Waste solid management using Machine learning approch

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***Abstract*—Information and communication technologies (ICT) allow the creation of smart cities to provide better quality services to citizens by exchanging information with the general public. In Morocco, the waste management is the primary challenge for the competent authority to reduce the amount of solid waste generated and satisfy the environmental regulations. The waste collection and treatment plan is the first pillar to optimize in order to better manage the quantities of waste produced by different industrial activities. Smart technologies were identified as alternative solution having the required qualifications for the creation the smart cities. They haves great potential to increase the efficiency and quality of waste collection. High costs and low efficiency are the two main challenges of smart garbage collection. An inconsequent management leads to resources waste at all levels. For example, the city resources are misused and a colossal amount of gasoline is wasted every day. This problem can be solved by managing and protecting all storage spaces using machine learning technics. A key goal of machine learning is the development of algorithms to make future predictions. Machine Learning Based Automatic Waste Recycling Framework has been proposed to classify and separate materials in a mixed recycling application to improve the separation of complex waste. The main purpose of the present paper is to assess machine learning algorithms used in recycling systems. As result, Machine Learning (ML) and Internet of Things (IoT) were proposed for smart waste management to surround the waste collection issue in the smart city. Powered devices can be installed in waste containers, including recycling bins, and provide real-time data on waste-generation**

Keywords— machine learning, smart city, Internet of Things, waste management

I. INTRODUCTION

In Morocco an inconsequent management leads to resources waste at all levels. For example, the city resources are misused and a colossal amount of gasoline is wasted every day. This problem can be solved by managing and protecting all storage spaces using machine learning technics. The problems of solid waste increased because of urbanization rise in the population, and the consumption of packaging products, etc.

Consequently, the significant changes were recorded in the society such as the change in lifestyle, environmental awareness, etc. Therefore, waste management is a big problem commonly faced by countries across the globe. Overall, waste management is based on the following: residents who generate garbage, waste collectors, city administration and stakeholders.

Currently, waste management modes are not advanced enough to have an efficient waste management mechanism

Waste management refers to activities and actions which are required from initial conception to end product. Waste can be gas, liquid, and/or solid. Several numbers of processes are evolved to deal with all types of waste, including biological, industrial, and household. Household waste can be cardboards, plastics, papers, glasses, bio waste, etc. In household activities, no trash can be recycled or classified into biological or materials

Adequate supervision of waste results in a friendly biological environment.

II. OUTLINE OF MACHINE LEARNING APPROACH USED FOR WASTE RECYCLING IN SMART CITIES

Waste management is the set of activities and actions necessary from the beginning to waste disposal [1].

It involves the collection, treatment, transport, and disposal of waste, monitoring, and control of waste management [2].

Waste management refers to several waste management strategies. They can be used to dispose of, destroy, recycle, treat, reuse or control waste [3]. Waste management is primarily aimed at reducing the number of unused materials and preventing potential health and environmental risks [4].

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Waste management can be described as the actions necessary for waste management, from waste collection to recycling and monitoring [5].

Waste is an unwanted or unnecessary substance created by the activities of people and can be of all kinds when managing waste [6].

With each technique and mode of disposal, waste can be solid, liquid, or gaseous [7]. Human waste disposal refers to the collection, distribution, cleaning, and disposal of waste [8]. Waste disposal covers all aspects of human waste, including waste reduction [9].

Waste management is a broad topic; Waste management is a broad topic, comprising various components [10].

There are several types of waste such as bio-hazardous waste, chemical, and organic waste. Disposal and management solutions for different forms of waste are needed.

Waste is often deposited in incinerators for disposal in landfills. Both types of typical waste disposal generate environmental problems [11].

Some toxins can be absorbed which can be used for drinking water and end up in underground rivers. Waste management considers all aspects of waste [13].

Technological advances designed to facilitate efficient use of resources to reduce waste and enable better procedures are increasingly playing their role in smart sustainability as an important strategic prerequisite resource [14].

