

# IoT Based Energy and Waste Management for Smart Cities

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## ABSTRACT

Over the centuries, humans have tried to reduce energy and one of the most efficient way to achieve this is to build a smart city. Many modernist cities have started using different methods to reduce energy consumption and also to create healthy surroundings. Few methods are used specially regarding road safety of passengers and waste management; thereby we are introducing a simplest way to avoid such problems using an idea of Internet of Things (IoT) i.e. an “IoT Based Energy and Waste Management System for Smart Cities”. Internet of Things is a simple way of connecting the software and hardware components to the internet. IoT refers to an emerging model consisting of combination of uniquely addressable things communicating with one another to form dynamic networks. Here this idea is used on street lights and dustbins where street lights promote security across city and improves safety for drivers, riders and pedestrians. Similarly, nobody wants to be in a place which is encompassed with waste or has awful smell, hence we introduce smart dustbins, which are capable of sending alerts when they are full and can be emptied immediately, giving no chance for the dustbin to be over flown .

**Keywords:** *Arduino Microcontroller, Dustbin, ESP Module, IoT, Sensor, Streetlight*

## 1. INTRODUCTION

The Internet of Things (IoT) is the network of hardware and software devices connected on to the ever available internet. Each factor is unambiguously recognizable through its embedded automatic data processing system. At times IoT is connected to an object and then they are invoked and controlled remotely. The IoT will usually be connected to associate information processing network to the worldwide net. IoT focuses on reducing human intervention. Commercial IoT, where local communication is usually either Bluetooth or LAN (wired or wireless), the IoT device will typically communicate only with local devices. The IoT promotes increase the level of awareness concerning our world and a platform to observe the reactions to the dynamic conditions.

India is a developing nation with massive population, due to which the energy consumed and waste produced is huge. Thus there is need for saving these resources and also to keep the city clean. Since energy is one in all the foremost vital resource in our life so it should be employed in economical ways to make use of the energy and save energy for future requirement. Over the century, humans have tried to cut back energy and one among the foremost economical manner is to create a sensible green home. Several modernist cities started adopting this technique to cut back energy and environmental

pollution over the past few years. Few of the major reasons are basically throughout night time all the lights on the main road stay ON for the passengers, similarly as for vehicles, however ton of energy is wasted once there's no vehicle or traveler movement. Dominant of street lamp is of utmost important in developing country like India to cut back the power consumption. Saving of this energy could be a vital issue lately as energy resources are getting reduced day by day.

Secondly, waste management is additionally one among the first drawback that the globe faces irrespective of the case of developed or developing country. Within the contemporary situation, many times we see that the dustbins are placed at public places within the town are seen flooded because of increase in the waste daily. It creates insanitary circumstances for the folks and creates awful smell which leads in spreading of some deadly diseases.

To avoid such issues, we are progressing to vogue “IoT Based Energy and Waste Management for Smart Cities”. This project describes about the circuit that switches the road lights ON during dedicated amount of time and remains OFF after steady time. The dynamic street lamp management depends on an inter-connectable IoT. Novel methods are adapted to make the connection of hardware units to speed up the connection to the internet faster. These details are usually accessed by the

municipal authorities from their place with the help of software. Admin has the authority to read the status of streetlight that is if the light is active or inactive and also read the dustbin that is he can check the level of waste. He/she can also view the graph that is the execution time.

## 2. RELATED WORK

Nabil Ouerhani et al. [1], the paper affords a real-global established solution for dynamic street light managing which is based on the fancy internet. Enormous interest is delivered on interoperability degree, the use of novel tool connection concept based totally on version-driven communicate marketers to connect the sensors to the internet. The paper shows the outcomes from actual-international assessments with deployed dynamic road lighting fixtures in cities. The proposed model will try to save the energy up to an estimate of 50% of the power consumed. Zigbee unit used in this system will ensure the safety in the operations.

Rohaida Husin et al. [2], the paper gives an idea about automatic streetlamp system supported by an inexpensive microcontroller. This method consists of a microcontroller, lightweight device, rain device, optical device and a collection of the LED units. The system was programmed to mechanically shut at the daytime and work during the night. Many numbers of tests are conducted to check and validate the projected image within the completely different environment. As conclusion, around at the max there is 80% of reduction in electricity usage can be achieved. This paper makes a case for the uses microcontroller and detector to browse the input and processes it to get needed output. It uses low price microcontroller. It doesn't use IoT.

