SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

A PROJECT REPORT

Submitted by

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In partial fulfillment for the award of the degree

Of

BACHELOR OF ENGINEERING

In

ELECTRONICS AND COMMUNICATION ENGINEERING

PSN ENGINEERING COLLEGE, TIRUNELVELI

ANNA UNIVERSITY : : CHENNAI 600 025

NOVEMBER 2022

ANNA UNIVERSITY : : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this report tittled "**SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES"**is the bonafide work of **" K.PARVATHI @ VIJI (952319106025) ,S.ANITHA (952319106001), K.PRIYA (952319106026), P.SNEKA (952319106033), A.ARUNADEVI (952319106004)** who carried out the project work under my supervision.

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EVALUATOR

ABSTRACT

This project proposes a novel system and intelligent sensing algorithm for real time solid waste garbage monitoring system that would contribute to the solid waste collection optimization. The monitoring application is based on decision algorithms for sensing solid waste data in a wireless sensor network. The system is built on a three level architecture like smart garbage, gateway and control station. The elementary concept is that, smart garbage's collect their status when any changes occur and transmit the status data to a server via an intermediate coordinator. A set of applications in server presents the updated garbage status on real time. Thus the proposed system has achieved its goal to provide real time garbage status information to the solid waste management operator. Later, these information can be used for collection route optimization to reduce collection costs and carbon emissions which in turn contribute to build green society.

TABLE OF CONTENTS

INTRODUCTION

Waste management

Waste management or Waste disposal is all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc.

The term normally relates to all kinds of waste, whether generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, or other human activities, including municipal (residential, institutional, commercial), agricultural, and social (health care, household hazardous waste, sewage sludge). Waste management is intended to reduce adverse effects of waste on health, the environment or aesthetics. Waste management practices are not uniform among countries (developed and developing nations); regions (urban and rural area), and sectors (residential and industrial).

Central principles of waste management

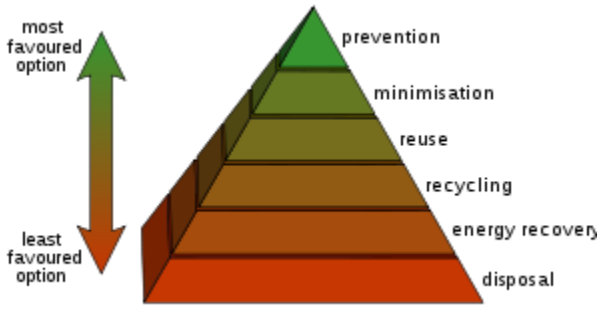

Diagram of the waste hierarchy

There are many concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:

Waste hierarchy

The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste; see: resource recovery. The waste hierarchy is represented as a pyramid because the basic premise is for policy to take action first and prevent the generation of waste. The next step or preferred action is to reduce the generation of waste i.e. by re-use. The next is recycling which would include composting. Following this step is material recovery and waste-to-energy. Energy can be recovered from processes that is landfill and combustion, at this level of the hierarchy. The final action is disposal, in landfills or through incineration without energy recovery. This last step is the final resort for waste which has not been prevented, diverted or recovered. The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management. The hierarchy represents the latter parts of the life-cycle for each product.

Life-cycle of a product

The life-cycle begins with design, then proceeds through manufacture, distribution, use and then follows through the waste hierarchy's stages of reduce, reuse and recycle. Each of the above stages of the life-cycle offers opportunities for policy intervention, to rethink the need for the product, to redesign to minimize waste potential, to extend its use. The key behind the life-cycle of a product is to optimize the use of the world's limited resources by avoiding the unnecessary generation of waste.

Resource efficiency

Resource efficiency reflects the understanding that current, global, economic growth and development cannot be sustained with the current production and consumption patterns. , we are extracting more resources to produce goods than the planet can replenish. Resource efficiency is the reduction of the environmental impact from the production and consumption of these goods, from final raw material extraction to last use and disposal. This process of resource efficiency can address sustainability.

Polluter pays principle

The Polluter pays principle is a principle where the polluting party pays for the impact caused to the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the unrecoverable material.

In this project we are using ‘solid waste dustbin management system using IOT’ is proposed in this paper. In the proposed system, the level of garbage in the dustbins is detected with the help of Sensor systems and communicated to the authorized control room through IOT. In Microcontroller is used to interface the sensor system with IOT platform. To monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently.

PURPOSE

OBJECTIVES

Smart waste management is a idea where we can control lots of problems which disturbs the society in pollution and diseases. The waste management has to be done instantly else it leads to irregular management which will have adverse

effect on nature. The Smart waste management is compatible with concept of smart cities.

The main objectives of our proposed system are as follows:

1. Monitoring the waste management.
2. Providing a smart technology for waste system.
3. Avoiding human intervention.
4. Reducing human time and effort
5. Resulting in healthy and waste ridden environment.

LITERATURE SURVEY

Prof. R.M.Sahu, Akshay Godase, Pramod Shinde, Reshma Shinde, "Garbage and Street Light Monitoring System Using Internet of Things" international journal of innovative research in electrical, electronics, instrumentation and control engineering, ISSN (Online) 2321 – 2004, Vol. 4, Issue 4, April 2016.

Hence our problem statement is to design a system based on any microcontroller for collecting the garbage from particular area whose public garbage bins are overflowing with prior concern. It is using a concept of Internet of Things in this project. So, continuous monitoring of garbage bins will helps to keep environment clean and safe. This paper also includes Street light monitoring which avoids accidents during night. Hence this paper will help to reduce power consumption and work force.

Kanchan Mahajan, Prof.J.S.Chitode, "Waste Bin Monitoring System Using Integrated Technologies", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 7, July 2014.

Zigbee and Global System for Mobile Communication (GSM) are the latest trends and are one of the best combination to be used in the project. Hence, a combination of both of these technologies is used in the project. To give a brief description of the project, the sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM seven Controller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention.

Md. Shafiqul Islam, M.A. Hannan, Maher Arebey , Hasan Basri , "An Overview For Solid Waste Bin Monitoring System", Journal of Applied Sciences Research, ISSN 181-544X, vol.5,lssue4, February 2012.

