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Literature survey for solid waste management using Artificial Intelligence and machine Learning Technique.

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Abstract:

Now a day's solid waste generation become a large problem. To manage the solid waste is important otherwise it will cause hazardous issue , Artificial Intelligence and Machine learning technology is used in waste management system. Due to Fast increase in population, the improper waste management in cities resulting in increased pests and spreading of diseases, dumping garbage onto the streets and in public areas is a common synopsis found in all developing countries and this affecting the environment and creating several unhygienic conditions. In order to deal with these problems there will be solution that developed proper design a combination of hardware and software technologies is like smart dustbin like that to the normal dustbin in order to provide free internet facilities to the user for a particular period of time. The technology awards the user for keeping the surrounding clean and thus work hand in hand for the proper waste management in a locality. Smart net bin uses multiple technologies firstly the technology for measuring the amount of trash dumped secondly the movement of the waste and lastly sending necessary signals and connecting the user to the Wi-Fi system. The proposed system will function on client server model, a cause that will assure clean environment, good health, and pollution free society

Keywords:

Smart waste management; solid waste generation; waste disposal; artificial Intelligence; machine learning; deep learning; smart cities.

Introduction:

Municipal solid waste term is defined as the everyday solid and semi-solid waste generated in urban areas. It includes household, business, constructional, medical, and organizational and Municipalities waste. Due to rate of increasing solid waste is very high it causes many imbalances of ecological system. Now a days we see the method of solid waste management is like collection of solid waste from every area by using vehicle which goes house to house which is very tedious, long term and time-consuming process. And we don't have surety about all garbage is collected properly or not. After that collection of solid waste is processing and landfill but this method is not more effective. Many researchers, scientist focus on solid waste management.it essential to manage and trace trash. It is becoming more commonplace to handle municipal waste globally. Municipal waste management is significantly impacted by legal, environmental, political, technical, social, and economic aspects. These problems are complex by a lack of knowledge implementation of and uncertainty, necessitating the adoption of advanced modelling techniques for study and implementation. Many technical complexities are present in municipal garbage management tasks. They also bring a variety of issues that need to be addressed and fixed on the political, economic, and social fronts. The concept is becoming more and more popular worldwide thanks to modern technology and an operational strategy. Implementing comprehensive municipal solid waste management plan is a crucial component of the idea of a smart city. The scientific community has connected inadequate planning and poor operational strategies to poor waste management. The application of artificial intelligence has changed many industries. The application of artificial intelligence (AI) is well established in the automotive, electronics, and other industries; however, more

recent developments have focused on the recycling and waste management sectors. The current waste management systems are unable to handle the enormous amounts of garbage that are produced every day.AI must be used to plan various municipal solid waste management tasks in order to control garbage, which is now a necessity. Reducing, reusing, recycling, and recovering are strategies to mitigate the damaging consequences of human activities on the environment. A number of institutional, professional, climatic, environmental, and financial restrictions frequently place restrictions on waste management practices. Providing computational solutions to problems with municipal solid waste management (MSWM), artificial intelligence (AI) technologies have recently become more significant. AI can help better planning and disposal strategies, analyzing data on what types of waste are being produced and where they are being disposed of, we can identify areas to improve our garbage disposal methods. Waste management companies need an efficient route plan for their trucks to do this as efficiently as possible. With the help of artificial intelligence, waste management companies can develop detailed maps of each area they service. They can use them to find the best routes for their trucks. This can help to reduce travel time and fuel costs, as well as emissions from the trucks. Recycling has not always been an integral part of waste management. Yet, it is becoming increasingly important as we move towards a more sustainable future. In most countries, the sorting and recycling of waste are done by hand.

This process is slow, inefficient, and often results in recyclable materials being discarded. With the help of artificial intelligence, we can develop sorting algorithms that can identify and separate different types of recyclable material with the utmost accuracy. This would speed up the recycling process, but it would also help reduce the amount of recyclable material discarded each year. With the help of artificial intelligence, we can develop sorting algorithms that can identify and separate different types of recyclable material with the utmost accuracy. This would speed up the recycling process, but it would also help reduce the amount of recyclable material discarded each year.

Literature review:

Waste is generated from many sources like agricultural industrial, hospital, household. Generally waste is classified into various types, Bio-medical waste are the waste generated from hospitals and clinics, this types of waste need to handle separately and safely, In Biodegradable waste, waste is generated from vegetable market, hotels, temples from this waste we can make successfully compost and vermicomposting [], another major problem of waste is E-waste ,this waste is generated from electronics product such as computer ,TV, Fridge
,scanner, printer like electronics waste it contain toxic material such as lithium, lead, mercury etc due to improper management of this waste it causes pollution and effect on human health. Plastic waste is a major problem now a days, due to improper management leads to leach into environmental, by using pyrolysis technique plastic waste converted into fuel.