The circular economy built on these ideas can be said to work as demonstrated in the literature [15].

It covers a manufacturing and consumption strategy based on the reuse or recycling of materials as a contribution to extending the life cycle of goods [16].

Essentially, in a broader perspective of circular economy, the consumption and manufacturing of service products, the efficient use of renewable energy, and the reduction of waste towards innovative production flows must be taken into account [17].

This broader view requires a systemic and holistic interdisciplinary approach to the functioning of the economy as an interconnected system [18].

Each part has an impact on the functionality of the whole system, increasingly propagating this perspective mainly for questions of environmental and demographic development [19].

Smart cities have been suggested to address the waste collection challenges mentioned above and promote a sustainable environment [20].

In this context, humans examine digitization, especially artificial intelligence, in environmental technologies and how automated waste recycling can contribute to the transition to environmental sustainability [21].

Waste classification is an important step toward efficient sorting and separating into different patterns and types [22].

The demand for intelligent sorting is therefore increasing to promote intelligent recycling. The rest is divided into the importance of automated waste recycling and sustainability to improve smart city efficiency.

The reduction of the waste impact on the environment, health, etc. is possible by implementing efficient waste management.

Paper, cans, glass, and other recyclable materials can all be used in this way. Disposal of hazardous or toxic waste is one of the many types of waste managed. Disposal, recycling, recovery, and treatment of resources complete the list of operational components of waste management.

Machine learning (ML) plays a crucial role in automated sorting techniques for higher accuracy and better quality of waste separation. In addition to navigation and tracking capabilities, analysis of waste processing and optimization of required information would ultimately improve waste management efficiency by improving waste management.

III. RELATED WORKS

Individuals using digital technologies (DTS) are suggested as key enablers of recycling and reuse. There is little systematic guidance on using DTs to realize the full potential of circular solutions to improve resource efficiency and productivity. The system can be useful in identifying the gap between existing requirements and expected requirements and the new objectives required to fill it and developing a common language to integrate operations in all areas of study such as information systems and the circular economy research method. In the circular economy, data from DTs can be used to support smart resource management by creating, analyzing, extracting and exchanging data. A company's ability to transition to and benefit from the circular economy at scale depends on its ability to use this digital revolution effectively [23].

The multilayer convolutional neural network (ML-CNN) explored cities with several problems, including waste management directly dependent on the proportion of people living there. Municipalities and city governments rely on inefficient and costly human waste categorization systems. Automatic waste classification and management are necessary to improve waste recycling in developed areas. By minimizing the need to obtain fresh raw materials, better waste recycling can reduce the waste sent to waste disposal. Image segmentation has been used to conduct real-time experiments. To dispose of each piece of trash, the model guesses its class and activates the appropriate hammer when the object enters its designated basket [24].

Developed a way to recycle and dispose of waste more efficiently using the detection strategy. [11]. demonstrated the YOLOv3 (YOLOV3) algorithm resulting in ecological imbalance. According to the experimental results, the suggested YOLOv3 approach has sufficient generalizability potential for all classes of waste with a wide range of waste components. According to the results obtained, the proposed work effectively separates waste into two categories: biodegradable and non-biodegradable. However, the reduced detection time combined with the extraordinarily high prediction probability leaves room for further investigation. Optimization of results and probability of predictions for other real-world waste can be the subject of future work and optimization of results.

Barriers to the Internet of Things (IoT) adoption are discussed for smart city waste management. The current

research used hybrid multi-criteria decision-making (MCDM) techniques. Policymakers, stakeholders and government can benefit from this research to better understand the importance of IoT brokers affecting waste management practices. They can be better equipped to remove these barriers for more efficient implementation of IoT in smart city waste management projects. As a result of our research, a small number of barriers to IoT adoption were discovered. Waste management in smart cities can be divided into services, and stakeholders can be more successful if they execute it correctly [25-29].