In this paper we have introduced an integrated system combined of Radio Frequency Identification (RFID), Global Position System (GPS), General Packet Radio Service (GPRS), Geographic Information System (GIS) and Web camera. The built-in RFID reader in trucks would automatically retrieve all sorts of customer information and bin information from RFID tag, mounted with each bin. GPS would give the location information of the collection truck. All The information of the center server would up-dated automatically through GPRS communication system. GIS map server is being used for truck monitoring. In this system, bin and truck database has been developed in the way that information of bin and truck ID, date and time of waste collection, bin and truck GPS coordinates information, bin status and amount of waste are compiled in a data packet and stored for monitoring and management activities.

Twinkle sinha, k.mugesh Kumar, p.saisharan, "SMART DUSTBIN", International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-3, Issue-5, May2015

This paper is a way to achieve this good cause. In this paper, smart bin is built on a microcontroller based platform Arduino Uno board which is interfaced with GSM modem and Ultrasonic sensor. Ultrasonic sensor is placed at the top of the dustbin which will measure the stature of the dustbin. The threshold stature is set as 10cm. Arduino will be programmed in such a way that when the dustbin is being filled, the remaining height from the threshold height will be displayed. Once the garbage reaches the threshold level ultrasonic sensor will trigger the GSM modem which will continuously alert the required authority until the garbage in the dustbin is squashed. Once the dustbin is squashed, people can reuse the dustbin. At regular intervals dustbin will be squashed. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on roadside.

Richu Sam Alex, R Narciss Starbell, "Energy Efficient Intelligent Street Lighting System Using ZIGBEE and Sensors", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-4, April 2014.

Solar Photovoltaic panel based street lighting systems are becoming more common these days. But the limitation with these ordinary street light systems is that it lacks intelligent performance. It is very essential to automate the system so that we can conserve energy as well as to maximize the efficiency of the system. In this paper a new method is suggested so as to maximize the efficiency of the street lighting system and to conserve the energy usage by the system with the help of ZIGBEE and sensors. It uses a sensor combination to control and guarantee the desired system parameters. The information is transferred point by point using ZIGBEE transmitters and receivers and is sent to the control terminal used to check the state of the street lamps and hence we can take immediate actions if required.

Existing Problem

In existing project is an automatic garbage level detecting system informing the concerned authorities timely and also classification among the wastes aiding efficient waste management.Whenever the garbage is full information can be send to the concerned authority to clean the bin. Here we use a low maintenance recent communication development like GSM. GSM is used in the project as a communication back bone for the whole system for various reasons likes easy to implement and less signal deterioration. Hence these networks can work even with meagre power. Suppose this project is being implemented in a city and the different garbage bins placed at different locations within a city send messages indicating the garbage levels in the respective bins to a local corporation office and simultaneously time to the head office as well. This adds to the social relevance of the project as it can also act as an automatic double check on the efficient functioning of the local authorities by the head office. In the existing project for security purposes, the keypad and the LCD may be interfaced only during the initial setup and then they may be removed. This thus allows only authorized users to alter the installed system.

PROPOSED SYSTEM

'Garbage management system using IOT' is proposed in this paper. In the proposed system, the level of garbage in the dustbins is detected with the help of Sensor systems and communicated to the authorized control room through IOT.

In Microcontroller is used to interface the sensor system with IOT platform. To monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently.

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2. .Sahu, Akshay Godase, Pramod Shinde, Reshma Shinde, “Garbage and Street Light Monitoring System Using Internet of Things” INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING, ISSN (Online) 2321 – 2004, Vol. 4, Issue 4, April 2016.

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4. Md. Shafiqul Islam, M.A. Hannan, Maher Arebey , Hasan Basri , “An Overview For Solid Waste Bin Monitoring System”, Journal of Applied Sciences Research, ISSN 181-544X, vol.5,lssue4, February 2012.

5. Twinkle sinha, k.mugesh Kumar, p.saisharan, “SMART DUSTBIN”, International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-3, Issue-5, May2015

6. Richu Sam Alex, R Narciss Starbell, “Energy Efficient Intelligent Street Lighting System Using ZIGBEE and Sensors”, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-4, April 2014.

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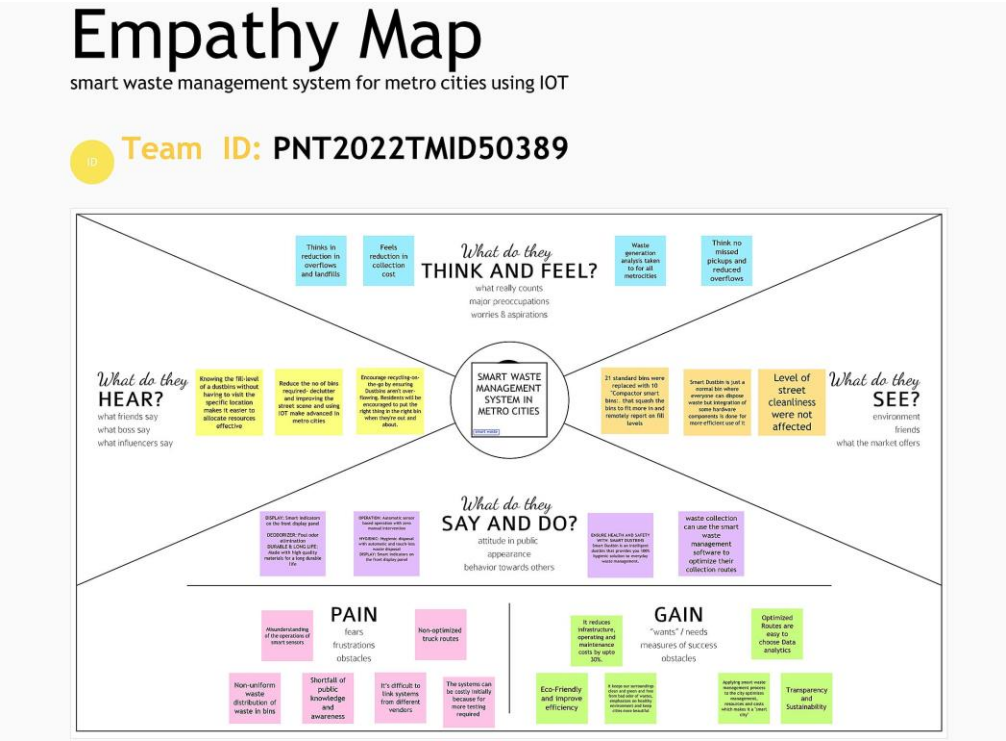
8. Emily Gertz, Patrick Di Justo,”Environmental Monitoring with Arduino”Copyright © 2012 Emily Gertz and Patrick Di Justo. All rights reserved. Printed in the United

Problem Statement Definition

Garbage Management and Collection in Cities, Town and Villages is a major concern and emerging problem in Smart City paradigm. Also lack of proper resource distribution in the process of Garbage collection is great risk to sanitation, cleanliness and health.

IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



IDEATION

PRODUCT FEATURES

With the web application, the administrator will be able to search for dustbins. The result will be based on the criteria the user inputs. There are several search criteria, and it will be possible for the administrator of the system to manage the options for those criteria that have that.

The result of the search will be viewed either in a list view or in a map view, depending on what criteria are included in the search. The list view will have one list item for each dustbin matching the search criteria and show a small part of the dustbin information, so the user can identify the dustbin. The administrator will be able to either select a dustbin as a target destination or get information on how to get there or view the information of a specific dustbin.

The web portal will provide the functionality to manage the system and the dustbin information. It will also provide information about the system, for example, showing when there is a new update.

A list of possible stakeholders of the system and a brief description of their needs, business rules, possibilities and connections with others is presented below:

1. City administration needs an understanding of the, generating reports, control over pricing etc.
2. District administrations are interested in controlling the process of waste collection, checking the quality of service (all waste collected, all in time, waste collected cleanly, waste transported to special places), quick and legal ways for solving disputes and problems.
3. Municipalities can also deploy and maintain smart city infrastructure like capacity sensors in waste bins and wireless networks for data transferring.
4. Waste trucks owning companies need a platform for organizing and optimization of their business process in general without serious investments in developing, deploying and supporting their own system. Such a system must include effective dynamic routing based on IOT data for the truck fleet. Additionally, controlling drivers and tracking the fleet is also an important issue.

5. Waste truck drivers need a navigation system for fulfilling their tasks. Another issue is reporting problems and passing them to the operators in the office instead of thinking about how to solve the problem, this can sufficiently save the time of a driver and vehicle. Drivers also need evidence that their work was done correctly and cleanly.
6. Managers of dumps and recycling factories can publish their possibilities or needs in acquiring a certain amount of waste for storing or recycling.
7. Staff that is responsible for trash bins in the current yards needs communications with waste management companies and truck drivers.

HARDWARE INTERFACE

ULTRASONIC SENSORS

Ultrasonic sensors

Ultrasonic sensors provide excellent repeatability and linearity in detecting the precise position of objects. The sensors provide high Precision performance on any material of any colour, irrespective of external light levels. They produce accurate results even when used with transparent objects such as film or glass surfaces and are completely unaffected by normal levels of soiling on the sensor surface. The sensors are also characterized by high sound intensity that makes it possible to detect even the smallest of objects with lofty reliability. This ability to maintain outstanding performance and reliability, even with the presence of suspended particles or water vapor, means that BERNSTEIN ultrasonic sensors are in daily use all over the World in a diverse range of demanding industrial applications.

Maximum functionality even under difficult operating conditions

Advantages

1. large detection range of up to 6000 mm(depending on design)
2. High linearity
3. High repeatability
4. Narrow sound beam of 8°
5. Adaptive 0-10 V voltage or 4-20 mA current output (analogue sensors)
6. Two switching outputs, can be used independently or together (switching sensors)
7. IP 67 type of protection

Measuring principle

The sensor emits a sound pulse that is reflected from the object to be detected. The sensor reads in the reflected pulse and the distance to the object is determined using a runtime measurement routine.

Applications:

Wind-on and wind-off control

Detection of the diameter of coils in the paper, plastics and textile as well as metal working industries.

Sag control

Detection of sag loop for controlling material tension or controlling quantity of material for the next production process.

Level measurement

Level measurement of liquids of bulk materials in containers and silos.

Thickness measurement

Thickness measurement of objects.

Completeness check

For checking completeness of objects in containers

Completeness check of bottles in crates

For checking the presence and height of bottles in crates.

Industries

- Machine construction
- Packing industry
- Storage systems
- Conveyor systems
- Analysis
- Handling systems
- Process technology

LCD – Liquid Crystal Display

Liquid Crystal Displays (LCDs) have materials, which combine the properties of both liquid and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric

layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer are pasted outside the two glass panels. This polarizer would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizer and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating / highlighting the desired characters.

The LCDs are lightweight with only a few millimeters thickness. Since the LCD's consume power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCD does don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size of the layout size is simple which makes the LCD's more customers friendly. The LCD's used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

LCD display use of our project title message and information message. Our project connect to a microcontroller unit data line connected to 4,5,6,7 and control lines connected to a 8&9 pin.

WI-FI MODULE (ESP8266)

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and

minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The meagre price and the fact that there were limited external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

Wi-Fi Protocols

• 802.11 b/g/n support
• 2 x Wi-Fi interface, supports infrastructure BSS Station mode / P2P mode / SoftAP mode support
• Hardware accelerators for CCMP (CBC-MAC, counter mode), TKIP (MIC, RC4), WAPI (SMS4), WEP (RC4), CRC
• 802.11n support (2.4 GHz)
• Supports MIMO 1×1 and 2×1, STBC, and 0.4 μs guard interval
• WMM
• UMA compliant and certified
• Antenna diversity and selection (software managed hardware)

• Configurable packet traffic arbitration (PTA) with dedicated slave processor based design provides flexible and exact timing Bluetooth co-existence support for a wide range of Bluetooth Chip vendor.