In a traditional method of waste management collection of solid waste is carried out waste is collected from door to door after collection transportation then segregation and dump the waste In landfill this technique is used. By dumping solid waste in open land can causes soil pollution, bad odour, when waste are burn it cause air pollution so it is necessary to manage solid waste. Solid waste management waste collection is important things, waste are collected at different places after collection of waste, waste segregation is important thing. There are many ways to filtering the waste .recycle and sorting of waste is possible due to segregation
,now a days waste is sorted manually so it is tedious and time-consuming task. By using advance technology like machine learning and artificial intelligence automated system can be possible.in machine learning algorithm machine algorithm is design according to requirement of operation on waste. In machine learning algorithm sensors can be include in algorithm and it is useful for decision making. The machine is trained for identification of Plastic, wood, glass etc according to those answers are stored in a system so after passing waste from that system it is sorted.

AI based techniques are used in solid waste management for prediction and optimization [1].by using optimizing technique collection of solid waste, find out proper place for bin, finding the best route for transportation and after that disposal is carried out.in solid waste management for classification of waste image processing techniques is useful technique where solid waste is classified into wood, plastic, rubber etc. Artificial Neural Network, particle swam optimization, K Nearest Neighbor, Support Vector Machine, these techniques are used in SWM [2].

For prediction of Generation of MSW various AI techniques have been used. ANN is more effective technique .hybrid techniques means combination of different techniques it is useful for better performance and provide higher accuracy [3].forecasting municipal solid waste SVM with least square, federated learning is used, also GA, Discrete wavelet theory, Artificial Neural Fuzzy Inference system (ANFIS) is used.[5]

Data pre-processing is vital role in SWM. If the data process properly then it is not difficult to train the data and will get proper output.

Analysis of current solid waste management:

In various city solid waste management carried out by municipality, municipality worker collect the solid waste from door to door and many bins are kept in crowded points like markets, riverside, complexes, hospitals etc but this is not proper management of municipality for solid waste because rate of solid waste generation is higher as compare that processing rate of solid waste is low

and it its take a lot of time the reason behind that is municipality don't have the sufficient resources and infrastructures, equipment's.one of the major thing is noticed that all these things have been doing manually so survey is not done on daily basis so problem of illegal dumping increases. Due to this reason forecasting of future waste unable to find out and due to not getting proper input unable to process or unable to find out which technique are useful for management of solid waste. Also, one thing is noticed that there is no proper monitoring of vehicle used for collection of solid waste so proper optimization technique are not used so fuel cost may increase. Also, one important factor about the collection of waste is that time is not fixed of vehicle so all waste is not collected on daily basis so people drop the waste at roadside and in open places so all these things damage image of city. For recovering all these things many techniques may useful for managing wastes.

Various AI and ML techniques are used

Machine learning algorithm are used for both regression as well as classification.

Algorithms:

Name	Description	Reference
ANN	It is useful for nonlinear relationship. Most important thing of ANN is it provide uninterrupted service. Use for regression and classification. It can store information on complete network. If one or more cell fail it can effect on output. It uses distributed memory system. For prediction of landfill, leachate generation, landfill area estimation.	Abunam et al(2019)
SVM	it is useful for small sample and minimal error generate it is used for pattern recognition , classification, regression. It can handle nonlinear data also.	Abunam et al(2019)

	For prediction of landfill, leachate generation.	
DT	by using result can be predicted accurately. Data processing and cleaning can possible with low data base.	Kannangara et al.[2021]
KNN	No need of assumption of input . No need of training for prediction of output. It is easy for implementation.	Abbasi and El Hanandeh[2016]
ANFIS:	It is combination of neural network and fuzzy logic but it is not suited for high dimensional feature	Abbasi and El Hanandeh[2016]
K-means	It can implement easily and two or technology can integrate into single device.	
RF	Reduce model variance and no feature selection required. Its noise is occurred still problem is solved. Is useful for regression and classification. No need of normalized data.	
Deep Neural Network(DNN)	It is useful for prediction, regression and classification.	
GA	Useful for clustering, classification and regression. It is useful for discrete as well as continuous data. Easy for modification.	
Multilayer Perceptron(MLP)	Useful for classification and regression. Useful for large Data set. It provides better solution for Nonlinear problem	
Recurrent Neural Network(RNN)	Useful for regression and classification. It is also useful for sharing. Easy for solving Time series forecasting problem	

For location of prediction, the methods used are multi-criteria spatial analysis for machine learning

Sr.No.	Methods	Input	Reference.
1	Multi-criteria spatial analysis.	RS and GIS Data	[6]
2	Expert analysis	Satellite Image Data	[7]
3	Multivariate Factor analysis using a GIS geostatistical model	GIS mapped data with different factors.	[8]

4	Expert analysis and Heuristic Model	Data Extracted from RS and GIS	[9]
5	Linear regression	Data Extracted from GIS mapped data with different sources.	[10]

