DOCUMENTATION

Team ID	PNT2022TMID11010
Project Name	Smart waste management system for metropolitan cities

INTRODUCTION

Internet of Things is nothing but the applications performing with the help of internet access. IoT Communication over the internet

has grown from user - user interaction to device – device interactions these days. The IoT concepts were proposed years back but

still it's in the initial stage of commercial deployment. Home automation industry and transportation industries are seeing rapid

growth with IoT. The basic project idea is to design a smart waste detection system which would automatically notify the officials

about the current status of various garbage bins inthe city, would have realtime monitoring capabilities, which would be remotely

controlled usingIoT techniques. This paper introduces you to the use of IoT on one such area, that is, Garbage Detection in smart

ways using IoT and see how this can also be a major part of developing a city into a smart city.

Project Overview

A big challenge in the urban cities is that of waste management as there is a rapid growth in therate of urbanization and thus there is

a need of sustainable urban development plans. As the concept of smart cities is very much trending these days and the smart cities

cannot be complete without smart waste management system. There needs to be system that gives prior information of the filling

of the bin that alerts the municipality so that they can clean the bin ontime and safeguard the environment. To avoid all such

situations we intend to propose a solution for this problem "Smart Garbage Bin", which will alarm and inform the authorized person

when the garbage bin is about to fill. Then message will be send to the authorized person to collect the garbage from the particular area. The authorized person will sends the message from his web application to the garbage collectors by sending a SMS .This system maintain a dry waste and a wet waste separately. This will help to reduce the overflow of the garbage bin and thus keeping the environment clean.
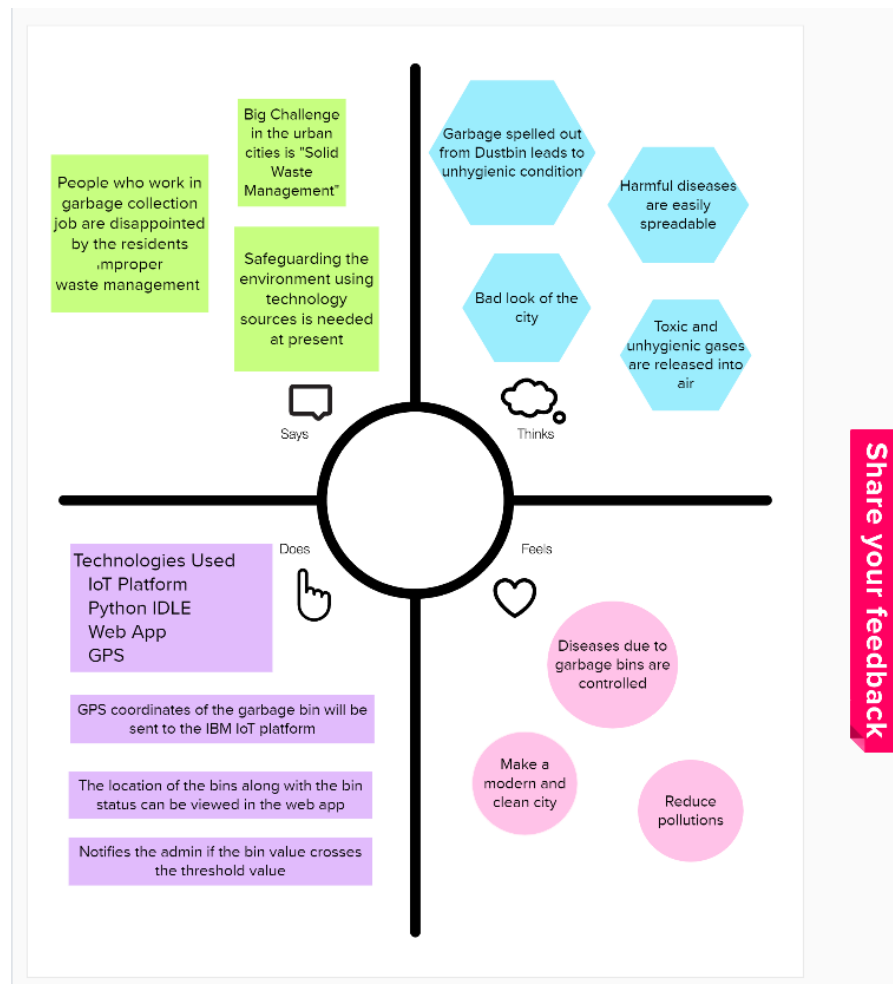
Purpose

This project helps the citizens to make their surroundings and environmentclean , pollution free and lead a healthy life throughout. It avoids the possibility garbage overflow, unhygienic environment, air-borne and water-borne disease , etc...

