushing. The whole assembly is covered with a plastic ring. All the bearings are permanently lubricated and therefore require no maintenance. The motor is

screwed to the gear box from inside. In this paper DC motor is used to open and close the dustbin door without human interface.

#### GPS Device:

GPS-634R” is a highly integrated smart GPS module with a ceramic GPS patch antenna. The module is with 51 channel acquisition engine and 14 channel track engine, which is capable of receiving signals from up to 65 GPS satellites and transferring them into the precise position and timing information that can be read over either UART port or RS232 serial port. Small size and high end GPS functionality are at lower power consumption, both of the LVTTTL-level and RS232 signal interface are provided on the interface connector. Here, GPS is used to find the co-ordinates of the location of the dustbin and street light. Red and Green LEDs are used to indicate filled and empty level of dustbin respectively. LCD is used to display the whole process. GPRS is used to send the information to Amazon cloud web server.

#### LDR:

Light-dependent resistor alternatively called an LDR, photo resistor, photoconductor, or photocell, is a variable resistor whose value decreases with increasing incident light intensity. An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its whole partner) conducts electricity, thereby lowering resistance. In this project we use LDR for automating the street lights to reduce power consumption, manpower and cost.

#### 3.2 Functional Requirements:

These are the core factors those have direct impact on the functioning of the system.

**Admin:** Admin is the one who will monitor the weight & volume levels of the dustbin.

**Cloud:** Cloud is managed by the cloud service provider, who also provides the storage services and has significant computational resources.

### IV. IMPLEMENTATION

The Internet of things (IOT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.

#### 4.1 Amazon Web Services (AWS):

Amazon Web Services provides on-demand computing resources and services in the cloud, with pay-as-you-go pricing. For example, you can run a server on AWS that you can log on to, configure, secure, and run just as you would a server that's sitting in front of you.

#### Benefits:

- Capacity exactly matches your need.
- You pay only for what you use
- Economies of scale result in lower costs

- Service is provided by a vendor experienced in running large-scale networks.

#### 4.2 Amazon Elastic Compute Cloud (Amazon EC2):

EC2 provides scalable computing capacity in the Amazon Web Services (AWS) cloud. Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.

#### 4.3 Snapshots



Figure.3. Device after activation



Figure.4. Dustbin opening automatically after sensing presence of a person



Figure.5. Street light automatically becomes ON during night



Figure.6. Remote login to amazon web page

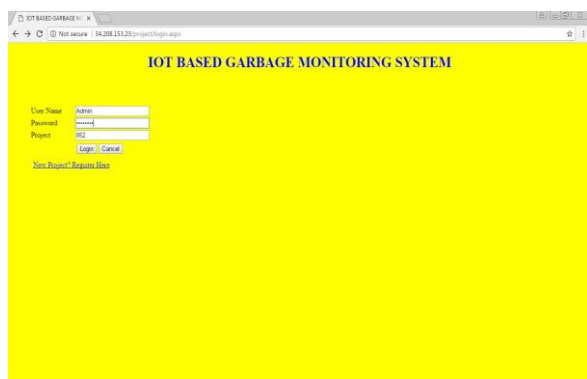


Figure.7. Login page for Admin

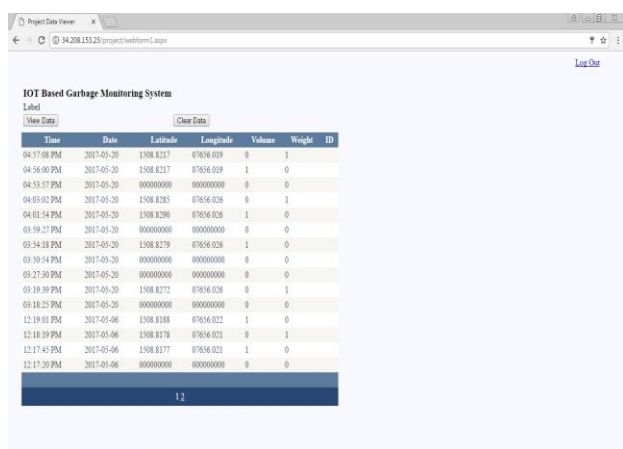


Figure.8. Data stored in Amazon web server and is monitored by the Admin

#### 4.4 Advantages

- It avoids soil and air contamination.
- Helps to keep clean and safe environment.
- Manpower and power consumption is reduced by automatic street light concept used.
- Easy to use.
- Efficient and reliable.

#### 4.5 Applications

- This project is helpful in the government project of Swaccha Bharat Abhiyan.
- Can be implemented in medical waste management in hospitals.

- Can be implemented to waste management of hazardous wastes like industrial waste.

## V. CONCLUSION

By implementing this project, we can avoid overflow of garbage from the bins in residential areas which were previously either loaded manually or with the help of loaders in traditional trucks. Manual loading takes much time and reduces the productivity of the vehicle and manpower deployed. Besides, manual handling of waste poses a threat to health of the sanitation workers as the waste is highly contaminated. It can also automatically monitor the street lighting system without need of human being.

## VI. FUTURE ENHANCEMENT

For project demo concern, we have developed a prototype model. In future, this project can be taken to the product level. To make this concept as user friendly and durable, we need to make it compact and cost effective. Going further, most of the units are embedded along with the controller on a single board with change in technology, thereby reducing the size of the system.

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