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Development of Smart Solid Waste Technology

Uma Maheshwari.V¹, Dr.K Yogeswari²

P.G. Student, Department of Civil Engineering, B.SAbdur Rahman Crescent Institute of Science & Technology,
Vandalur, Chennai, India¹

Associate Professor, Department of Civil Engineering, B.SAbdur Rahman Crescent Institute of Science & Technology,
Vandalur, Chennai, India²

ABSTRACT: “Environment is immense economic growth to our nation”. But we are impoverishing the nature by spawning the waste which is not properly done with from collection till disposal. This will lead to an unhealthy and hazardous environment. SSWM technology furnishes enhancement in the environment. Through adopting smart technology like the sensors in garbage bin which serve real-time monitoring system. The conventional solid waste management existing system is not functioning properly as a result of the inadequacy of employees, convoluted in the solid waste management system and improper monitoring system. This paper discussed the work related to the smart technology in solid waste management by conducting various literature survey, SWOT analysis is done based on the literature survey. The smart technology involves the process from collection to disposal. A SWOT analysis will help to find the strength, weaknesses, challenges involved in the smart technology of solid waste management (SWM). The result of this analysis can find a better way to implement smart technology in solid waste management infrastructure.

KEYWORDS: Smart technology, waste management, sensor, waste collection, waste segregation, strength, challenges.

I. INTRODUCTION

A clean and healthy environment is the key need in the human habitable environment. Due to expeditious growth in population, the waste generated by each individual results in a tremendous amount. Solid waste is a considerable cause of pollution which will result in an unhealthy environment. Waste management is an important task to enhance the standard of life and economic growth of a nation. Institution building mechanism includes the collection, segregation, transportation, processing, and disposal of waste together along with control and management. The waste disposal is done through a collection bin at a commonplace or at a particular spot. There is no proper management and monitoring system in the collection of waste, segregation, and place for disposal. Certainly, there is unfettered and unsystematic dumping of waste that has brought about a rising number of interventions to human life. Besides, there is a lack of basic information regarding the spawning of waste, segregation, collection, transportation, and disposal.

The review focuses on the evolution of sustainable smart solid waste management with innovative technologies in order to improve the healthy environment and therefore to promote the economic growth of a nation and by analyzing the various strategies and risks, through SWOT analysis.

II. OBJECTIVES

To identify the required smart technologies in smart solid waste management through a literature survey and to do the SWOT analysis.

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III. LITERATURE SURVEY

A. International Status

Praveen Kumar Gupta et.al, (2019), established the aim of artificial intelligence and machine learning in the use of modern technology in smart waste management and recycling. The author addressed the key issues in place of public garbage bin which gets overflowed which creates hazardous to the environment. In order to scale down the problems related to the spill of garbage waste, smart technology will be improvised the situation. The smart technology needs from the point of collection till final disposal. The ingenious system of recycling should need in order to reduce waste and reuse of waste for other products. The proposed prototype model is based real-time scenario using open data in place of Copenhagen. The system involves the entanglement of GIS, Optimization of graph theory and concept in machine learning. Based on the sensor it senses the volume of trash in the bin and sends the information through transmitter with the help of the internet. With this system, it helps to track and to initiate the cleaning process. The machine learning system can able to change the situation by assimilating advanced circumstances. This system reduces human interaction cost and travel time in the use of artificial intelligence and machine learning.

Omar M.F et.al, (2016) explained the smart waste management system implementation in Malaysia to enhance the standard of the city along with advances services into the communal approaching the application of smart city. This paper reviewed on MPS & MDKL waste management monitoring process. The ultrasonic sensor by virtue of IoT technology is manipulated by geospatial technology and intelligent sensor and for waste collection operator solid waste management provide a greater base into real-time monitoring work of waste by the local authority into establishing the service along enhancing cost and movement time. The main issue is regarding in which way into bringing to the local authority along competing for cost and low care price. the prevailing system, for limited apartment and condominium implementation is done based on inside the apartment waste chamber, the sensor device which is provided on the top of the bin and this paper also explained about the future recommendation, the implementation is done to the citizen as small IoT devices which are used for monitoring purpose and it also should provide in facial of each terrace house along with bungalow.