SPECIFICATIONS

Table 1-1. Specifications

Categories	Items	Parameters
Wi-Fi	Certification	Wi-Fi Alliance
	Protocols	802.11 b/g/n
	Frequency Range	2.4G ~ 2.5G (2400M ~ 2483.5M)
	Tx Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: –91 dbm (11 Mbps)
		802.11 g: –75 dbm (54 Mbps)
		802.11 n: –72 dbm (MCS7)
	Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware	CPU	Tensilica L106 32-bit processor
	Peripheral Interface	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/ADC/PWM/LED Light & Button
	Operating Voltage	2.5V ~ 3.6V
	Operating Current	Average value: 80 mA
	Operating Temperature Range	–40°C ~ 125°C
	Storage Temperature Range	–40°C ~ 125°C
	Package Size	QFN32-pin (5 mm x 5 mm)
	External Interface	-
Software	Wi-Fi Mode	Station/SoftAP/SoftAP+Station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Software Development	Supports Cloud Server Development / Firmware and SDK for fast on-chip programming
	Network Protocols	IPv4, TCP/UDP/HTTP/FTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

SOFTWARE DESCRIPTION

Arduino Software IDE

Arduino Software IDE

A screenshot of the Arduino IDE showing the "Blink" program, a simple beginner program

Developer(s)	Arduino Software
Stable release	1.6.7 / 17 December 2015; 49 days ago[17]
Written in	Java, C and C++
Operating system	Cross-platform

Type	Integrated development environment
License	LGPL or GPL license
Website	arduino.cc

Arduino programs may be written in any programming language with a compiler nthat produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development enviroment (IDE), which is a cross-platform application written in Java. It originated from the IDE for the Processing programming language project and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism for compiling and loading programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the C and C++ programming languages using special rules of code organization. The Arduino IDE supplies a software library called "Wiring" from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub main () into an executable cyclic executive program:

Setup (): a function that runs once at the start of a program and that can initialize settings.

Loop (): a function repeatedly called until the board powers off.

After compilation and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

Software

The software that is used to program the microcontroller, is open-source-software and can be downloaded for free on www.arduino.cc. With this “Arduino software” you can write little programs witch the microcontroller should perform. This programs are called “Sketch”.

In the end the sketches are transferred to the microcontroller by USB cable.

More on that later on the subject “programing”.

Installation

Now one after another the Arduino software and the USB driver for the board have to be installed.

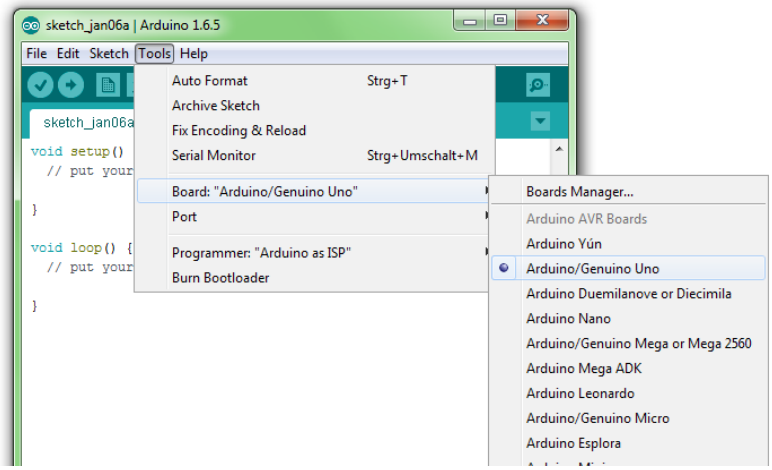
Installation and setup of the Arduino software

Download the Arduino software on www.arduino.cc and install it on the computer (The microcontroller NOT connected to the PC). After that you open the software file and start the program named arduino.exe.

Two set ups on the program are important and should be considered.

a) The board that you want to connect, has to be selected on the arduino software.

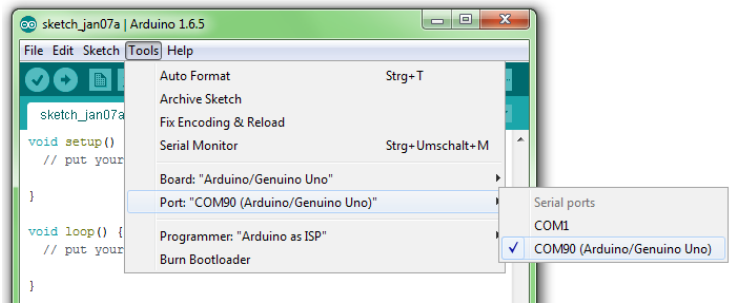
The “Funduino Uno” is here known as “Arduino / Genuino Uno”.



b) You have to choose the right “Serial-Port”, to let the Computer know to which port the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way:

At the moment the Arduino isn't connected to the PC. If you now choose “Port”, under the field “Tool”, you will already see one or more ports here (COM1/ COM2/ COM3…).

The quantity of the shown ports does not depend on the quantity of the USB ports on the computer. When the board gets connected to the computer, YOU WILL FIND ONE MORE PORT.



Installation of the USB driver

How it should be:

1. You connect the board to the computer.

2. The Computer recognizes the board and suggests to install a driver automatically.

ATTENTION: Wait a second! Most of the time the computer can't find the driver automatically to install it. You might choose the driver by your own to install it. It can be found in the Arduino file under “Drivers”.

Control: At the control panel of the Computer you can find the “Device manager”. If the board has been installed successfully, it should appear here. When the installation has failed, there is either nothing special to find or you will find an unknown USB device with a yellow exclamation mark. In this case: Click on the unknown device and choose “update USB driver”. Now you can start over the manual installation.

PHP:

PHP is a server scripting language and a powerful tool for making dynamic and interactive Web pages.

MySQl:

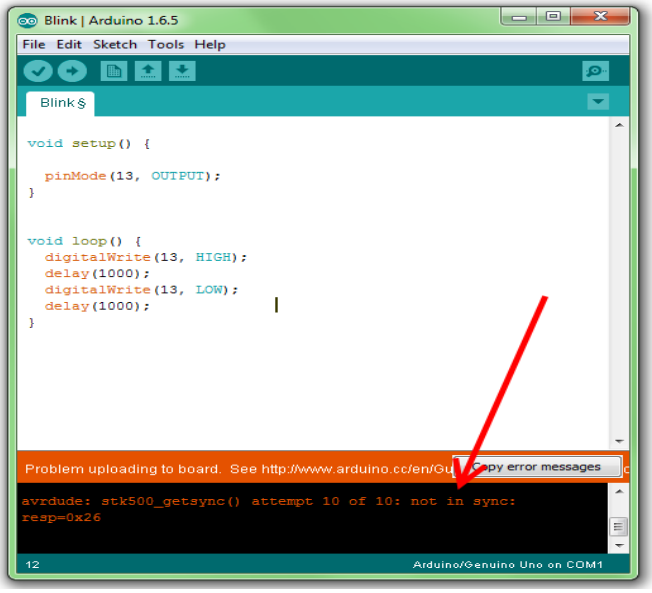
MySQL is an open-source relational database management system (RDBMS). It is swift, reliable, and easy to use.

