Abstract: Expanded epidemic outbreaks and spreading of infections due to inappropriate waste administration in urban areas which are having a drastic and exponential population growth. In current circumstances, the Garbage Collecting Vehicle (GCV) amasses the waste few times in a week. In this way, the issue is over streaming of wastage on the streets. Thus, to beat this restriction, in the present thesis a different scheme on smart waste management using Radio-Frequency identification devices (RFID), Machine to machine (M2M), pneumatic system, Internet of things (IOT), plasma technology are explained in detail and the best method of treating solid waste using smart solid waste management techniques is suggested basing upon the Summary of the data collected from Tullur, Rayapudi, Velagapudi, Nelapadu villages respectively, Where one of these new systems is implemented. After gathering the questionnaire, which is prepared basing upon the Quantitative survey, the results were analyzed using mathematical methods and confirm the advanced techniques in SWM Is better than traditional or conventional methods.

Index Terms: Solid Waste Management (SWM), Machine to Machine (M2M), Internet of Things (IOT), Radio Frequency Identification Techniques (RFID), Pneumatic System, Plasma Technology, Smart Solid Waste Management (SSWM).

I. INTRODUCTION

Solid Waste Management (SWM) is a universal problem that the World is facing today and being no exception, over the years the New Capital city will grow significantly both in population and in density, which may result a great pressure force on the resources of the city [1]. The municipal solid waste of residential area and waste products of commercial area are the two major solid waste produced in the Amaravati region.

The utmost challenge for Amaravati region is the disposal of enlarging quantities of solid waste. The present methods of solid waste disposals in the State are not been satisfactory [2]. The wastes that are being disposed are most unscientific (land) thereby posing a great threat to environment and public health.

Waste reduction and Operational efficiency are the two advanced methods of smart solid waste management [3] by using number of technologies is presented in Figure 1.

This methods are newly innovated. By using thiste methods we can get the maximum utilization of resources while following the integrated solid waste management. I am considering four villages of amaravathi region that is new capital city of andra pradhashthey are Thullur, Velagapudi, Rayapudi, Nelapadu. Why I am considering this four villages are this are the four corners of the capital city of amaravathi. The information related to solid waste that are mainly corresponded to reduce, reuse, and recycle which is also known as 3R system is shown in Figure 2.

A. Reduce

The first priority of the solid waste management is to reduce the waste at the sources. If we reduce the waste then the quantity of the harmful waste gets declined. By using this reduce process the impact on environment will be reduced.

And the new methodology for the minimization of waste is to reduce the usages of packing materials and to motivate the customers to return the package materials, stir up the ecofriendly products. This system will be also useful for the reducing the usage of virgin material. The awareness camps...
should be launch at the local body to educate people about the segregation of solid waste. Segregation can be divided into organic and inorganic waste. They are also known as biological waste and lifeless waste. The biological waste includes vegetable waste, paper waste, fruit waste etc. This organic waste converted to manure and helpful for growth of plants. The lifeless waste includes plastic waste, e-waste, glasses, metals etc. This can’t be converted into the manure and there is no impact on the improvement of the plant life. Segregation will be helpful easy for treatment. In the primary segregation, we have to separate the solid waste and liquid waste.

B. Recycling

A procedure by which the materials are assembled to be handled to either reuse or undergo remanufacturing. This recycling helps get rid of any kind of metropolitan or business waste to transfer or carried forward for years letting the pollution to happen, which in this way used to help save the nature from any kind of damage and also the responsibility of waste management on the officials. With proper planning methods, procedures etc. this recycling would definitely help creating jobs or rather would also create great incomes.

Although there are a lot of advantages of recycling, cost reduction and control of environmental pollution are thought to be more significant among all. And the solution would be collection of the waste produced. This collection of waste currently is being done by the informal sector through waste pickers, door to door collectors and so on. The building up or knocking down of waste constitutes most of the total solid waste which contains about 6.82% of paper and 6.03% of plastic. Coming to e-waste generation or electronic waste generation, there has been an increase of about 10% per annum, which is as observed; not being managed properly. The estimated solid waste management in 2050 is presented in Figure 3.

C. Recovery

By using municipality waste as raw material for the production process of energy in the form of electricity or heat. In the plasma technology, we can heat the inorganic or lifeless waste to convert them into electricity in the form of heat and this had implemented in GIFT city(gujarath international finance tec city),this is the first smart city in india. The energy can be recovered form the solid waste by the incineration process in the form of heat or electricity and it will be helpful for production process of RDF (refuse derived fuel). This fuel

Derived fuel is the segregation of high fraction of processed municipal solid waste .repeatedly in pellets from it is produced from combustable elements of household and commercial waste. It is good quality fuel from waste. If we compare incineration vs waste to energy technologys, in majority cases incineration will be choosen, because the waste to energy technology is a costly process and requires high supervision with the latest technologies. The envirnmental issues are raised due to plants are not operated effctively.