Problem Statement

The waste management system provided earlier are not very reliable, efficient, cost effective and does not have any advanced processing features like automatic close of bin and alert intimations system .The following is a well articulated problem statementthat allows you to find the ideal solution for the challenges faced.

EMPATHY MAP:

Says (green notes):
- People who work in garbage collection job are disappointed by the residents improper waste management
- Big Challenge in the urban cities is "Solid Waste Management"
- Safeguarding the environment using technology sources is needed at present

Thinks (blue hexagons):
- Garbage spelled out from Dustbin leads to unhygienic condition
- Harmful diseases are easily spreadable
- Bad look of the city
- Toxic and unhygienic gases are released into air

Does (purple notes):
- Technologies Used
  IoT Platform
  Python IDLE
  Web App
  GPS
- GPS coordinates of the garbage bin will be sent to the IBM IoT platform
- The location of the bins along with the bin status can be viewed in the web app
- Notifies the admin if the bin value crosses the threshold value

Feels (pink circles):
- Diseases due to garbage bins are controlled
- Make a modern and clean city
- Reduce pollutions

IDEATION PHASE:

Empathy Map

Dwell into the mind of the user for focused product development

● Build empathy and keep your focus on the user by putting yourself in their shoes

TEAM MEMBERS DETAILS

S.NO	NAME	POSITION	COLLEGE
1	JOTHIKA M	TEAM LEADER	K.RAMAKRISHNAN COLLEGE OF ENGINEERING
2	ARTHI A	TEAM MEMBER 1	K.RAMAKRISHNAN COLLEGE OF ENGINEERING
3	DHARANI M	TEAM MEMBER 2	K.RAMAKRISHNAN COLLEGE OF ENGINEERING
4	HARINI M	TEAM MEMBER 3	K.RAMAKRISHNAN COLLEGE OF ENGINEERING

Empathy Map notes

- People who work in garbage collection job are disappointed by the residents improper waste management
- Big Challenge in the urban cities is "Solid Waste Management"
- Safeguarding the environment using technology sources is needed at present
- Garbage scattered out from Dustbin leads to unhygienic condition in environment
- Harmful diseases spread easily
- Bad look of the city
- Toxic and unhygienic gases are released into air

Says / Thinks / Does / Feels

Does:
- Technologies Used: IoT Platform, Python IDLE, Web App, GPS
- GPS coordinates of the garbage bin will be sent to the IBM IoT platform
- The location of the bins along with the bin status can be viewed in the web app
- Notifies the admin if the bin value crosses the threshold value

Feels:
- Diseases due to garbage bins are controlled
- Make a modern and clean city
- Reduce pollutions

Share your feedback

BIG IDEAS

- IoT Platform
- Robotized Equipment
- Bio-degradable sensor
- Non-bio degradable Sensor
- Ultrasonic filling sensor
- GPS
- Cloudant DB to store data
- Node Red Web UI

PRIORITIZATION

IMPORTANCE (HIGH / LOW) vs FEASIBILITY (LOW / HIGH)

- GPS
- IoT Platform
- Ultrasonic filling sensor
- Non-bio degradable Sensor
- Node Red Web UI
- Robotized Equipment
- Cloudant DB to store data
- Bio-degradable sensor

NEED STATEMENT

| Metropolitan cities | needs a way to | manage waste | so that | To make clean and green city |

Metropolitan cities needs a way to manage the waste in order to make clean and hygienic city so that we can prevent various disease caused due to unhygienic waste

LITERATURE SURVEY

EXISTING PROBLEM

In the existing system garbage is collected by the corporation weekly once or twice. Sometimes the garbage stinks and overflows from the bin and spread over the roads and pollutes the environment. This also produces a heavy air pollution and routes to various air-borne diseases Many a times the street dogs and other animals eat these waste and scatter these waste aroundthe surroundings which creates the spread of various diseases and situation of unclean environment.