Programming

Now we can start properly. Without to much theoretical information we start directly with programming. Learning by doing. On the left side you can find the “sketches”, on the right the accompanying explanation for the commands in grey. If you work trough the tutorials with this system, you will soon understand the code and be able to use it by yourself. Later you can familiarize yourself with other features. These tutorials are only meant as first steps to the Arduino world. All possible program features and codes are referred on www.arduino.cc under „reference“.

First of all a short explanation for possible error reports that can appear while working with the Arduino software. The two most common ones are:

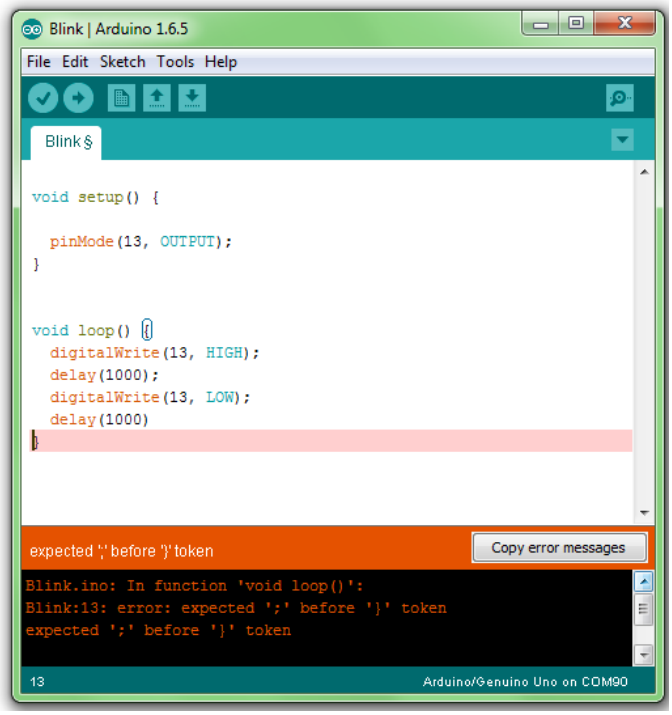
1. The board is not installed right or the wrong board is selected. After uploading the sketch, there will appear an error report underneath the sketch. It looks like the one in the picture on the right. The note “not in sync” shows up in the error report.



2.) There is a mistake in the sketch.

For example, a word is misspelled or a bracket is missing. In the example on the l

eft the last semicolon in the sketch is missing. In this Case the error report often starts with “excepted..”. This means that the program is still expecting something that is missing.



Basic structure of a sketch:

A sketch can be divided in three parts.

1. Name variable

In the first part elements of the program are named. This part is not necessary.

2. Setup (absolutely necessary for the program)

The setup will be performed only once. Here you are telling the program for example what

Pin (slot for cables) should be an input and what should be an output on the boards.

Defined as Output: The pin should put out a voltage. For example: With this pin a LED is meant to light up.

Defined as an Input: The board should read out a voltage. For example: A switch is actuated. The board recognized this, because it gets a voltage on the Input pin.

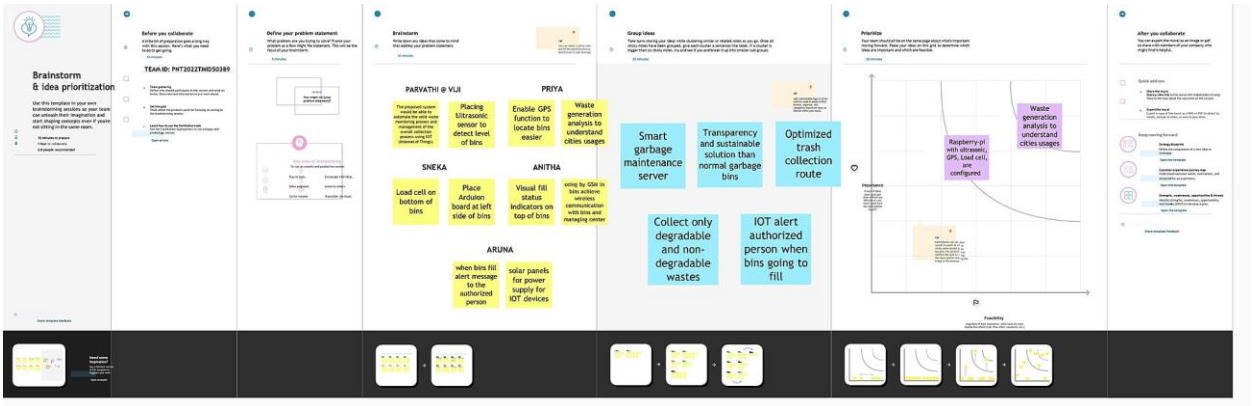
3. Loop (absolutely necessary for the program)

This loop part will be continuously repeated by the board. It assimilates the sketch from beginning to end and starts again from the beginning among other e.

Applications

1. Building and Home automation
2. Manufacturing
3. Medical and Healthcare systems
4. Media
5. Environmental monitoring
6. Infrastructure management
7. Energy management
8. Transportation

BRAINSTORMING



Proposed Solution

STEP 1

Problem Solving Cards

-Basic question

*Problem Statement

One _ Whats most valuable to the customer?

STEP 3

Ideas

Problem Solution

1. What are we the best at?
2. Where are we looking to improve

STEP 2

Framing Statements

STEP 3

Previously there were numerous initiatives on waste management and educating people to dispose waste properly, and as they failed to achieve significant results, we have figured out the scopes that could be develop. To solve this problem, we have designed a process that ensures proper disposal and efficient waste collection. The procedures we designed involves creative initiative that will inspire people to dump in designated area or bins, and innovative method by using Decreasing Time algorithm or DTA for monitoring garbage generation and collection of the garbage's.