For Location Identification and classification following methods are used

Sr.No.	Methods	Input	Reference.
1	Multitemporal photo Interpretation using a multipara metric sensing platform for Heuristic Model.	RS-multispectral high spatial resolution data sets mapped with GIS	[12]
2	Heuristic and manual analysis using ArcGIS 10.3 and Statistica 12 software	GIS mapped previous data	[13]
3	Heuristic method using multi-Temporal land surface temperature contours and overlay analysis.	RS-Thermal images.	[14]
4	Discriminant analysis technique for feature selection.	Data extracted from RS and GIS	[15]
5	A Heuristic algorithm based on trace transformation using discrete orthogonal transformations.	Remote Sensing High resolution satellite images	[16]

For Image Classification following methods are used

Sr.No.	Methods	Input	Reference.
1	Spatial and spectral information analysis	Satellite Image Data	[17]
2	Principal Component Transformation and spectral signature analysis using unsupervised algorithm ISODATA	RS thermal maps	[18]
3	Support Vector machine and Random Forest Classifier	RS-high-resolution image data	[19]
4	Multi-features detection algorithm followed by expert photo-interpretation	RS-optical satellite images mapped with GIS	[20]
5	k-nearest neighbour,naïve Bays and support vector machine	Manually captured street data	[21]

6	A Heuristic algorithm based on trace transformation using discrete orthogonal transformation	Remote sensing high resolution satellite images.	[22]
7	ResNet50 algorithm and feature pyramid network	Satellite aerial imagery data	[23]

Above techniques are used for SWM but for effective management of SWM grouping of 2 more technique may be useful. For forecasting of output for generation of solid waste ANN can be group with RSM,GA, MLP. Calculating of How much waste is generated in specific time is very important factor in solid waste management. If this is not calculated correctly it causes many problems.so many AI techniques are useful for prediction of solid waste. For hospital waste generation prediction AI and Regression technique is useful. (Golbaz et al., 2019). For forecasting solid waste mainly used area, socioeconomic satisfaction and population used for analysis. Time series analysis is useful for prediction of solid waste Generation. CNN model is useful for train the data set for classification of model from this will get higher accuracy. Generally, in solid waste management waste like paper, metal etc is recycle and reuse. The waste is which biodegradable is converted into compost

Land fill is area where solid waste is dumped. Landfill is large area, where the waste which are unable to recycle that waste is collected in this place. By using ML algorithm solid monitoring of solid waste is possible. By using ML algorithm classification of solid waste into hazardous and non-hazardous will be possible. For generation of energy from waste traditional method is incineration in this process waste material is burn and produces ash, gas and heat. This is traditional method. Waste is burn at very high temperature and it react with oxygen in air so it causes air pollution.

illegal dumping is a major problem, the reason behind that is bin are not fixed at proper places and time of collection of waste is not fixed .so for this dump detection technique is used usually this technique is carried out manually in this technique open place, road side area like is used for dumping that area is find out supervised by human being but this not proper technique. Illegal dumping waste causes many problems like pollution of air, water, soil. Also decreases soil fertility also. Better solution for illegal dumping will be use of machine learning algorithm, CNN is more useful technique used for image recognition, CNN helpful for train the data for classification of solid waste like organic, recycle ,non-recycle material, hazardous
, non-hazardous waste. From waste if we want separate some objects that also possible by using object detection technique. Segmentation is useful for analysis as well as accurate measurement. CNN is also useful for sorting the waste like rubber, plastic ,wood, also useful for classification of same color or shape wise or size wise objects. CNN has an ability to classifying direct images from Data.by using satellite imagery data illegal dumping in city cab be identified. The open-source software tensor-flow is useful for training and inferencing in CNN based model, for this construction of model dataset are form by using online images from sources as well as camera captured images. After that image are cleaned which are images are not useful are deleted from data base, image scaling is carried out, after that dataset is divided for training set. After that tune the hyper parameters and analyses why model is not developed yet according to that correct parameter selection process carried out, CNN architecture defines and train the model and then evaluate that how much garbage is collected and processed.

Dump Detection related work, the traditional dump detection process is very time consuming, expensive and manual process.in this process identifies the illegal dumping spot after that collected waste and transport that waste at particular place after that segregation is carried out. For this process required more manpower. For this procedure continuous survey required. Many methods and techniques are published some are mention below, In 2002 for classification of industrial waste disposal site images of illegal dumping are taken using spatial and spectral information and analysis of images machine learning model are used in that where input is given to that model is satellite images and generated output is classified images and analysis is carried out.

Conclusion:

In Waste management system AI and ML are very powerful technique for sorting of waste. Recycling process is carried out with the help ML algorithm and AI technology which is reduce the cost, pollution increase the speed of operation, recycling process is cleverly carried out. Separation of waste into glass, plastic, cardboard, wood is possible. AI also helpful for composting technique.AI Technique is useful for accurate detection of waste. Using sensors waste bin filling system monitored. Wet or dry waste also separated

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3) (Ahmadi et al., 157 2021; Huang et al., 2021; Mirzadeh et al., 2022; Ullah et al., 2022a)

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