Deepak Kapgate [3], the paper describes the employment of wireless sensing element network for streetlight observation and management. As we glance at existing systems the ability consumption and maintenance price of streetlight management department is high. This technique would provide associate in nursing optimum cost accounting for lamp maintenance and control. System utilized use of network process device for sensing of sunshine then gathered information is used for dominant lamp ON/OFF. Lifetime of streetlight depends on the length for which they get used. During this analysis, this will be able to try and scale back the required length that lamp ought to get on, focuses on increasing band for network nodes to urge most possible rate and additionally discuss the parameters needed to automatic detection and removal of nodes within the network. This paper discusses concerning the usage of Wireless Sensor Network (WSN) to control and monitor the road light-weight. The control center will manage and monitor all street at real time. It uses Zigbee that may not secure and conjointly the coverage is restricted.

Dr. N. Sathish kumar et al. [4], The problem that people face in current days are the garbage is overflowed and there is no proper waste management. It in turn ends up in numerous hazards appreciate dangerous odour and create unhealthy atmosphere which could be seen as a number one cause for uninvited diseases. To prevent all these dangerous situation and to maintain a healthy surrounding, the proposed work is to

have a feasible garbage management system. This paper tries to tackle the problem by cleaning the garbage as soon as it is full with keeping in mind some of the criteria, primarily based on level of garbage filling. The garbage system works in very simple way, once the bin is full to certain level the alert is sent the respective municipal authority sever and the cleaning is taken care of. The proposed system is taken care with the help of RFID tags, these tags help in verifying the signals that are to be sent to the system. The IoT system is segregated with the other components and the process is completed.

Twinkle Sinha et al. [5], the paper discusses relating to the design of model for a 'Smart Dustbin' that indicates directly that the waste bin is crammed to a particular level by the rubbish and cleansing or evacuation them may be a matter of immediate concern. This prevents lumping of garbage within the edge waste bin that finally ends up giving foul smell and health problem to folks. The design of the sensible waste bin includes one directional cylinder associated an arduino UNO. Here the garbage system uses the alerting way to notify the municipal through some method of alerting system. There is a level sensor which indicates the level of the garbage, it sends notification when a defined level is reached. The signals are received as in a format of glowing diodes.

## 3. SYSTEM DESIGN

System design is the process of describing the data, architecture and modules for a system to fulfill the specified requirements.

### 3.1 Architecture Diagram

Architectural diagrams are used to illustrate the relationship between different components of a system. It is very important to understand the complete concept of the system. The figure 1 shows the architectural diagram of our proposed system. The proposed system consists of IR sensors which will identify the level of the garbage bin. When the garbage bin is full it sends the level details to the arduino microcontroller, which sends alert to the admin. The streetlights are monitored for their states and their status is sent to the admin. ESP module is used for communication with the web server.

## 4. IMPLEMENTATION

Implementation is the process of carrying out an execution, application of a plan in particular manner. The process of implementation is done to see how information will be processed, installed, deployed into a working operational unit.

### 4.1 C#

C# is a programming language that encompasses functional, imperative, generic, object-oriented (class-based), and component-oriented programming disciplines. C# is intended to be a simple, modern, general-purpose, object-oriented programming language. We have used c# to design a software.

### 4.2 Microsoft Visual Studio 2010

Microsoft visual studio is an integrated development environment from Microsoft. It is used to develop console and

graphical user interface applications along with websites and web pages. Visual Studio supports different programming languages by means of language services. Visual studio is used for front end to design our software.

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#### 4.4 MySQL

MySQL is an open source Relational Database Management System (RDBMS) that runs as a server providing multi-user access to a number of databases. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL is a popular choice of database for use in web applications, and is a central development of the widely used LAMP open source web application software stack. MySQL is used for back end to design our software.

#### 4.5 Ultrasonic Sensor

In this project we have made use of Ultrasonic sensor. Ultrasonic sensor mainly works by using ultrasonic signal, it sends the signal to check the distance between the objects. Sound wave is sent at particular frequency to measure the distance there is some frequency at which sound bounces back. When the object is detected it sends those values to the processing unit.

#### 4.6 Arduino Uno

Arduino is an open source software and hardware company that manufactures single board micro controllers. Arduino boards have an Atmel 8-bit AVR microcontroller. Arduino Uno is one of the most common ones these days, they have six pins for pulse-width modulated signals and another six analog inputs, which can also be used as six digital I/O pins and 14 digital pins. Which is the main unit in our project that combines the two circuits.

