

Garbage Collection and Identification System

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ABSTRACT

Garbage collection and identification encompass a series of essential processes aimed at gathering, recognizing, and categorizing diverse waste materials to ensure their appropriate disposal and recycling. Considering the escalating global waste generation, it has become increasingly vital to devise effective strategies for waste management and reduction. Garbage identification can be carried out through manual inspection performed by trained personnel or by leveraging advanced technologies such as artificial intelligence (AI) and machine learning (ML). Manual inspection involves visually examining the waste and categorizing it into various types, including organic waste, plastic waste, metal waste, hazardous waste, and others. However, this method can be time-consuming and subjective, hence the integration of AI and ML technologies (like CNN, DenseNet121, TrashNet etc) to automate and enhance the identification process. Recycling processes that require a lot of work might be simplified with the help of an automatic classification robot based on efficient image recognition. DenseNet121 and other convolutional neural network (CNN) models improved traditional image identification techniques at the time and were the industry standard. The effectiveness of the CNNs was evaluated using TrashNet, a well-known benchmark dataset made up of 2527 pictures containing six different sorts of waste. Ultimately, these efforts contribute to reducing waste generation and conserving valuable resources.

Keywords:- Garbage collection, CNN, DenseNet121, TrashNet, AI and ML algorithms, identification, resources.

INTRODUCTION

Garbage collection and identification is the process of collecting, identifying, and separating different types of waste materials to facilitate efficient waste management practices. The increasing amount of waste generated by society has led to a growing need for more efficient and sustainable waste management practices. Trash identification plays a crucial role in ensuring that recyclable materials are separated from non-recyclable materials and processed

correctly. Here, the project uses manual labour; advanced technologies such as computer vision and machine learning are to be used to improve the accuracy and efficiency of trash identification.

By utilizing AI and ML algorithms, waste materials can be classified accurately and efficiently. These technologies can analyse the characteristics of the waste, such as its composition, colour, texture, and shape, to determine its category. This automated identification process not only saves time but also enhances accuracy and

consistency, leading to more effective waste management outcomes.

Garbage identification also involves educating individuals about the significance of proper waste disposal and recycling practices. By raising awareness and promoting environmentally responsible behaviour, the amount of waste generated can be reduced. Public education campaigns can emphasize the importance of waste sorting, recycling, and the long-term benefits of sustainable waste management practices.

Fine-tuning the hyper-parameters of CNN's fully-connected-layer was never used. The data augmentation method may be used to increase the accuracy of trash classification powered by CNNs. Consequently, this study also aims to utilize a Genetic Algorithm (GA) to optimize DenseNet121's fully connected layer in order to improve DenseNet121's classification accuracy on TrashNet and provides the optimized DenseNet121. Recycling and landfilling are two waste management practices that result in waste removal. Real-time data monitoring and classification are both made possible by deep learning and the Internet of Things (IoT). The system's objective is to improve waste management procedures by utilizing cutting-edge technologies.

Proper identification and segregation of waste are crucial for implementing suitable disposal methods. Each type of waste necessitates specific handling and treatment to minimize environmental impact and public health risks. For instance, organic waste can be composted, while plastic waste may require recycling or appropriate disposal in landfills. Identifying waste accurately ensures that it is managed in the most suitable and environmentally friendly manner.

Furthermore, separating recyclable materials from non-recyclable waste is a

key step in waste reduction and resource conservation. By identifying and segregating recyclable items, such as paper, glass, or certain plastics, they can be sent for recycling instead of being discarded in landfills. Recycling helps conserve natural resources, reduce energy consumption, and mitigate environmental pollution associated with the production of new materials.

Waste management is critical to maintain a healthy ecosystem. To accomplish this, it is critical to identify and segregate various types of waste materials, as well as increase trash sorting efficiency. We may limit the amount of waste sent to landfills and promote sustainable waste management practises by doing so. Furthermore, it includes direct payment to rag-pickers by linking their bank accounts to motivate and support their efforts. Aside from that, it must be taught to the people the moral teachings to keep the environment clean and promote the concept of reducing, reusing, and recycling waste for a brighter future for our world.