D. Land fill

In this process we are filling the land in different places like in the open land, ponds and pits etc. the process of dumping the waste materials consists of five phases as shown in the Figure 5 among those five phases, each phase consists of different types of solid waste. If they have filled with organic matter that can be changed like manure. If they fill inorganic matter, they are undecomposed and stay for longer period. And each phase has certain goals to accomplish the final goal. This landfill should be located outside the country side or city. Proper maintenance works should be included. And did not burn the tiers and plastic without proceedings.

Figure 3: Solid waste generation at 2050
(Source: Amaravati concept handbook)

Figure 5: Land filling layers
(Source: Section of municipal solid waste management)
II. RESEARCH SIGNIFICANCE
Identification of Suitable Technique to improve the Solid waste Management in the Selected Field of Study, conducting the questioners and Recommending of the Suitable technique for smart waste management in new capital city Amaravati.

III. DESCRIPTION OF WORK
This paper Explain about the Smart solid waste management system in Amaravati region new capital city of Andhra Pradesh are divided into the three zones show in the Figure 6

- Zone -1
- Zone -2
- Zone -3

Again zone -1 can be divided into three faces of construction they are

- Phase -1
- Phase -2
- Phase -3

Each zone has one Transit Station (TS), Three Land fill station and one treatment plant.

When the zone 1 only divided into three phases why because when the total capital region government complex and seed access area in zone 1 only while starting the capital in this area of access only when another two zones comes under the LPS (Land pooling scheme).

Latest Technologies in Solid Waste Management
The latest technologies and it consists of the equipment’s, scanners, devices are parts of the prescribed below they are

- RFID
- M2M
- Pneumatic
- IOT

A. RFID (Radio frequency identify devices)
The RFID playing the main role in latest technologies in solid waste management.in this system has using in different areas in waste management like smart bins. If the RFID tag was attached on the bottles then the smart bins are automatically open. At the same time when bottle is RFID tagged it will be identified in mixing of solid waste. Figure 7 explains about the when the plastic water bottle has RFID tag while in the same time bins having the sensor when the user puts the bottle near to the bins the bins are opened.In that same time when the glass particles and paper particles are nearer to the bins when the bins are opened by using RFID tags and sensors.

Figure 7 RFID based selective bins system
(Source: Amaravati Concept Handbook)

The RFID tagged water bottles are the mixed with the solid waste and they have easily identified while passing through the conveyor the one machine has RFID scanner that are scanned the all the matter and picking the plastic water bottle from the solid waste and that bottle recycled shown in Figure 8.

Figure 8 RFID Tagged plastic bottle
(Source: An example of a smart waste)

A. M2M (Machine to Machine)
This system is used for sorting, shredding and conveying of solid waste. Compare with the other technologies, the equipment cost in this technology will be higher, because it’s totally mechanized. It is suitable for the huge amount of solid waste. The maintenance cost of the system is also higher. This system is interlinked to RFID. By attaching the magnet to the machine, it will attract all the iron particles in solid waste. This system required less man power. It is easy to operate and sustainable technology. The main advantage of machine to machine is to segregation of unsegregated (i.e. solid and liquid) waste.
B. PNEUMATIC SYSTE

Pneumatic waste collection system is a totally water & air tight system, eliminating bad smell & dirt.
It is based on a network of underground pipes through which a powerful vacuum is created to transfer the waste to collecting station at 55 to 70 km/hour & stored into big container and further transferred.

C. IOT (Internet of Things)

Presently Indian city’s struggling with the solid waste management to get rid of things by using IOT. Internet of things plays the crucial role on solid waste management. It is a cyclic process. It consists of analysis, collection, transportation, Recovery and Recycling/Disposal. The dust bins which are located at the streets are connected with WiFi, once if the dust bin was full then the alert signal will send to an app. Then the workers identified the location and by using trucks intimates time to reach location. It is moderate technique. And easy to conveying the waste to the dumping yard. It is GPS based tracking solution. The truck is attached with GPS tracking system. Once the bins were full then we send the signal to the truck via mobile or computer. We can track the vehicles by using software with in a mobile or computer. Hence by using the IOT it is the best method to convey the solid waste in smart cities.

IV. RESULT AND ANALYSIS

In order to perform the questionnaire survey 30 questions had been selected from various factors which leads to cause of Municipal technical persons risks, Household risk, and Municipal workers risks. In this survey 120 responses were collected. In selected villages Tullur, Rayapudi, Velagapudi, Nelapadu.

Each response in questionnaire survey is analyzed by using Relative Importance Index (RII) [6]

$$RII = \frac{\sum W/A*N}{\sum W}$$

Where $\sum W = 5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1$, (1-5) is liker scale values, and $(n_1, n_2, n_3, n_4, n_5)$

Is the no. of responses recorded for each opinion in the questionnaire?