Disadvantages of existing system:

- Time consuming and less effective.

- Overflow of waste from the bin.

- Unhygienic Environment and look of the city.

- Stinky smell and unpleasant situations.

PHASE DESIGN 1 SOLUTION FIT:

Problem-Solution fit canvas 2.0

IOT Based Smart Waste Management System

1. CUSTOMER SEGMENT(S) — CS
Who is your customer?

According to our problem statement. waste holders such as private individuals, property owners and companies.

6. CUSTOMER CONSTRAINTS — CC
What constraints prevent your customers from taking action or limit their choices of solutions?

Our bin tracker application is on budget and it would work only with network connection and it is available on all smart devices.

5. AVAILABLE SOLUTIONS — AS
Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have?

When the notification option is not working then an emergency call or message would be passed on to the respective person.

2. JOBS-TO-BE-DONE / PROBLEMS — J&P
Which jobs-to-be-done (or problems) do you address for your customers?

The bin tracker application requires quite a number of jobs like, it should maintain the exact location of all bins and it should notify the respective person when the bin is filled.

9. PROBLEM ROOT CAUSE — RC
What is the real reason that this problem exists? What is the back story behind the need to do this job?

If there is no internet connection there would no sharing of information from one person to another and GPS would be no use in the absence of network connection due to these flaws the problem exists. The world functions with the help of networks so our bin tracker application also operates in internet connection.

7. BEHAVIOUR — BE
What does your customer do to address the problem and get the job done?

The customer could get help from the help option in the settings of the application and if they are facing any issues they can make a report in that option and the authorities would look into the problem.

3. TRIGGERS — TR
What triggers customers to act? i.e. seeing their neighbor installing

For example : By using this technology the street becomes very clean and look great. The neighbor street get inspired and apply to their street.

10. YOUR SOLUTION — SL
If you are working on an existing business write down your current solution first fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

Our Solution to waste management is to track the bin and dispose the waste at right time to make the city clean and hygiene.

8. CHANNELS of BEHAVIOUR — CH

8.1 ONLINE
What kind of actions do customers take online?

If it is in online mode, the customers can make a report in the help section present in the setting option.

8.2 OFFLINE
What kind of actions do customers take offline?

If it is in offline mode, the customers can directly send a feedback mail or message to the manufacturer

4. EMOTIONS: BEFORE / AFTER — EM
How do customers feel when they face a problem or a job and afterwards?

The customers would feel anxious at first then they would try to think of an solution to solve it themselves.

AMALTAMA

ARCHITECTURE:

