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IOT Enabled Smart Garbage

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Abstract *— Waste management is a common and serious problem faced in urban areas. Overloaded garbage's can cause major outbreak of many diseases and also proper monitoring and handling of Garbage's has become challenging nowadays .This issue can be controlled by using IoT based smart bin Garbage collection. By using this technology, each bin is embedded with a sensor and communication facilities to update the information about the bin to the system and also notify the garbage collector to collect the wastes whenever it is necessary which reduces the collection time. This paper addresses about efficient garbage disposal management by using ID3 classification technique.*

Key Words**: Data Mining; Decision Tree; ID3 Algorithm; Smart Bin Waste Management;**

I. INTRODUCTION

The major challenge faced by garbage collectors and municipal officers in the current waste management system is proper monitoring and timely collecting of garbage's that covers the entire geographical area and another issue is overflow of garbage's can cause various diseases to humans and also makes our environment unhealthy. Our current waste management system can be replaced by using smart technology called IoT (Internet of Things). In this system each bin is embedded with a ultrasonic sensor and communication occurs on the basis of internet connectivity, GSM module will send GPS location of the smart bin to the monitoring systems through SMS and also it will notify the garbage collector through SMS to collect the wastes only when it is necessary and makes the process fully automatic. Most of the smart bin is solar cell panel based and it is powered by lithium battery.In this paper we have addressed about implementation of a decision tree algorithm called ID3 (Iterative Dichotomiser 3) for monitoring each bin activity that is whether it is high , low or medium.

The software used is Rapid Miner tool which can be used to generate decision tree from our sample data set. We have also added idea of segregating the waste , Instead of ,dumping all types of wastes into a single bin ,this smart bin also has a capability of segregating the wastes into degradable and non-degradable .

II. LITERATURE REVIEW

[1]A review paper on "IOT" & its Smart Applications by Vandana Sharma, Ravi Tiwari- It gave a clear concept about IOT(Internet –of-Things) and how the application under IOT works Smarter and the communication that occurs between these devices is based on sensor.

[2] Smart Bin: Internet-Of-Things Garbage Monitoring system-This paper describes about monitoring the smart bin and also smart waste management design is created based on IOT .The paper author's Prakash and Prabhu gave solution for overflow of Garbage Bin by the implementation of transmitter and sensor in smart bin.

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[3] IOT Smart Garbage and waste collection bin by S.S Navghane ,M.S killedar,D.R.V.M Rohokale :This paper gave an idea about attachment of components and creation of webpage i.e., attached microcontroller, IR sensors in dustbin which shows the current state of bin and it is implemented as a web application using html and through internet connectivity provided by wi-fi , the level of each bin can be updated to the html page

[4] Waste Management Overflow System Using IoT And Classification Using Data Mining by Nanda Kumar Parameshwaran1, Bhagyashri Badgujar2, Pournima Bandgar3, Priya Parate4 - this paper focuses on using a data mining algorithm for developing a smart garbage monitoring system.

[5] Efficient Garbage Monitoring System :An Aspect of Smart City by Anaika Deshpande,Sushma Singh,Sujay Dangrikar,Prof.rajeshri thorat – This paper describes the role of ID3(Iterative Dichotomiser 3) algorithm in smart waste management system which establish the classification of attributes and compute entropy classification, and calculation of Information Gain is done for each attribute in R using classification attributes.

III. PROPOSED SYSTEM

SYSTEM ARCHITECTURE

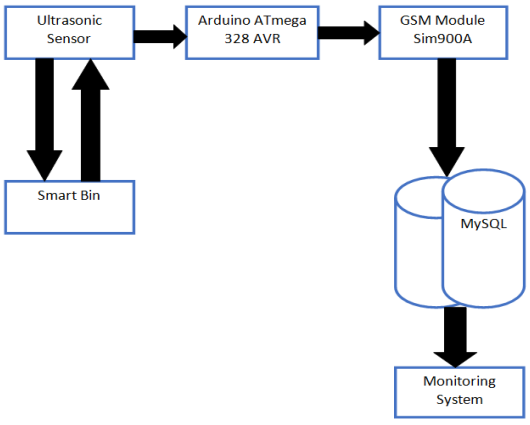

Fig 1 block diagram of waste monitoring system

Fig1 shows the system architecture of waste monitoring system. Ultrasonic level fill sensor can be used to detect the level of garbage in smart bin.