Jose M.Gutierrez et.al, (2015) focused on intelligence trashcan for waste collection by creating a prototype model using an IOT implanting with sensor and that read, gather volume of trash data transmitted over the internet. With the help of this data graph theory optimization algorithms are processed and establish into spatial-temporal context by this it can be used to handle waste collection strategies in an effective way. The author carried out an experiment on a GIS in order to investigate the betterment of contagious available data about the city of Copenhagen Denmark of such a system and compare the approaches and economic factors included in the conventional waste collection. The economic feasibility analysis of the proposed system shows betterment inefficiency by deploying but it shows higher with the comparison of total costs included in strategies of different collection. However, this work experiments knowing on numerical results highly depend on it under the considered on assumption. Moreover, the future work will be conducted on the use of historical data analysis by this it will improve the efficiency in strategies on the collection of waste.

David C. Wyld et.al, (2010) examined according to what radio frequency identification is ready to support transfer the approach of trash and Municipal solid waste. In the united stated the waste management system is not effective, present-day the volume of the trash gets increased. The trash is disposed of in fewer landfills. The author investigated regarding RFID in what way it can be operated in the municipal solid waste areas into the pair of ease advancement of Pay as you throw established billing services for waste management along directed toward benefit motivation based recycling programs, in the pair of that to cut down the amount of waste coming into landfills. Also, the author discussed the future aspect of RFID is introduced into what is now a \$52 billion market for the handling of waste.

Wager P.A et.al, (2005) evaluated the RFID labels applications of potential impacts in the waste area. The valuable and toxic substances dissipation established recycling systems potential disruption, these are the major potential impacts that are considered in a proper sequence in case of which figure of measures are appropriated. These potential risk measures are considered for the precautionary principle. The precautionary principle founds in the forecast and

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curtails the potential risks beneath unpredictability conditions. This principle has been applied in much national protection for environmental protection and sustainable development. In this paper, the author has discussed the result of the precautionary principle in the application of the smart label of municipal solid waste. The valuable and toxic substances like few risks are dissipated by smart labels. By the use of smart labels and regarding composition these risks can be averted through precautionary measures. According to resource management and environmental protection, the precautionary measures should be enforced as soon as possible in order to troublesome inevitable improvement.

B. National Status

KalyanChakravarthi.G et.al, (2019) presented the study on SSWM in Amravati. In cities with an aggressive population, there is no proper waste management system so there is a chance of spreading infectious diseases. Thus the author addresses various technology which involves treating solid waste which includes radio frequency identification devices machine to machine, pneumatic system, IoT, plasma technology. From the summary of data collected from the tullur, rayapudi, velgapudi, nelapuda the solid waste management techniques are identified. From that one of the technology is implemented. The traditional and conventional methods are compared based on the analysis using a mathematical model which is drawn from the quantity survey of gathering questionnaires from this which confirmed the advance techniques of solid waste management. Among the four methods, the author stated that based on the questionnaire carried out in the four villages for solid waste disposal systems pneumatic system has found best for the Amravati city.

HarendraK.Vasava et.al, (2019) explained smart city Gandhinagar SWM which is integrated. In this, the author focused on the reprocessing of waste and reduction of waste entering the landfill by treating the waste in the biogas plant. From 105 tons of waste 42tons of waste is treated. Gandhinagar city has an adequate SWM system. The waste is collected on the new concept which is introduced by the GMC. The door to door collection system is covering all the residential areas. The waste is collected on the scheduling basis of the working hour. In the evening time, the waste is transferred to a hydraulic euro III vehicle with a closed system. From there waste is carried to the transfer station to the treatment plant. In Gandhinagar, GMC has solid waste management facilities like the vermicomposting plant, refuse transfer station, biogas plant and open dumping site in the corresponding sector. Based on the waste generated in the city the waste is getting treated in biogas treatment plants. The author designed based on the biogas plant treatment according to what high energy will be generated and how much amount of waste can be prevented by entering into landfills.