III. Municipal Solid Waste Management Practices in the Study Area (Beni Mellal Morocco)

The city of Beni Mellal is a component of the region of Beni Mellal-Khenifra consistent with the new regional division admitted in Morocco in 2015 It covers a territory with a locality of 39 km and had approximately 192 676 inhabitants in keeping with the 2014 census. It's located within the centre of Morocco to the border of the western high range of mountains. The town is characterized by a continental climate: cold winters with hot summers and a median temperature of 18 °C. The subsequent figure shows the geographical situation of the town of Beni Mellal, the target of this study:

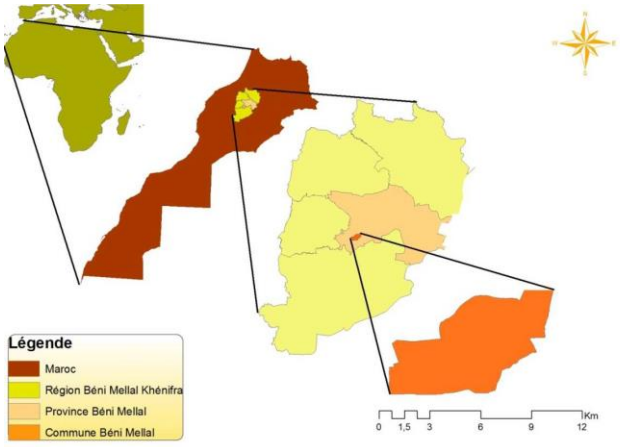

Figure 1 : Geographical location of the study area

IV. Automatic Machine Learning-Based Waste Recycling Framework (AMLWRF)

Recycling has become increasingly important as overcrowded cities grow around the world. As waste generation increases and resources become scarcer, recycling becomes more important. Recycling is one of the foremost critical and complicated environmental issues in the world. It's necessary to form a system capable of eliminating or a minimum minimizing this problem. Yes, this may be eliminated or reduced by creating a system. In addition to not knowing the way to recycle. Because of its ability to cut back greenhouse emission emissions, like CO2, CH4, N2O, and CFCs, recycling helps protect the environment by reducing air and pollution, and reducing energy consumption. Today, the govt. aims to make a wise environment or transform existing places into green infrastructure. Smart city technology should take solid waste collection seriously because it's important for the environment and influences society. There's a risk of spreading disease thanks to overflowing garbage cans. A rapid increase in the number of individuals wasted results in inefficient waste management. The burden sensor was inserted into one of all the dustbins and may be wont to discover the number of dust collected. The system software will be designed so that when the bin is full, the remaining height of the barrier height is displayed on the screen. Ultrasonic sensors can alert a GSM modem when the waste reaches the limit level. The modem can still send alerts to a chosen expert of garbage already collected from the bin. Garbage vehicles can collect garbage using robot components when the local expert sends a message to the separate admin. Figure 1 explores the fundamental scheme of waste management in an exceedingly smart city. Various wet and dry bins are placed during a certain geographical region (areas) and monitored and picked up under this technique. Garbage separation and collection were central to the event of a prototype waste management system. Trash cans equipped with sensors and communication systems are a part of the hardware subsystem, which monitors garbage status and collection schedules. Data management and visualization subsystems are included for management and analysis. In this fashion, we will build all the mandatory bins. The system architecture is about up once the subsequent steps are completed. They designed and built the hardware prototype of a waste bin level indicator. Each area has bins that contain solid waste, and all ultrasonic sensors. The sensors predict the waste from each container. A computer and technological circuits transmit the state of the ash-bin to a central cloud server. This module is liable for calculating the fastest route from garbage pickup vehicles to garbage cans as a part of its responsibilities. It implements an application that has this location and standing of waste containers on a world area display. This module can display bin status updates on the online application and send notifications to customers' mobile apps since bins transmit status updates in real time. Through this smartphone application, trash pickup truck drivers may be notified if the bins are in situ or on the shortest route to require emptying the refilled bins.