Proposed Solution

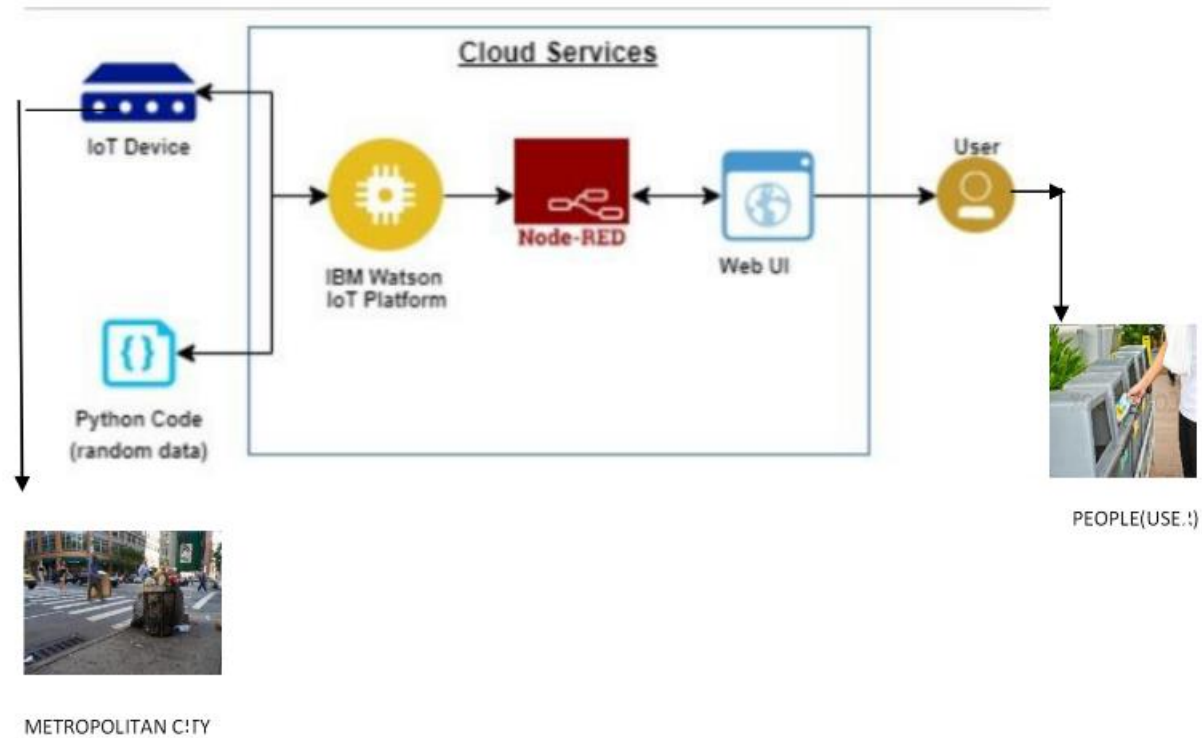|		
Traditional waste management system is inefficient and so it leads to air pollution and produce harmful diseases.	To manage the bins using GPS and Web app automatically with the help of IOT	Reduces manpower requirement to handle garbage collection process.
Each sensor has its own area of responsibility and there is no overlap between areas of various sensors.	The end product will be efficient in both financial and economical factor	Smart waste management improves the management of the city services by using in-built sensors

Cloud Services

IoT Device — IBM Watson IoT Platform — Node-RED — Web UI — User

Python Code (random data)
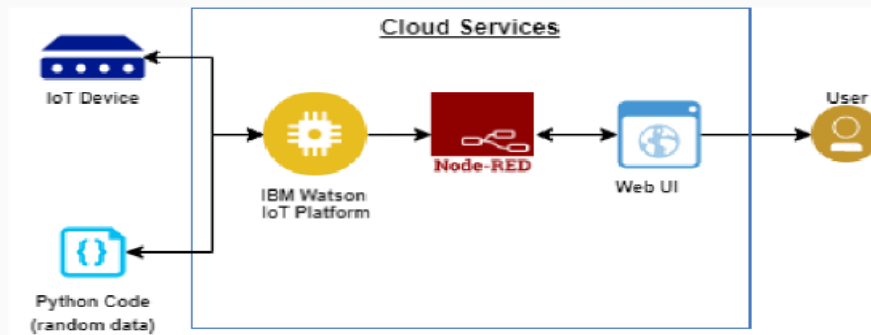
PHASE DESIGN 2:(CUSTOMER JOURNEY MAP)

PHASES	Motivation	Information gathering	Analyzes various products	chooses the most efficient product	Payment
Actions	wants to reduce the tension about the waste management	wants to choose an efficient product to get better waste management	Available other products are Normal Dustbin	Smart dustbins are more efficient compared to normal dustbin	After the product satisfication
Touch points	The buyers feel excited	After installation the government no need to worry much about the waste management	The user amuse by thevarious typesof product available.	After getting this the government won't worry about the safety	After find the product worthy, the government get's it.
Customer Feeling	☺	☒	☺	☺	☺
Customer Thoughts	Customer thinks it will helpful for better status of health condition	Customer thinks it will leads long duration	Customer thinks alter solution willbe available	The product choosing will be easy and comfortable for them	They think the productwill be userfriendly
Opportunities	The customer gets the better waste maragement	The customer known about the process of product	The customer will be aware of other product	The customer comes to know which product is best one	The customer will enjoy the journey

TECHNOLOGY ACHITECTURE:

Cloud Services

IoT Device

IBM Watson
IoT Platform

Node-RED

Web UI

User

Python Code
(random data)

PEOPLE(USE.)