LITERATURE REVIEW

An automatic classification robot based on effective image recognition could aid in the reduction of labour-intensive recycling operations. Convolutional neural network (CNN) models, such as DenseNet121, advanced classical image recognition technologies and were the leading approach to image recognition at the time. TrashNet, a well-known benchmark dataset consisting of 2527 photos with six different garbage types, was used to assess the performance of the CNNs [1-4].

The data augmentation method might be used to improve the accuracy of waste classification driven by CNNs, however fine-tuning the hyper-parameters of CNN's fully-connected-layer was never applied. Subsequently, notwithstanding information

increase, this review looks to utilize a hereditary calculation (GA) to streamline the completely associated layer of DenseNet121 for improving DenseNet121's characterization exactness on TrashNet and offers the upgraded DenseNet121. Squander the board prompts the destruction of waste led by reusing and landfilling. Classification and real-time data monitoring can both be accomplished quickly with the help of both the Internet of Things (IoT) and deep learning. Utilizing cutting-edge technology, the system aims to improve waste management procedures.

The suggested technique in the study involves using IoT (accessories like AtMega328p, sensors like passive infrared (PIR) sensor and many more) and Bluetooth connectivity for data monitoring purposes. The IoT technology enables the collection and transmission of real-time data from waste management components. This means that waste management activities can be remotely monitored and controlled, providing valuable insights into the system's performance [2].

Additionally, Bluetooth connectivity is utilized to facilitate short-range data monitoring. This can be achieved through either an Android application or a website, allowing users to access and monitor waste management data from nearby devices. The use of Bluetooth enables convenient and wireless communication between the waste management system and the monitoring interface.

By combining deep learning algorithms, IoT, and Bluetooth connectivity, the proposed waste management system aims to improve overall efficiency, accuracy, and convenience in managing waste. The system provides real-time data insights and enables remote monitoring, which can assist in identifying patterns, optimizing

waste collection routes, detecting anomalies, and making data-driven decisions for better waste management practices.

When employed for environmental big data analysis, the efficacy of widely used term-weighting techniques and machine learning (ML) classifiers with default parameter values was assessed. Support vector machine (SVM), Naive Bayes (NB), logistic regression (LR), random forest (RF), and extreme gradient boosting (XGBoost) were five different ML classifiers that were tested.

Five term-weighting plans were likewise tried, including term recurrence (TF), TF-converse archive recurrence (TF-IDF), Best Match 25 (BM25), TF-backwards gravity second (TF-IGM), and TF-IDF-reverse class recurrence (TF-IDF-ICF). The most successful text-classification systems and classifiers, respectively, were TF-IDF-ICF and LR. According to evaluation criteria, their combination gave the best results of any scheme and classifier combinations for the complete study of environmental data [5].

METHODOLOGY

The proposed system operates as follows: When a user has recyclable waste, they enter the type of waste (Dry, Wet, or E-waste) and the quantity into the system. This information is then relayed to the waste collector along with the user's location.

Upon receiving the information, the waste collector assesses whether the waste matches the description provided by the user and verifies the quantity. If the waste matches and meets the required quantity, both the user and the waste collector are rewarded with a small monetary incentive. This reward system serves as a motivating

factor for users to participate in waste recycling efforts.

However, if the waste does not match the user's description or does not meet the required quantity, the waste collector charges a small fee for its removal from the user's location. This fee acts as a deterrent for improper waste disposal and encourages users to accurately report their waste.

Once collected, the waste is then segregated into the different types mentioned earlier (Dry, Wet, and E-waste). If enough of each waste type is accumulated, it is sent for recycling. Recycling facilities require a minimum amount of waste to be cost-effective and efficient in their processes. Therefore, by storing the waste until a minimum threshold is reached, the system ensures that the recycling process can be carried out effectively.