The high performance Ardiuno AT Mega 328 8 bit AVR RISC is used as micro controller .SIM900a GSM module can be used to send data to MySQL database. HTTP POST/GET method in GSM is used to send data to PHP script residing at a web address and then with that PHP Script, data can be inserted into MySQL.

IV. RESULTS

GENERATING ID3 DECISION TREE USING RAPID MINER TOOL

The main aim of our proposed system is to use Iterative Dichotomiser 3 classification technique for smart bin waste management system. This algorithm determines the like hood of collecting the garbage for various regions based on the level of garbage filled.

	A	B	C	D
1	**regions**	**waste**	**level**	**garbage collection**
2	thiruvottiyor	non degradable waste	high	yes
3	royapuram	degradable waste	high	yes
4	royapuram	non degradable waste	high	no
5	sholinganullur	non degradable waste	medium	no
6	virugampakkam	non degradable waste	high	no
7	perambur	degradable waste	low	no
8	egmore	degradable waste	low	yes
9	anna nagar	degradable waste	medium	no
10	alandur	degradable waste	low	yes
11	ɐepauk-thirvallike	degradable waste	medium	no
12	madavaram	degradable waste	high	no
13	velacherry	degradable waste	high	yes
	alandur	degradable waste	high	no
15	anna nagar	degradable waste	low	no
16	ambattur	degradable waste	low	no
17	tnagar	non degradable waste	low	yes
18	mylapore	non degradable waste	high	no
19	anna nagar	non degradable waste	high	no
20	alandur	degradable waste	medium	no
21	madavaram	degradable waste	high	yes
22	egmore	degradable waste	low	no
23	madavaram	degradable waste	medium	no
24	saidapet	non degradable waste	medium	no
25	ɐepauk-thirvallike	non degradable waste	low	yes
26	thiruvottiyor	non degradable waste	low	yes
27	anna nagar	degradable waste	medium	yes
28	thousand lights	non degradable waste	low	yes
29	sholinganullur	non degradable waste	medium	yes
30	harbour	degradable waste	high	yes
31	velacherry	degradable waste	medium	yes
32	ɐepauk-thirvallike	non degradable waste	medium	no
33	royapuram	non degradable waste	medium	no
34	thousand lights	degradable waste	high	yes
35	saidapet	non degradable waste	low	no
36	thousand lights	degradable waste	medium	no
37	maduravoyal	non degradable waste	low	no
38	ambattur	non degradable waste	high	yes
39	royapuram	degradable waste	high	yes

Fig.2 Sample dataset

The following set of sample data set is considered for this proposed system. This data set comprises of quantitative measures for different regions in the city. The attribute such as degradable waste, non degradable waste and levels are taken into consideration. Using this dataset, ID3 decision tree can be generated. This algorithm gives a decision tree with leaves as the decision that is to collect garbage or not. The primary node consists of regions which comprises various regions of the city. The possible values are Degradable waste and Non Degradable waste. The final leaf node comprised of low, high, medium. If the level is high then the garbage is ready to be collected on high alert areas. With these attributes, decision tree using Rapid Miner can be generated.

Tree (ID3)

Tree

```
regions = alandur
|   waste = degradable waste
|   |   level = high: no {yes=0, no=1}
|   |   level = low: yes {yes=1, no=0}
|   |   level = medium: no {yes=0, no=1}
|   waste = non degradable waste
|   |   level = high: yes {yes=1, no=0}
|   |   level = low: no {yes=0, no=1}
|   |   level = medium: yes {yes=1, no=0}
regions = ambattur
|   waste = degradable waste: no {yes=0, no=1}
|   waste = non degradable waste: yes {yes=1, no=0}
regions = anna nagar: no {yes=0, no=4}
regions = chepauk-thirvallikeni
|   level = high: no {yes=0, no=2}
|   level = low
|   |   waste = degradable waste: no {yes=0, no=1}
|   |   waste = non degradable waste: yes {yes=1, no=0}
|   level = medium: no {yes=0, no=2}
```