METROPOLITAN CITY

Architecture and Data flow of the IOT Based Industry - specific Fire Management System

DATA FLOW DIAGRAM:
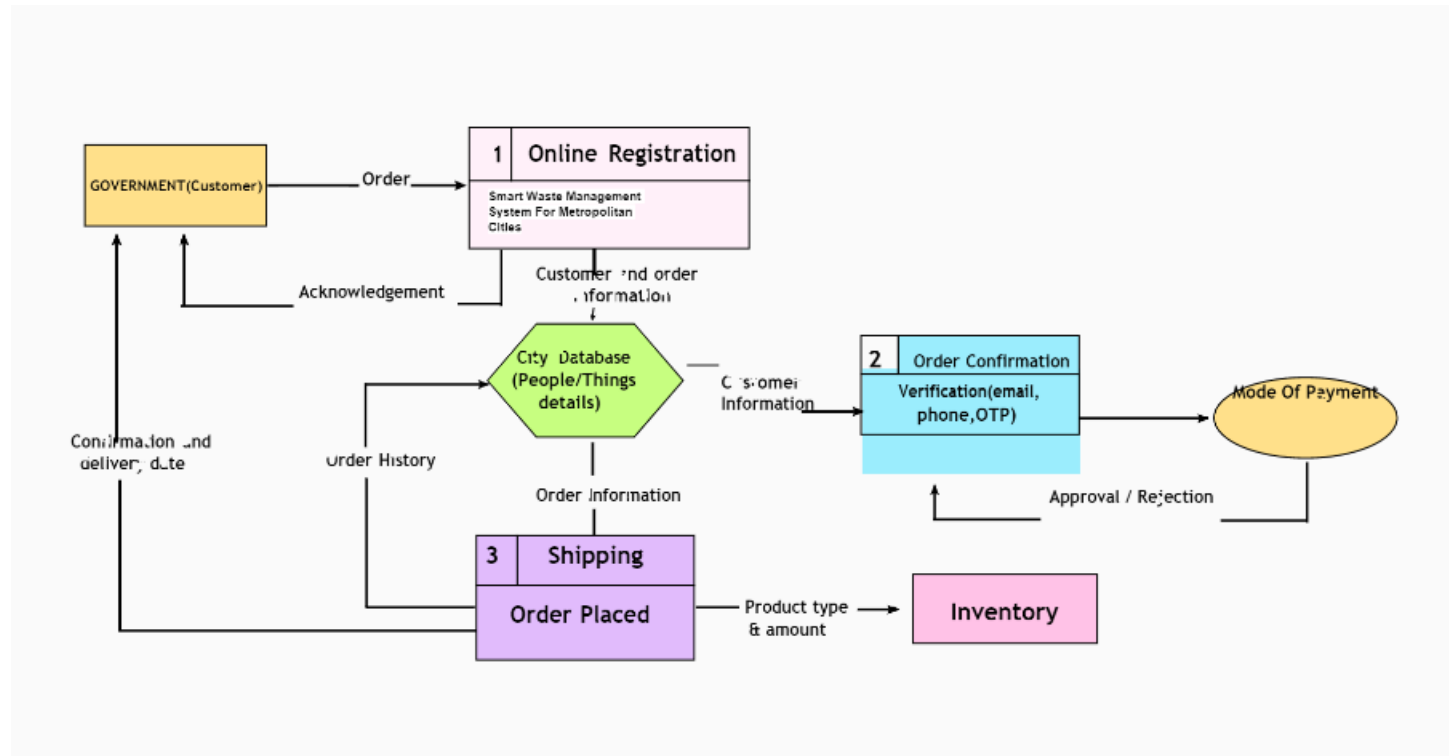
PREREQUISITES:(CLOUD ACCOUNT CREATION)

PREREQUISITES :(SOFTWARE)