#### 4.7 IR Sensor

IR Sensors work by selecting light wavelength in the InfraRed (IR) spectrum by using a specific light sensor. One can look at the intensity of the received light by comparing the intensity of received light.

#### 4.8 LCD

LCD is used to display the percentage of dustbin fill in our project.

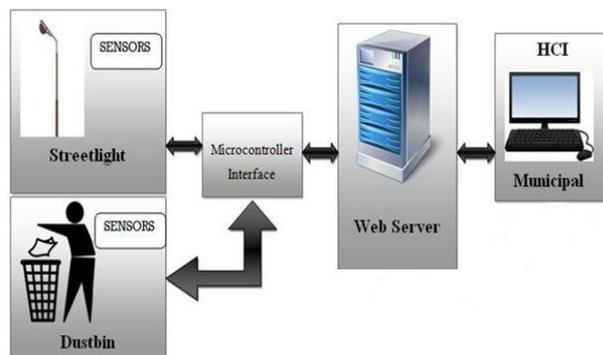


Figure 1: Architecture diagram of proposed system.

#### 4.9 ESP 8266

It connects microcontroller i.e. Arduino Uno to Wi-Fi network and creates a simple TCP/IP connection. The two pins of the ESP module were used to create the communication, i.e. Rx and Tx. One is used for transmitting and the other one is used for receiving purposes.

### 5. RESULTS AND ANALYSIS

The hardware prototype of our project "IoT based Energy and Waste Management for Smart Cities" has been developed using Arduino as the microcontroller, IR as level sensor. There is a screen to monitor the garbage level. When the level is 25%, 50%, or 75% the level message is shown to the admin. Streetlights are turned ON during the night time and switched OFF during the day, the status of the streetlight is displayed to the admin.

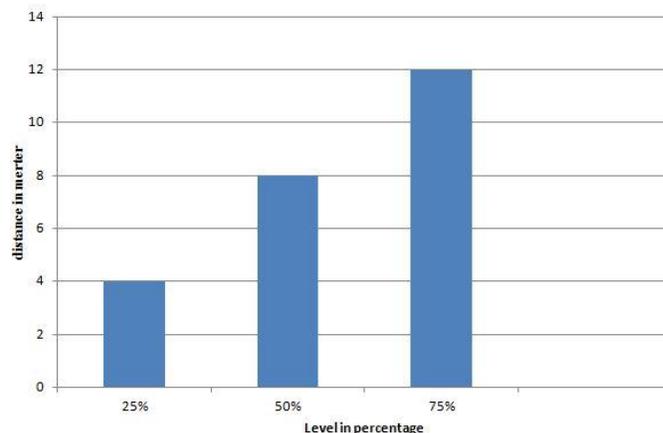


Figure 2. Graph indicating the status of dustbin

### 6. CONCLUSION AND FUTURE WORK

IoT based energy and waste management aims at keeping the environment clean by continuously monitoring the dustbin. Here the level of waste filled in the bin can be detected by the

admin thus helping in cleaning the bin immediately once it is filled and also helps in monitoring the streetlight hence preventing the accidents caused at the night and any other filthy acts. Hence this project would be of great benefit to the society.

The proposed system is built in such a way that there is room for further enhancement. New additional features can be added without any hassle. In future this system can be designed as mobile/IOS application so that the user can publish the online publication without cost per click.

## REFERENCES

- [1] Nabil Ouerhani, Nuria Pazos, Marco Aeberli, Michael Muller, "IoT Based Dynamic Street Light Control for Smart Cities", IEEE University of Applied Sciences, Switzerland, 2016.
- [2] Rohaida Husin, Syed Abdul Mutalib Al Junid, Zulkifli Abd Majid, "Automatic Street Lighting System for Energy Efficiency Based on Low Cost Microcontroller", International Journal of Simulation Systems, Science and Technology, Vol.13, 2012.
- [3] Deepak Kapgate, "Wireless Streetlight Control System", International Journal of Computer Applications, Vol.41, 2012.
- [4] Dr.N.Sathish kumar, B.Vijayalakshmi, R.Jeniferprarthana, A.Shankar, "IoT Based Smart Garbage Alert System Using Arduino UNO", 2016.
- [5] Twinkle Sinha, K.Mugesh Kumar, P.Saisharan, "Smart Dustbin", International Journal of Industrial Electronics and Electrical Engineering, Vol.3, 2015.