In brief, the system incentivizes users to accurately report their recyclable waste by providing small monetary rewards for matched and enough. In cases where the waste does not meet the requirements, a fee is charged for its removal. The waste is then segregated and stored until a minimum quantity is reached for efficient recycling. This approach encourages responsible waste management, rewards proper waste disposal, and ensures effective recycling processes are in place.

RESULT

Cleaning the environment is a crucial responsibility that we all bear to ensure the preservation of a healthy and sustainable ecosystem. However, for many individuals, this task can be quite unpleasant and repulsive. Therefore, it is of utmost importance to introduce uncomplicated, incentive-based solutions that motivate people to act.

One effective approach to encourage individuals to clean up their environment is by implementing a system like LitterLess. This system involves the provision of easily accessible recycling containers, making the process of recycling straightforward and convenient. To further incentivize and acknowledge people's consistent recycling efforts, a rewards program can be integrated into the system. This reward-based approach taps into people's intrinsic motivation, providing them with a sense of achievement and satisfaction for actively contributing to a cleaner environment.

In addition to individual efforts, community involvement plays a significant role in environmental cleanliness. Organizing community clean-up events can foster a sense of duty and ownership among participants. By actively engaging in cleaning activities together, community members develop a shared responsibility for the environment. Recognizing and rewarding the efforts of these participants can further reinforce the idea of collective action and inspire others to get involved.

It is essential to recognize that even small improvements can make a significant impact. Encouraging individuals to make minor changes in their daily routines, such as reducing waste or opting for sustainable alternatives, can collectively contribute to a cleaner and healthier environment. Offering incentives and rewards can serve as powerful motivators to inspire people to adopt these sustainable practices and actively participate in preserving the environment for future generations.

By combining straightforward solutions, such as LitterLess and community clean-up events, with incentivization and recognition, we can foster a culture of environmental responsibility. By encouraging everyone to do their part, we

can collectively create a cleaner, healthier, and more sustainable environment that benefits current and future generations.

CONCLUSION

Advanced technologies such as computer vision, machine learning, and IoT devices have the potential to accurately and efficiently identify waste products. By harnessing these technologies, valuable data can be obtained, leading to improvements in waste collection and recycling processes, a reduction in waste pollution, and the preservation of natural resources. The application of computer vision and machine learning allows for the automated recognition and classification of waste items. This technology can analyse images or video footage of waste materials and identify their specific categories, such as plastic, glass, paper, or organic waste. The data obtained from this process can then be utilized to optimize waste management strategies.

By accurately identifying different types of waste materials, several positive outcomes can be achieved. Firstly, it enables environmental conservation efforts by facilitating more efficient recycling practices. Waste items can be sorted correctly, ensuring that recyclable materials are appropriately processed, and non-recyclable waste is disposed of in an environmentally friendly manner. Apart from that, this waste identification method finds applications in municipal and industrial waste management. It aids in monitoring and managing waste generated by cities and industries, allowing for better planning and allocation of resources. The data collected can inform decision-making processes and enable the implementation of targeted waste reduction initiatives.

Additionally, this technology supports smart waste management systems. IoT devices can be integrated into waste bins

and containers to monitor the fill level and optimize waste collection routes. This helps in minimizing the amount of garbage that is transported to landfills, leading to cost savings and a reduction in environmental impact. Furthermore, the identification and sorting of waste materials can assist in the safe disposal of hazardous substances. By separating and handling hazardous waste appropriately, potential risks to human health and the environment can be mitigated.

An important aspect of implementing waste detection technology is the opportunity to reward individuals involved in waste management, such as rag-pickers or recycling workers. By accurately identifying the different waste categories, it becomes feasible to track and reward their efforts accordingly. This recognition can serve as a motivation for these essential workers and promote a sense of value and appreciation for their contributions.

In conclusion, leveraging advanced technologies like computer vision, machine learning, and IoT devices for waste identification offers numerous benefits. It enables improvements in waste collection, recycling processes, resource conservation, and the safe disposal of hazardous materials. By accurately identifying waste categories, we can minimize landfill waste, preserve natural resources, and provide incentives to those involved in waste management.

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