### Table 1 - Relative Importance Index (RII) values for Household

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>RII Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Awareness of Solid Waste to the Public</td>
<td>0.752</td>
</tr>
<tr>
<td>2</td>
<td>Satisfaction related to location of Garbage Dumping point</td>
<td>0.758</td>
</tr>
<tr>
<td>3</td>
<td>Separation of Dry waste and Wet waste</td>
<td>0.746</td>
</tr>
<tr>
<td>4</td>
<td>RFID Method for the Solid waste management</td>
<td>0.702</td>
</tr>
<tr>
<td>5</td>
<td>Pneumatic Method for the Solid waste management</td>
<td>0.868</td>
</tr>
<tr>
<td>6</td>
<td>M2M Method for the Solid waste management</td>
<td>0.606</td>
</tr>
<tr>
<td>7</td>
<td>IOT Method for the Solid waste management</td>
<td>0.842</td>
</tr>
</tbody>
</table>

### Table 2 - Relative Importance Index (RII) values for Workers

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>RII Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Level of satisfaction for the Garbage collection from garbage point</td>
<td>0.861</td>
</tr>
<tr>
<td>2</td>
<td>Maintenance problems during routine work</td>
<td>0.759</td>
</tr>
<tr>
<td>3</td>
<td>Awareness of Solid Waste</td>
<td>0.889</td>
</tr>
<tr>
<td>4</td>
<td>RFID Method for the Solid waste management</td>
<td>0.623</td>
</tr>
<tr>
<td>5</td>
<td>Pneumatic Method for the Solid waste management</td>
<td>0.918</td>
</tr>
<tr>
<td>6</td>
<td>M2M Method for the Solid waste management</td>
<td>0.740</td>
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<tr>
<td>7</td>
<td>IOT Method for the Solid waste management</td>
<td>0.692</td>
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</table>

### Table 3 - Relative Importance Index (RII) values for engineers

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>RII Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Level of satisfaction on the existing garbage collection methods</td>
<td>0.806</td>
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<tr>
<td>2</td>
<td>Recycling Procedures for the solid waste Management</td>
<td>0.794</td>
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<tr>
<td>3</td>
<td>RFID Method for the Solid waste management</td>
<td>0.736</td>
</tr>
<tr>
<td>4</td>
<td>Pneumatic Method for the Solid waste management</td>
<td>0.928</td>
</tr>
</tbody>
</table>
The above results and analysis among through four villages I had found out the maximum number of peoples are gone with pneumatic system and RFID comparatively majority of the people had selected pneumatic system only.

V. DISCUSSIONS

Finding out the Problems in solid waste dumping, maintenance and Recycling. And the below pie charts explain about the different systems in that four villages. Results of smart solid waste management in Tullur region is shown in Fig.10

Tullur Region:

Majority of the thullur village people had selected the Pneumatic system. To show in chart 1 and they have some lack of Things is their like

- Daily collection of garbage.
- Garbage dumping point.
- Separation of Dry Waste Wet waste.

Rayapudi Region:

Results of Smart solid Waste Management in Rayapudi is shown in Fig.11. Higher amount of the Rayapudi village people had selected the pneumatic system as parallel to the RFID system to show in the second pie chart and they have some lack of Things is their like,

- Maintenance works.
- Recyling the Waste

In this village garbage collection in proper manner and the people aware about the dry waste and wet waste.

Vellagapudi Region:

While coming to the two villages pneumatic system and RFID considering the equal importance in the nelapadu region. Results of Smart solid Waste Management in Rayapudi is shown in Fig. 12.

Nelapadu Region:

Majority of the Nelapadu village people had selected the pneumatic system. To show in the chart 3 and they have some lack of Things is their like,

- Lack of Selection of dumping sight
- Lack of Municipality workers

Vellagapudi Region:

Results of Smart solid Waste Management in Vellagapudi is shown in Fig.13. Majority amount of the vellagapudi villagers had selected the pneumatic system to show in the chart 4 and in this village have proper maintenance of solid waste and it should be useful for the next 5 years only. Why because of vellagapudi become one of the main part in the Amaravati region.

VI. CONCLUSION

Based on the questionnaire carried over the four villages in Amaravati region, it is concluded that majority of the people are using bins and trashcans for the collection of all types of waste such as organic waste (vegetable waste, leaves), inorganic waste, E-waste form the households. The disposal of this waste is carried out manually and mechanically. Four methods of solid waste disposal systems such as RFID, Pneumatic system, M2M and IOT are considered to find out which system is best suitable for the selected region. By analyzing the questionnaire survey
conducted among the various stakeholders it is found that pneumatic system is best suitable for the increasing population in the Amaravati capital city.

REFERENCES

6. APCRDA (Andhra Pradesh capital region development authority)

AUTHOR PROFILE

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I had done my bachelor of engineering in CIVIL engineering and later doing masters in KL University. I had publish one paper in Scopus in my bachelor degree only. Research work in smart solid waste management. Membership in ISRD, ID: SM3140907015. Got 1st prize in many colleges in Guntur and Vijayawada region. Got prize in IIT Delhi fest in 2016,and attending to many workshops in Bangalore, Chennai and Delhi.

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