

## Smart Waste Management System over IoT

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### ABSTRACT

*A smart dust bin system has been developed that is able to detect the quantity of dust in both dry and wet dust bins. In the development of this application, we have considered the two sections; one is application side (dust bins) and the corporation management side (Monitoring section). Here at the dust bins area, the raspberry pi board is connected with the sensors and other devices circuitry. This system consists of ultrasonic sensors each for dry bin and the wet bin, the USB Camera, and the GSM Module interfaced all with the raspberry pi 3 board which has inbuilt wifi adapter. When the dust is filled, the ultrasonic sensor detects the percentage amount or the distance remained in the dust bin. Then the camera starts live streaming and sends the data to the department via SMS and to the internet link. With the help of this link, the department can check by seeing the live streaming of particular dust bins.*

### INTRODUCTION

Internet of things, IoT, as an important part of the new generation of information technology, have developed rapidly both in theory and practice since proposed, and gradually derived many applications such as smart home, intelligent environmental Monitoring. From the Xerox first launch of the Network Coke Vending Machine in 1990, to the ubiquitous RFID tags to achieve the extensive interconnection between things, Internet of Things not only liberated a lot of manpower, but also achieved a standardized, automated management.

In recent years, the continuous expansion of colleges and universities and the social rising demands of graduates' practical abilities, not only results in a sharp increase in the amount of experimental teaching work at the, but also put forward a huge challenge to the laboratory construction and management. Especially computer labs have higher environmental requirements: equipment composition is complex, the use of time is very long, the user has uncertainty and mobility. The current backward management approach which needs special staff to control access, air conditioning and other facilities, is a great waste of manpower. Indoor environmental monitoring and control system, a new application of IoT proposed in recent years, can be a good solution to it, but it is limited due to the high cost, the reliability of model and the difficulty in Integration with existing facilities. And the indoor environment monitoring and control system specifically for the university room is rare.

### EXISTING METHOD

One of the challenges to innovate and create an IoT-enabled solution is in monitoring and management of the environment. Effective management of solid wastes is one of the prerequisites for Malaysia to achieve a developed country status. It is generally recognized that there is a strong relationship between the effective management of solid wastes and a good quality of life

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and a healthy environment. The attractiveness of the country to foreign visitors and investments is very much influenced by a clean and healthy environment. By 2030, almost two-thirds of the world's population will be living in cities. This requires the development of sustainable solutions for urban living. These trends support the development of Smart City concepts, which are intended to improve living in urban areas by using innovative technologies. The “Internet of Things” provides new opportunities for making cities smarter.

## PROPOSED METHOD

We propose a smart waste collection system on the basis of level of wastes present in the waste bins. The data obtained through sensors is transmitted over the Internet to a server for storage and processing mechanisms. It is used for monitoring the daily selection of waste bins, based on which the routes to pick several of the waste bins from different locations are decided. Every day, the workers receive the updated optimized routes in their navigational devices. The significant feature of this system is that it is designed to update from the previous experience and decide not only on the daily waste level status but also the predict future state with respect to factors like traffic congestion in an area where the waste bins are placed, cost-efficiency balance, and other factors that is difficult for humans to observe and analyze. Based on this historical data, the rate at which waste bins gets filled is easily analyzed. As a result, it can be predicted before the overflow of wastes occurs in the waste bins that are placed in a specific location.

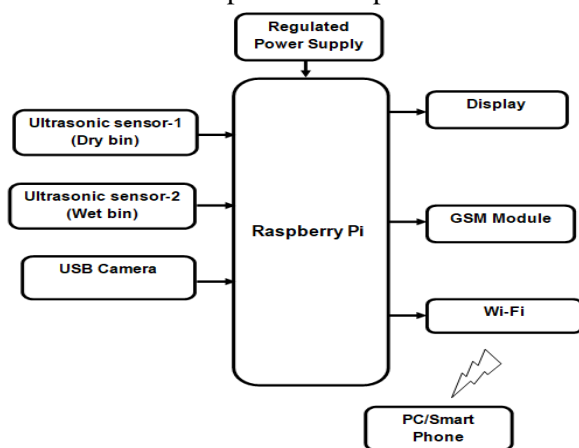


Fig.1: Proposed block diagram

## HARDWARE IMPLEMENTATION RASPBERRY PI BOARD



Fig.2: Raspberry pi 3 board

### BCM2837 features:

A Raspberry Pi 3 board contains BCM2837 controller which supports ARM11 processing unit. This is the Broadcom chip used in the Raspberry Pi 3, and in later models of the Raspberry Pi 2. The underlying architecture of the BCM2837 is identical to the BCM2836. The only significant difference is the replacement of the ARMv7 quad core cluster with a quad-core ARM Cortex A53 (ARMv8) cluster.

- Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
- 1GB RAM
- BCM43143 WiFi and Bluetooth Low Energy (BLE) on board
- 40-pin Extended GPIO
- 4x USB 2 ports
- 4 Pole stereo output and composite video port
- Full size HDMI
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- Micro SD port for loading your operating system and storing data

### Ultra sonic 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. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

### **GSM Modem:**

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

### **USB Web Camera:**

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and emailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

## **SOFTWARE IMPLEMENTATION**

### **LINUX:**

Linux or GNU/Linux is a free and open source softwareoperating system for computers. The operating system is a collection of the basic instructions that tell the electronic parts of the computer what to do and how to work. Free and open source software (FOSS) means that everyone has the freedom to use it, see how it works, and changes it.

There is a lot of software for Linux, and since Linux is free softwareit means that none of the software will put any license restrictions on users. This is one of the reasons why many people like to use Linux.