Proposed Solution Fit

S.No.	Parameter	Description
● 1 .	Problem Statement (Problem to be solved)	*Indiscriminate disposal of solid waste is a major issue in urban cen-ters of most developing countries and it poses a serious threat to the healthy living of the citizens. *The rate at which solid wastes are produced in most developing countries is becoming alarming.
2.	Idea / Solution description	*The smart, sensor based dustbin will judge the level of waste in it and send the message directly to the municipal corporation.

		*It can sense all types of waste material either in the form of solid or liquid. *According to the filled level of the dustbin, the vehicles from the municipal corporation will choose the shortest path with the help of the "TRANSPORTATION SOFTWARE ", which will save their time. *It emphasizes on "DIGITAL INDIA ".
3.	Novelty / Uniqueness	* With the help of proper technology (GPS & SOFTWARE APPLICATIONS) we can guide the trucks to choose the shortest path. *It also favours the "SMART CITY" project and "DIGITAL INDIA". *Introducing Iot makes it smartest and easiest.

4.	Social Impact / Customer Satisfaction	*Reducing waste will not only protect the environment but will also save on costs or reduce expenses for disposal. *It keeps the surroundings clean and green, free from bad odour of wastes, emphasizes on a healthy environment and keeps cities more beautiful. *Reducing manpower required to handle the garbage collection. Reducing the diseases which are spread by the waste.
5.	Business Model (Revenue Model)	*By using this method the collection of waste in the city becomes easier. It helps in reducing air pollution, traffic flow, man power, time and money. *With the help of proper technology (GPS & SOFTWARE APPLICATIONS) we can guide the trucks in selecting the shortest path for garbage collection.

6.	Scalability of the Solution	*This project is very effective in managing waste in any big city. *Rather than using conventional periodic collection methods here priority system is used to ensure the city is clean all the time without any overflowing dumpsters. *It has been tested and verified properly to ensure all the different parts work together for a smooth function of the whole system.

REQUIREMENT ANALYSIS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Real time monitoring	In this , a 24*7 monitoring system is designed for monitoring dumpsters.
FR-2	Sensor	Sensor is used for measuring the level of waste in the dumpster. it can sense all type of waste material it is in the form of solid or liquid.
FR-3	Smart bin	If bin reached maximum level the notification sends to the admin. The admin will post the location and garbage id to the truck driver. Then the truck driver reaches the destination and pickup the trash in a proper time. When used this idea it eliminates the missed pickups.
FR-4	Mobile application	Citizens easily access information about the public waste using mobile application. It is used to detect the bin level and capture image when we need. If bin reach maximum level notification sends to the receiver. if it not cleans in a proper time notification sends to higher authority.

FR-5	Server	If dustbins are relocated to another location, it will automatically register with new server with new location.
FR-6	Truck	Waste collectors can use the smart waste management software to optimized their collection routes. it is essential for picking up trash and its efficient disposal.

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system should be user friendly to make it efficient. Easy way to track and detect the solution
NFR-2	Security	1. User name and password 2. Backup facility 3. Privileges 4. Safety requirement for admins to protect the user from eye problem
NFR-3	Reliability	1. Error free operation 2. Easy to access 3. Easier way to improve cleanliness
NFR-4	Performance	The system should be performed as desired user. More eco-friendly reducing overflow in bins and ensuring community safety
NFR-5	Availability	The system should able to run all times. it is easier to municipal corporation for their better management of regarding collection of wastes.

PROJECT DESIGN

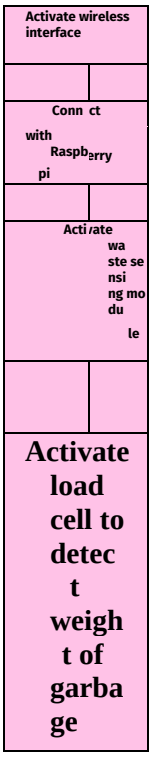
Develop The Data Flow By Using The Shapes and Connectors In The Key
Adjust And Fine Tune The Data Flow Graph
Review The Data Flow

Control Center

Ultra sonic sensor

Load Cell

STARTUP PHASE



Insert garbage waste data

Level data

Monitoring system

Cloudcell

Control Center

Run fill level alert

Admin of that location

Level Detection
>80 or <80

Raspberry Pi
GSM (track location of garbage)

Send SWB metadata to the server

Transmit garbage level data

Waste Garbage

Smart Fone(to get GPS location for dustbins which are filled)

Truck track car

Web portal to show the location of garbage id which can be accessed by waste collector