Tajne K.M et.al,(2019) described the smart compost bin in Smart cities. This author explained how the smart compost bin acts as a mitigation for the waste generation and which is a smart way for the reduction of waste. It also explained the characteristics and structure of the smart compost bin. The compost of waste can be used for agriculture purposes as a fertilizer which gives more growth and less pollution. Smart compost bin method is good practice keeps aesthetically good as from environment and economical perspective it is more beneficial compared to the existing method. The component of the smart bin is metal & detection of plastic, unit for composting and provision of fertilizer which is produced. The temperature, moisture content, & oxygen content are some parameters that are used for controlling the purpose of the composting process. And in the course of composting period temperature fluctuation is maintained. Some microorganisms are needed in order to make more successful and this system works totally due to solar energy. In order of recycling the waste contained organic matter back to the soil, it will improve the structure of soil along with productivity.

SanhitaBandyopadhyay et.al, (2015) explained the technology of smart meter in the field of smart solid waste management for smart cities. In India, the primary system of waste collection is not effective most of the waste is left or overflowed in the open spaces of the streets or communities. Due to the overflow of the waste in the street, serious health issues are arises which makes the city more hazardous. Being expeditious growth of population and unexpected urbanization process drive more serious problems, and in which solid waste is one of the cause for changing of nature. The author aimed to structure out about smart metering technique that deals with the process from the being of management of waste process until the end product of recycling. Smart metering provides the platform to solve the

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issues in the city by addressing segregation, and there won't is any waste remain left in the land it will be a useful resource.

Arunkumar.H et.al,(2013) studied smart waste management in the Bhubaneshwari Nagar area of Bangalore city. The author aimed to focus the currently existing by monitoring and also concentrate on the financial analysis, potential issues arising in the area by fragmentation of generation of waste in respective areas. The target of the project comprises of 3R's concept which means reduce, reuse and recycle. The analysis is done based on the secondary data from the analysis the segregation process is done based on the wet waste, dry waste. The segregated wet waste is collected from the resident and they were given to the neighboring university GKVK as long as for purpose of research and manure and dry waste is recycled by ITC company and the remaining waste is transfer to landfill and author suggested smart bin technology, RFID, handwritten technology. From the current practices in Bangalore city which result in maximum revenue, recovery of resource, less expense in transportation also with less pollution.

IV. SWOT ANALYSIS

SWOT Analysis is done to analyze the strength, weaknesses, opportunities, threats, and challenges faced in the smart technology of solid waste management. This analysis can help to improve the infrastructure in smart cities.

A. Strength

- a) Through adopting the smart bin saves times, cost by using smart transport vehicle to collect the filled containers and reduces the operating and maintenance cost.
- b) Since limited waste collection vehicles in the road result in less air pollution and also decrease in a traffic flow which will happen due to the smart dustbin and service operators' two-way communication.
- c) If the cities become clean, green and free against the awful odor of wastes which results in a healthy environment and puts more beautiful.
- d) It shortens human intervention in case of handling the process of collection of garbage.
- e) In advertisements on Smart devices which helps the administration to generate the extra revenues
- f) Establish a waste management organization in the framework of a municipality.
- g) Endorse the municipal solid waste management to the municipality which will create a strong perception.
- h) Keeping an informational program about recyclable waste which will create awareness to the public
- i) The precondition of a system in waste collection salaried by residents.
- j) Processing combustible fraction in RDF (refused driven fuel)
- k) Public-private endeavor moderately diminished the burden of landfill.
- l) SMSW combined the standard in the life of the community.
- m) Improve the income of society.
- n) The opportunity of activity in a teamwork structure.
- o) Recycling of waste materials can finder easily.
- p) Creating awareness by paying tax for wastes.
- q) Digitalized process
- r) Innovative technology processing the presence of MSW.

B. Weakness

- a) The number of population in the city system requires a smarter dustbin for separate collection of waste. Smart dustbins result in high costs compared to other methods.
- b) The memory size of the sensor node is limited which is used in the smart dustbin.
- c) People who involved in a smart waste management system require training.
- d) Unemployment will increase for an unskilled person due to a reduction in manpower requirements.
- e) The system uses wireless technologies such as ZigBee and Wi-Fi to have a shorter range and lower data speed.
- f) Traffic is getting increased due to improper schedule of a garbage vehicle

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- g) Recycling is not considered.
- h) Garbage producer experiences little benefits of garbage recycling.
- i) Ability Lack in the probability of recycling and segregation technology.
- j) Inappropriate choice of site for garbage interment.
- k) More amount of unrenovable garbage production.
- l) Smart waste management technology involves high costs.
- m) Inadequacy of awareness in environment and knowledge about SWM
- n) Lack of financial resources.
- o) Chance in technical failure.
- p) Deficiency in germinate accomplishment process
- q) Fragile institutional building mechanism, statutory of SWM specifically in implementation, observing & interpretation
- r) Since most of the models of a variety of sensors are not well exposed due to high and less volume of waste in height.