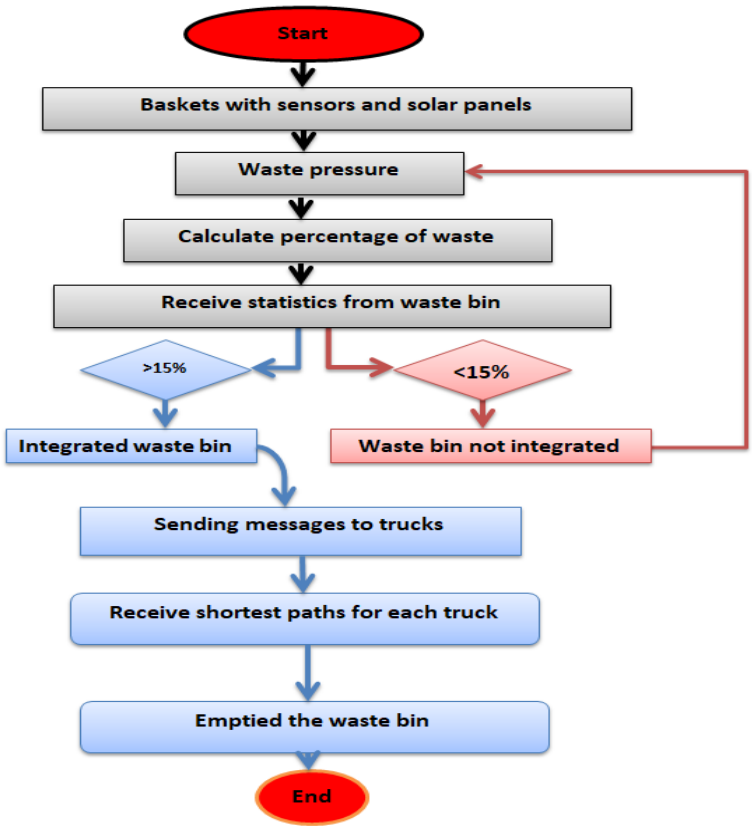

Figure 2 : Basic diagram of waste solid management in smart city (Beni Mellal).

in the structure of this intelligent system the trash are controlled with capture and using the energy of the solar panel because the city Beni Mellal is a sunny city then the pressure of the waste using the simple pressure of the waste as pressed cardboard is plastic. Once the pressure is carried out the sensor must be calculated percentage of each bins is calculating the statistics of bins. Receives messages from our system to know the shortest way to empty the baskets If not the trash not integrated and we are waiting for another percentage calculation.

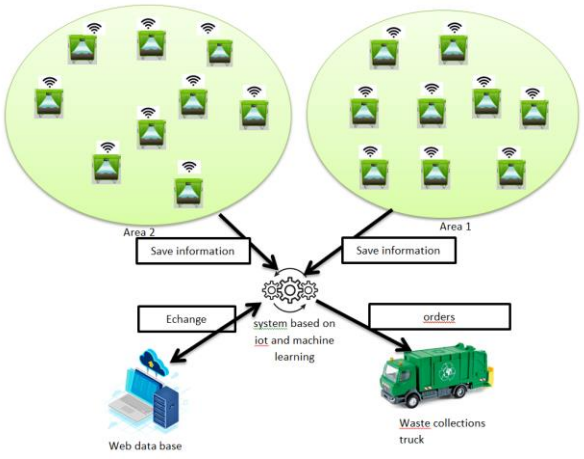

Figure 3: Waste solid collection process

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Through this smartphone application, a pickup driver is additionally notified if the bins are in situ or on the shortest route to require emptying the refilled bins.

V. CONCLUSION

The results reported during this article demonstrated how automated machine learning might be utilized in technology computing to accurately identify when a container has been fulfilled an evacuated.

This system develops the a part of management in an exceedingly more powerful and intelligent thanks to keep town cleaner and fewer of the matter of waste which is one in every of the challenges of the globe The system carries solutions to challenge solid waste must be to attenuate the price, circulation, cost, and number of emptying bins.

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