Fig. 3 ID3 decision Tree Description Using Rapid Miner

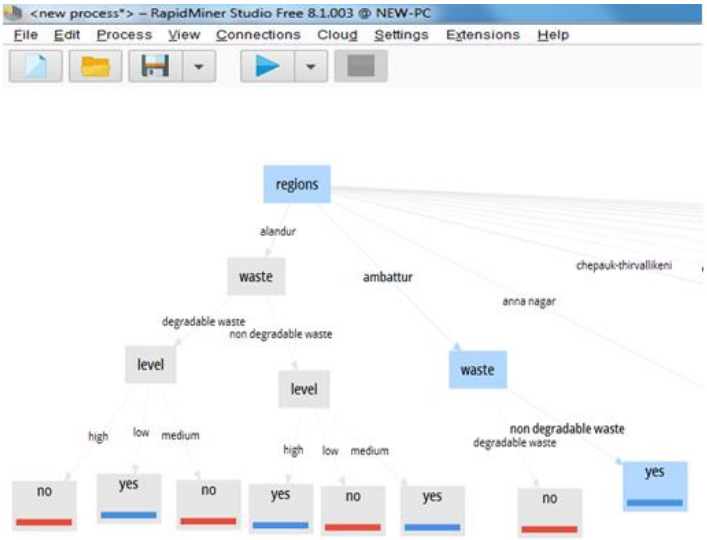

Fig. 4 ID3 Decision Tree Using Rapid Miner

ID3 PSEUDOCODE

***Step 1*:** create a feature list S, attribute list A.

Feature list are region, levels, degradable and non degradable Attributes list for given regions of 100 records.

Step 2: Find the maximum information gain among all the attributes. Assign it to the root node Information Gain(S, A)=entropy(S) –Σ [p(S/A).entropy(S/A)]

Entropy can be calculated by Entropy(S) = Σ - P_A log2 P_A where pi is probability of S belonging to attribute A

Step 3: Remove the feature assigned in root node from the feature list and again find the maximum increase in information gain for each branch. Assign the feature as child node of each branch and remove that feature from feature list for that branch.

***Step 4*:** Repeat step 3 until you get branches with only leaf node such Yes or No

V. CONCLUSION

The result of this ID3 algorithm helps to monitor the regions that have high level garbage's. Smart Waste Management system prevents the overflow of garbage and each bin will report their status whether it is high, medium or low to the centralized systems and thus this helps the garbage collectors, The following web application prototype for Smart Garbage Monitoring system will allow the Garbage collector or municipal officials to login in to the website with their unique user id and password. The real time status regarding the level of garbage for the particular region can be monitored by manually selecting the region, type of waste and level of garbage as show in the fig 5. and municipal officers to take timely decision to collect garbage on high alert areas. So, truck collector is sent to the appropriate area to collect the garbage . The mobile applications and web application also serves the purpose of keeping the municipal officials to be informed about the garbage levels By this way the time and energy of worker can be reduced majorly and even the overflow of garbage can also be reduced.

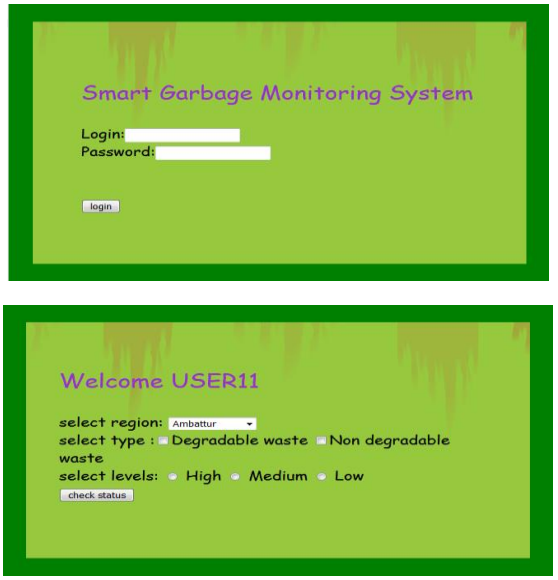

Fig. 5 Web application prototype for smart Garbage monitoring system

VI. FUTURE WORK

This ID3 decision tree can be implemented using PHP in web and mobile application. CrateDB can be used as database because it is much faster and efficient than SQL database on handling complex time series and new volumes of data and it provides query versatility and efficient real time performance. The result of ID3 decision tree which was in form of trees can be translated to PHP code in the form of if else ladders. These if else ladders can be placed into PHP class methods that accept only splitting attributes –regions, waste types ,levels as method parameters. The class methods return the final result of that particular

input, indicating whether the garbage can be collected or not.

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