C. Opportunities

- a) As long as the collection, deal with circling data wireless sensor networks are liable directed towards enhancing inheritance of the city infrastructure and make-believe the smart city. Transport and recycling also focused on SC's
- b) It has competence directed towards the development of the system in real-time, meanwhile collection activity criterion along with the methods that influence the waste collection, so this will help to integrate towards a smart transportation structure that consequence in actual time routes afford into the collection trucks.
- c) Sensors and WSNs facilitate the amount about substantial quantities along with the conversion into digital signals, whatever are refined wirelessly through an ad-hoc network infrastructure.
- d) Low-power radio communications and low-cost embedded devices facilitate the sensors to integrated RFID tags
- e) Actuators are embrace directed towards vitalize and permit evaluation into digital systems through combining, in the physical layer, along with the infrastructure.
- f) Effective scheduling & routing are realized by the use of a smartphone network. Collection truck drivers will get any information regarding waste management infrastructure.
- g) Since the collection and recovering web-based decision support systems (DSS) are used, which facilitates DSS schedulers into achieving collective reversal supply chain management operations.
- h) Smart solid waste management technology is enforced into pragmatic industrialized surroundings along with is proven into surge productivity along with reversal supply chain management
- i) Partnership opportunity of the private sector found in detritus interment.

D. Challenges

- a) As long as collection and transportation deficit in manpower and transportation is the sole of key challenges in smart solid waste management.
- b) The absence of outlining landfill sites for ultimate disposal is likewise considerable challenges.
- c) The contractor doesn't have a significant system in place to adequately track and monitor. This work was given by the municipal bodies to contractors.
- d) There will be a tremendous amount of population in the future. So the chance of lack of awareness in segregation and incompetence directed towards imposing separation.
- e) Public disposing of their waste only in their designated garbage bins.
- f) Segregation is a major factor for waste processing and treatment both are firmly surmised on segregation.
- g) Defined (limited) opportunity and thus have not certainly benefited the complete value of a smart solution.
- h) The main challenges are not related to technology is mainly depend on people's mentality.
- i) Smart solid waste management solution deployments are slowing down due to delays in decision making.
- j) Varied portion appropriate to waste diminished the long term energy content about the municipal solid waste.

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k) Powerless implementation of aborted guidelines and design relevant to the waste sector.

E. Threats

- a) Inadequacy appropriate to consciousness amidst waste handler around occupational well-being threats
- b) Environmental pollution, as a result, of into origination of leachate also landfill gases against the open dumping site.

V. RESULT & DISCUSSION

Table I. Summary of SWOT Analysis in Smart Solid waste Technology

Sr.No	Parameter	Discussion
1.	Strength	Smart Solid waste technology improves the growth of society and reduces time.
2.	Weakness	Requires a more skillful person with proper training and cutback for inexperienced person
3.	Opportunities	Using sensor technology, in smart Solid waste technology facilitates powerful monitoring.
4.	Threat	Improper collection and handling of waste which turns hazardous to public health.

The summary of the table shows that in smart solid waste technology there are some advantages and drawbacks. Future development is based on smartness. The smart technology will provide benefits along with also help to identify the problem involved in the implementation. In order to implement the infrastructure project, SWOT analysis techniques will help to find challenges, threats involved in the technology.

VI. CONCLUSION

From the SWOT analysis of SSWM infrastructure, the paper concluded that the function of smart technology in the WM process will optimize the cost and resources in the long run and makes the city smarter and healthy environment. It also improves the income of society. People who involved in a smart waste management system require training and unemployment will increase for an unskilled person due to a reduction in manpower requirements. Thus, smart solid waste management technology will provide more benefits to citizens at the same time there are some drawbacks & challenges in the technology. But solid waste management infrastructure development is needed in every city in order to improve the standard of living and to make a safer environment. Smart technology makes it more efficient in an effective manner.

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