### **User interface:**

The user interface, also known as the shell, is either a command-line interface (CLI), a graphical user interface (GUI), or through controls attached to the associated hardware, which is common for embedded systems. For desktop systems, the default mode is usually a graphical user interface, although the CLI is available through terminal emulator windows or on a separate virtual console. Most low-level Linux components, including the GNU userland, use the CLI exclusively. The CLI is particularly suited for automation of repetitive or delayed tasks, and provides very simple inter-process communication.

### **Raspbian OS:**

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.

### **QT EMBEDDED FRAME WORK:**

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) (in which cases Qt is classified as a *widget toolkit*), and also used for developing non-GUI programs such as command-line tools and consoles for servers.

Qt uses standard C++ but makes extensive use of a special code generator (called the *Meta Object Compiler*, or *moc*) together with several macros to enrich the language. Qt can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. It has extensive internationalization support. Non-GUI features include SQL database access, XML parsing; thread management, network support, and a unified cross-platform application programming interface (API) for file handling.



## GCC COMPILER:

The original GNU C Compiler (GCC) is developed by Richard Stallman, the founder of the GNU Project. Richard Stallman founded the GNU project in 1984 to create a complete Unix-like operating system as free software, to promote freedom and cooperation among computer users and programmers. GCC, formerly for "GNU C Compiler", has grown over times to support many languages such as C++, Objective-C, Java, Fortran and Ada. It is now referred to as "GNU Compiler Collection".

## ADVANTAGES

1. It saves time and money by using smart waste collection bins and systems equipped with fill level sensors. As smart transport vehicles go only to the filled containers or bins. It reduces infrastructure, operating and maintenance costs by upto 30%.
2. It decreases traffic flow and consecutively noise due to less air pollution as result of less waste collection vehicles on the roads. This has become possible due to two way communication between smart dustbins and service operators.
3. It keeps our surroundings clean and green and free from bad odour of wastes, emphasizes on healthy environment and keep cities more beautiful.
4. It further reduces manpower requirements to handle the garbage collection process.
5. Applying smart waste management process to the city optimizes management, resources and costs which makes it a "smart city".
6. It helps administration to generate extra revenue by advertisementsmart devices.

## APPLICATIONS

1. This project can also be used in the "SMART CITY".
2. This project is also helpful in the government project of "SWACHH BHARAT ABHIYAN".
3. With the help of this reduction of diseases can be achieved.
4. A cleaner and greener city can be achieved.
5. It is helpful in detection of any suspicious things in the bin like bomb through the live streaming option.

6. Crime rates can be reduced like child dumping.
7. Human illness as well as other living species illness is avoided by this project.

## RESULTS

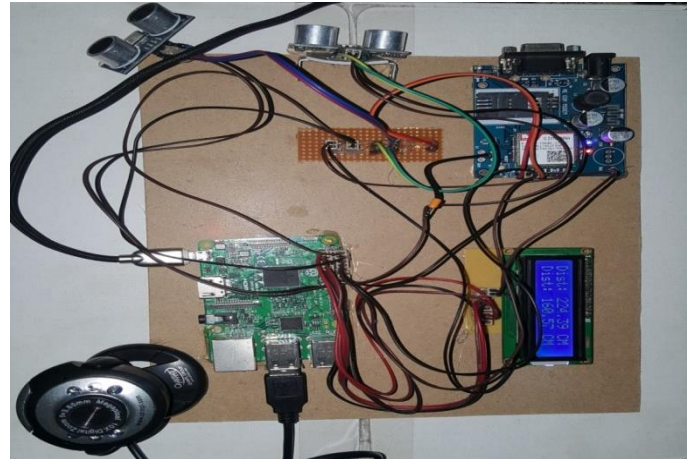


Fig.3: Typical hardware experimental system

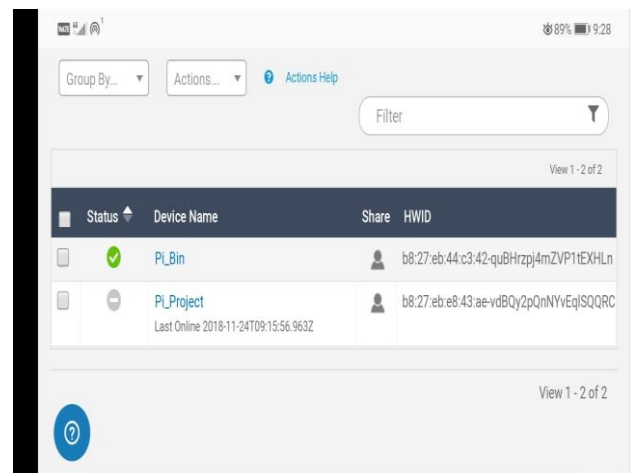
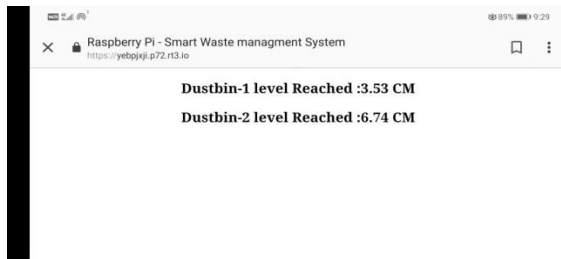


Fig.4: Server database for waste management



Fig.5: Streaming the data at garbage bins through remote server



**Fig.6: Garbage level monitoring through web page**

## CONCLUSION

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of “Smart waste management system”, mainly concentrates on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment. The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn’t have enough time for managing waste. The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be distributed among the residents leading to cheaper service provision.

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