File Edit Format Run Options Window Help

```python
print("hello World")
```

IDLE Shell 3.10.7

File Edit Shell Debug Options Window Help
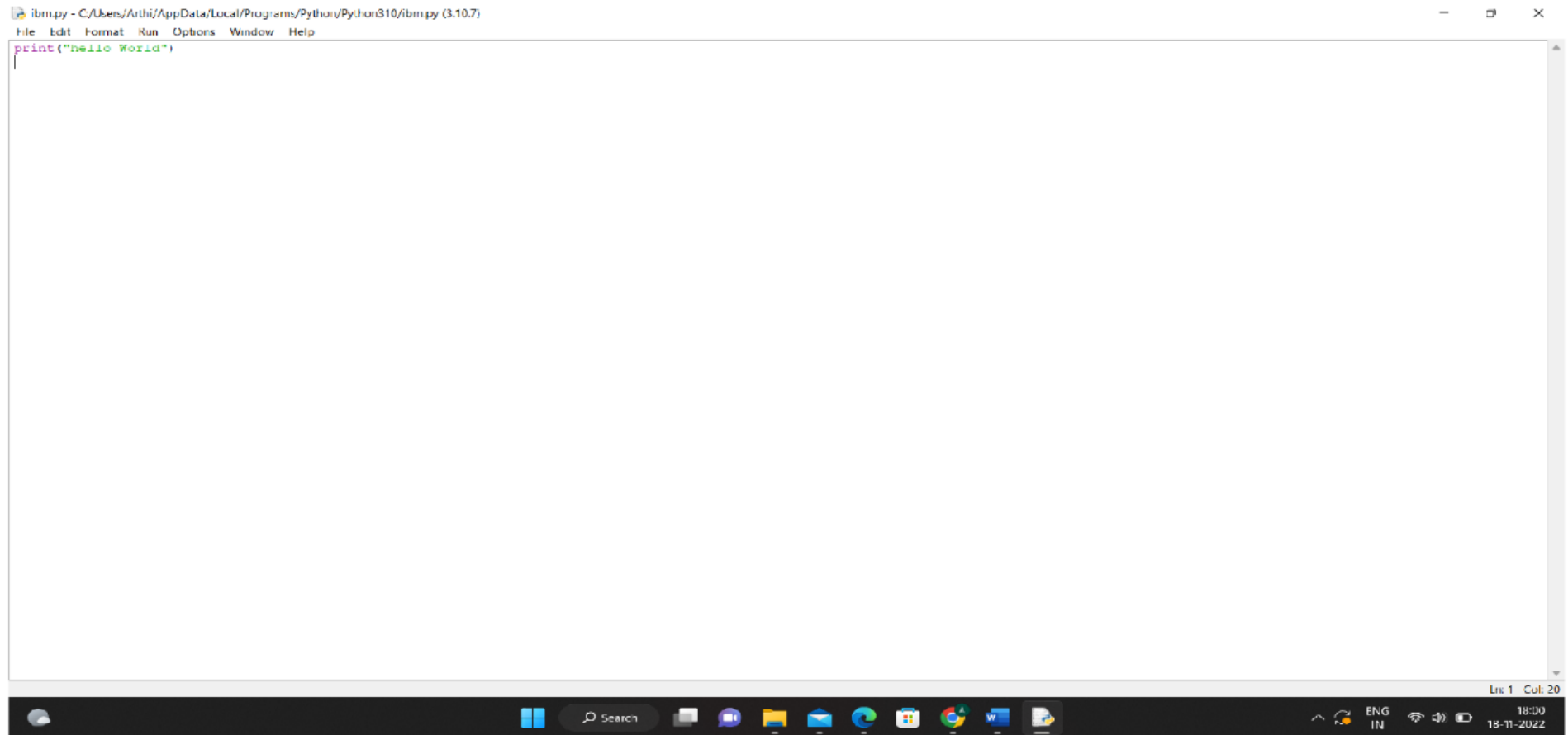
```
Python 3.10.7 (tags/v3.10.7:6cc6b13, Sep  5 2022, 14:08:36) [MSC v.1933 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: C:/Users/Arthi/AppData/Local/Programs/Python/Python310/ibm.py ====
hello World
>>>
```

Ln: 6 Col: 0

Ln: 2 Col: 0

CREATE AND CONFIGURE IBM CLOUD SERVICES:

CREATE IBM WATSON IOT PLATFORM AND DEVICE:

CREATE NODE-RED SERVICE:

CREATE A DATABASE IN CLOUDANT DB:

DEVELOP THE PYTHON SCRIPT:

```python
#Through python coding we are going to access the subcriber
import paho.mqtt.client as paho
import time
import random


def on_publish(client, usrdata, mid):
    print("Publish the data ")

client = paho.Client()
client.on_publish = on_publish
client.connect('broker.Mqttdashboard.com', 1883)
client.loop_start()
while True:
    temp = random.randint(1,30)
    (re,mid) = client.publish('iottopic',str(temp),qos=1)
    print(temp)
    time.sleep(10)
```

```
Python 3.6.5 (v3.6.5:f59c0932b4, Mar 28 2018, 17:00:18) [MS
C v.1900 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more informatio
n.
>>>
========= RESTART: E:/IBM/Others/Develop a python script/
publish.py =========
7
Publish the data
19
Publish the data
10
Publish the data
```

```python
import paho.mqtt.client as paho
def on_subcribe(client,userdata,mid,grated_qos):
    print("subscriber:" + str(mid)+str(granted_qos))

def on_message(client,userdata,msg):
    print(msg.topic + "" + str(msg.qos) + "" + str(msg.payload))

client = paho.Client()
client.on_subscribe = on_subscribe
client.on_message = on_message
client.connect('broker.mqttdashboard.com', 1883)
client.subscribe('iottopic',qos=1)
client.loop_forever()
```

```
Publish the data
13
Publish the data
3
Publish the data
25
Publish the data
19
Publish the data
2
Publish the data
7
Publish the data
9
Publish the data
```

S.no	Bin Level (cm filled)	Bin Status	Location
1	45	Safe	Kanyakumari
2	78	Safe	Coimbatore
3	112	Warning	Trichy
4	169	Warning	Chennai
5	186	Warning	Ooty
6	193	High_Alert	Tirunelveli
8	0	Safe	Chengalpattu
9	35	Safe	Madurai
10	101	Warning	Salem
11	132	Warning	Thanjavore

12	158	Warning	Vellore
13	93	High_Alert	Erode
14	93	High_Alert	Karur
15	93	High_Alert	Cuddalore
16	30	Safe	Kumbakonam
17	110	Warning	Ambur
18	180	Warning	Sivakasi
19	195	High_Alert	Neyveli
20	80	Safe	Krishnagiri

Note: *The bin location provided above is default. When the user access the bin , the locationand status of the bin displayed to the admin.*

USER ACCEPTANCE TESTING

Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Smart WasteManagement System project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they wereresolved.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	3	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	78

TEST CASE ANALYSIS

This report shows the number of test cases that have passed , failed and untested.

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

Reduction in Collection Cost
No Missed Pickups
Reduced Overflows
Waste Generation Analysis
CO2 Emission Reduction

DISADVANTAGES

System requires a greater number of waste bins for separate waste collection as perpopulation in the city.
This results into high initial cost due to expensive smart dustbins compare to other methods. Sensor nodes used in the dustbins have limited memory size.

Conclusion:

A Smart Waste Management system that is more effective than the one in use now is achievable by using sensors to monitor the filling of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human intervention, minimizing human time and effort, and producing a healthy and trash-free environment. The suggested approach can be implemented in smart cities where residents have busy schedules that provide little time for garbage management. If desired, the bins might be put into place in a metropolis where a sizable container would be able to hold enough solid trash for a single unit. But these may price bit high.

FUTURE SCOPE:

The concept of green points would encourage the involvement of residents or end users, making the idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of 'Swachh Bharath'.
Having case study or data analytics on the type and times waste is collected on different days or seasons, making the bin level predictable and remove the reliance on electronic components, and fixing the coordinates.

Sensors:

➢ PIR motion sensor: PIR sensors allow you to sense motion, almost always used to detect whether a

   human has moved in or out of the sensors range.

➢ Ultrasonic Distance Sensor : Ultrasonic Sensors measure the distance to thetarget by measuring the

   time between the emission and reception.

GITHUB LINK:

Link : https://github.com/IBM-EPBL/IBM-Project-6128-1658823824

Video demo link: https://youtu.be/1d3ZM6mn83M

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