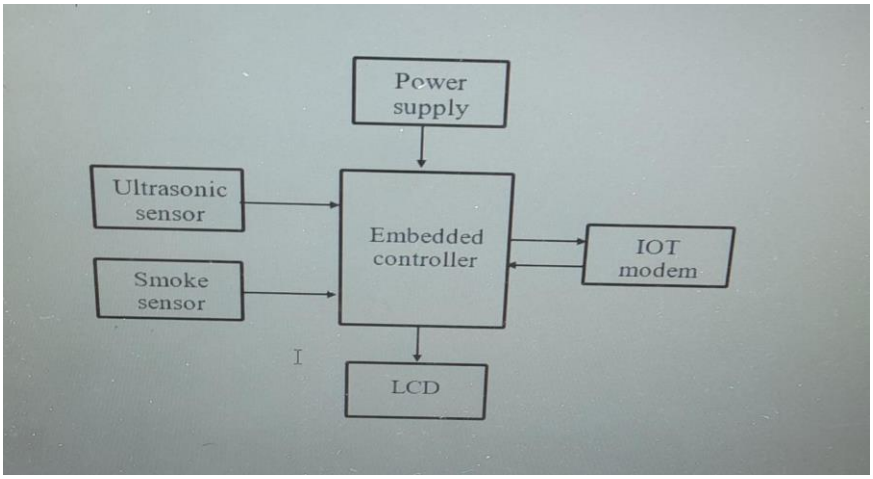
LAND FILLS

Garbage dumping site

TRUCK TRASH

RECYCLE

TECHNICAL ARCHITECTURE



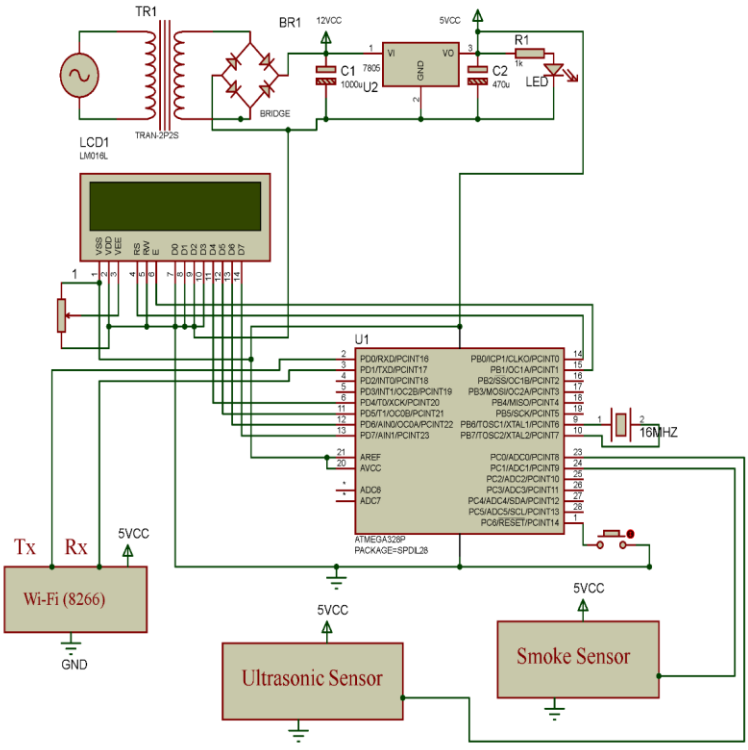
USER STORIES

TECHNICAL ARCHITECTURE DESCRIPTION

Power supply is given to all the units. A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power

supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. The circuit operation can be controlled by ATMEGA 328 and it is one of the most popular microcontrollers. The Arduino will get the level of the garbage from the ultrasonic sensor Ultrasonic sensor emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The smoke sensor we will use is the MQ-2. This is a sensor that is not only sensitive to smoke, but also to flammable gas. The MQ-2 smoke sensor reports smoke by the voltage level that it outputs. The more smoke there is, the greater the voltage that it outputs.

CIRCUIT DIAGRAM



CIRCUIT DIAGRAM DESCRIPTION

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. Capacitor used to charge AC components and discharge on ground. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted DC component. Load will be LED and resister. LED voltage is 1.75V.if voltage is above level beyond the limit, and then it will be dropped on resister. In this project we used Atmega328 controller. Reset switch is connected to pin no 1. It is used to reset the program. Ultrasonic sensor is connected to controller port A0 (pin no 23), Smoke sensor is connected to controller port A1 (pin no 24). Controller receive the sensor signal, and update the information in internet through IOT. Wi-Fi Esp8266 is connected to controller port 2 & 3. It is used for serial communication between controller and IOT.

PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers , research publications etc.	28 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem Statements	24 SEPTEMBER 2022

Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	25 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	23 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	30 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	28 SEPTEMBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions and experiences with the application (entry to exit).	20 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	8 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	9 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	10 OCTOBER 2022
Prepare Milestone and Activity	Prepare the milestones and activity list of the project.	22 OCTOBER 2022

List		
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop and submit the developed code by testing it.	IN PROGRESS..

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality	10	High	Parvathi @ Viji
Sprint-1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID	10	High	Aruna Devi
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time	20	High	Priya

Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Anitha
Sprint-4	Dashboard	USN-5	As a Municipality officer, I will ensure everything is proceeding as planned and without any problems	20	High	Sneka

Project Tracker, Velocity & Burndown Chart

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022

Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity

Imagine we have a 10 day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day).

CODING & SOLUTIONING

FEATURES 1

Sample program

A typical program for a beginning Arduino programmer blinks a light-emitting diode (LED) on and off. This program is usually loaded in the Arduino board by the manufacturer. In the Arduino environment, a user might write such a program as shown:

```
#define LED_PIN 13


void setup() {
  pinMode(LED_PIN, OUTPUT);       // Enable pin 13 for digital output
}


void loop() {
  digitalWrite(LED_PIN, HIGH);    // Turn on the LED
```

```
    delay(1000);                // Wait one second (1000 milliseconds)
    digitalWrite (LED_PIN, LOW);    // Turn off the LED
    delay(1000);                // Wait one second
}
```

FEATURES 2

```
 #include<LiquidCrystal.h> const int RS = D6, EN = D5, d4 = D1, d5 = D2, d6 = D3, d7 = D4;
LiquidCrystal lcd(RS, EN, d4, d5, d6, d7);

#include <ESP8266WiFi.h>

const char* ssid     = "wifi003"; const
char* password = "12345678";

const char* host = "iotproject19-20.000webhostapp.com";
const char* streamId   = "....................."; const
char* privateKey = ".....................";

const int trigPin = D7; const
int echoPin = D8;
//define sound velocity in cm/uS
#define SOUND_VELOCITY 0.034
#define CM_TO_INCH 0.393701
```

```
const int gs = D0;
int it=0; int lvl=0;
long duration;
float distanceCm;
float distanceInch;
const int alarm =
D8; void setup() {
Serial.begin(11520
0);   lcd.begin(16,
2);
lcd.setCursor(0,0);
lcd.print("Garbage
Level");
lcd.setCursor(0,1);
lcd.print("
Monitor ");
pinMode(trigPin,
OUTPUT); // Sets
the trigPin as an
Output
pinMode(echoPin,
INPUT); // Sets the
echoPin as an
Input
```

```
  pinMode(alarm,OUTPUT);
digitalWrite(alarm,LOW);
pinMode(gs, INPUT);
delay(10);

  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

}

int value = 0;

void loop() {
delay(1000);
  ++value;  // Clears the
trigPin   digitalWrite(trigPin,
LOW);
delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);   delayMicroseconds(10);
digitalWrite(trigPin, LOW);
```

```
  // Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);


  // Calculate the distance   distanceCm =
duration * SOUND_VELOCITY/2;


  if(distanceCm>100)
  {
    distanceCm=100;
    }
    lvl = 100-distanceCm;
  lcd.clear();
lcd.setCursor(0,0);
lcd.print("Level:");
lcd.print(lvl);



   lcd.setCursor(0,1);
lcd.print("Gas  :");   gssen();



  String url = "GET http://iotproject19-20.000webhostapp.com/dustbin/update.php?lvl="; // Getting info from my online database through my online website
```

```
  url+=lvl;
url+="&gs=";   url+=it;









  }


void gssen()
{
  if(!digitalRead(D0))
  {     it=1;
lcd.setCursor(6,1);
lcd.print("    ");
lcd.setCursor(6,1);
lcd.print("HIGH");
    }
else
    {     it=0;
lcd.setCursor(6,1);
lcd.print("    ");
lcd.setCursor(6,1);
lcd.print("LOW");
      }
}
```

TESTING

TEST CASES

A 

a 

B 

b 

RESULTS

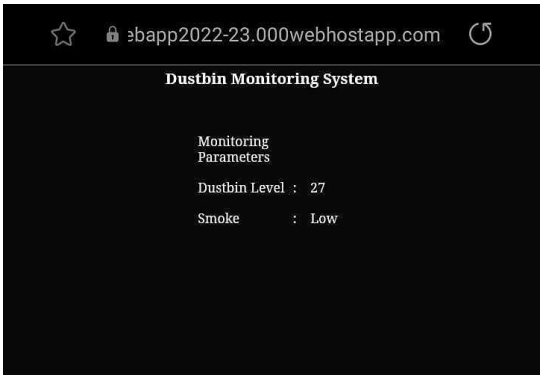
PERFORMANCE METRICES

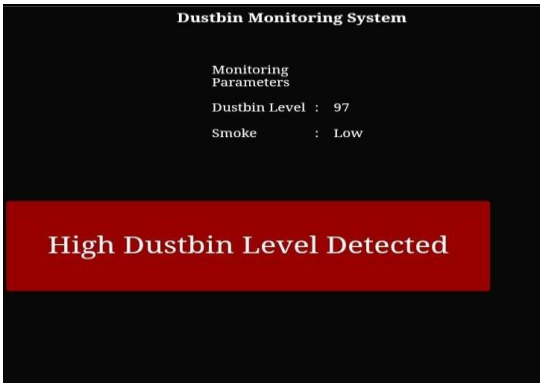
FEATURES 1

Power LED (Red) and Integrated LED on Line 13 (Green) on Arduino Compatible Board (made in China)

Most Arduino boards contain an LED and a load resistor connected between pin 13 and ground which is a convenient feature for many tests.

TESTING RESULTS

Aa) 

Bb) 

ADVANTAGES

1. The garbage will be collected on time-to-time basis.
2. There would not be any bad smell around the bin.
3. Real time notification to collect the garbage.
4. Saving on fuel consumption, thus reducing the threat to the environment.

DISADVANTAGES

1. This results into high initial cost due to expensive smart dustbins compare to other methods.
2. Sensor nodes used in the dustbins have limited memory size.
3. Wireless technologies used in the system such as Zigbee and WiFi have shorter range and lower data speed .

CONCLUSION

This project shows the implementation of smart garbage management system using wireless sensor embedded controller and IOT. 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 reduces the total number of trips of garbage collection vehicle and hence reduces 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.

FUTURE SCOPE

Every project is always has scope for improvement perhaps the most pressing issue of separation of waste is when there disposed simultaneously. The waste segregator can be improvised to include the separation of paper and plastic, safe segregation of biomedical waste generated at home, compact and aesthetic mechanical design.

APPENDIX

Source Code

```
#include<LiquidCrystal.h> const int RS = D6, EN = D5, d4 = D1, d5 = D2, d6 = D3, d7 = D4;

LiquidCrystal lcd(RS, EN, d4, d5, d6, d7);


#include <ESP8266WiFi.h>


const char* ssid     = "wifi003"; const

char* password = "12345678";


const char* host = "iotproject19-20.000webhostapp.com";
```

```
const char* streamId   = "....................."; const
char* privateKey = ".....................";

const int trigPin = D7; const
int echoPin = D8;
//define sound velocity in cm/uS
#define SOUND_VELOCITY 0.034
#define CM_TO_INCH 0.393701

const int gs = D0;
int it=0; int lvl=0;
long duration;
float distanceCm;
float distanceInch;
const int alarm =
D8; void setup() {
Serial.begin(11520
0);   lcd.begin(16,
2);
lcd.setCursor(0,0);
lcd.print("Garbage
Level");
lcd.setCursor(0,1);
lcd.print("
Monitor ");
pinMode(trigPin,
```

```
OUTPUT); // Sets
the trigPin as an
Output
pinMode(echoPin,
INPUT); // Sets the
echoPin as an
Input

  pinMode(alarm,OUTPUT);
digitalWrite(alarm,LOW);
pinMode(gs, INPUT);
delay(10);

  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

}

int value = 0;

void loop() {
delay(1000);
```

```
  ++value;  // Clears the
trigPin   digitalWrite(trigPin,
LOW);
delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);   delayMicroseconds(10);
digitalWrite(trigPin, LOW);


  // Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);


  // Calculate the distance   distanceCm =
duration * SOUND_VELOCITY/2;


  if(distanceCm>100)
  {
    distanceCm=100;
    }
    lvl = 100-distanceCm;
  lcd.clear();
lcd.setCursor(0,0);
lcd.print("Level:");
lcd.print(lvl);
```

```
 lcd.setCursor(0,1);
lcd.print("Gas  :");   gssen();




  String url = "GET http://iotproject19-20.000webhostapp.com/dustbin/update.php?lvl="; // Getting info from my online database through my online website
  url+=lvl;
url+="&gs=";   url+=it;









  }


void gssen()
{
  if(!digitalRead(D0))
  {     it=1;
lcd.setCursor(6,1);
lcd.print("    ");
lcd.setCursor(6,1);
lcd.print("HIGH");
    }
else
```

```
   {    it=0;
lcd.setCursor(6,1);
lcd.print("    ");
lcd.setCursor(6,1);
lcd.print("LOW");
     }
}
```

GitHub & Project link

GitHub link: https://github.com/IBM-EPBL/IBM-Project-51881-1660986398

Project link: https://www.youtube.com/embed/y4viWpwlTwU