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Development Management Through The Use Of The Internet Of Things In Waste With An Emphasis On Smart Cities

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Abstract: With the development of the Internet of Things (IoT), waste management has emerged as a serious issue. Waste management is a day-to-day task in urban areas that requires a large workforce and affects the natural, budgetary, efficiency and social aspects. Lays; There are many methods for optimizing waste management such as using the nearest neighbor search, colony optimization, genetic algorithm and particle swarm optimization methods, however, the results are still very vague and cannot be found in real systems, such as universities Or cities, to be used, IoT-based citizens' waste management applications make urban waste management practices more sustainable, optimizing waste collection routes based on the amount of garbage filled by sensors is one of the most effective applications. Finally, waste recycling management requires deeper cooperation between the public and private sectors; in this article, while examining waste management with the IoT approach, the importance of this issue is examined and, of course, suggestions are made for metropolitan areas.

Keywords: IoT, waste management, smart city, Development management.

1. INTRODUCTION:

In recent years, urban management with the Internet of Things has developed a lot. Today, the Internet of Things has also opened its doors to municipal waste management systems. In other words, Android developers came up with the idea to build apps that make the waste management system easier in cities and allow waste to be collected separately (Cerchecci et.al 2018: Malapur, B. S., & Pattanshetti, 2017). It is interesting to know that in this regard, the bins are also equipped with an intelligent system. In such a way that sensors are used in these bins that inform the information to the municipal data center before the bins are filled. This seemingly small move has had a significant impact on waste management and has led to deeper cooperation between the public and private sectors, with sensors attached to roadside bins tracking the amount of waste in the bin and IoT to garbage trucks (Shyam et.al, 2017). Garbage warns automatically, but part of the problem is with garbage dumped directly on the road. In this case, the intervention of a citizen or human rights defender is needed to cover the collection of waste. The data of sensors and images sent by citizens are analyzed through a complex and multi-layered system, and from the previous data for machine learning platform training (ML), Waste identification and classification is used (Saha et al., 2017: Wen et.al, 2018). The ML platform uses images taken from the garbage of more than 60 places in the

city at different times of the day. The ML platform is also trained on common items commonly found in trash can so that it can be easily identified (Baby et.al, 2017: Gupta et.al, 2019). Every time garbage is thrown in a trash can, it should behave in a way that does not harm the environment or citizens. Therefore, it is very important to ensure that the waste is transported properly. Common waste disposal strategies include recycling, reducing or converting energy, and disposing of waste or placing it through waste surfaces before discharging non-combustible waste to landfills (Mirchandani et.al, 2017: Kanangara et al., 2018).

Using the ML application and analysis, landfills can manage capacity once an hour with dashboards to track each activity and daily mapping and landfilling. This enables them to accurately measure the exact size of the combustion processes, the amount of flue gas to be used, as well as the amount of energy required, the amount of waste collected from the flue gas, the ash produced and the solid components Non-mineral components that are not incinerated are also mapped. Appropriate measures can be taken in cooperation with other city government officials before the waste is transferred to recycling centers (Hong et.al, 2014: Anagnostopoulos et al., 2017).

Historically, the criterion of capacity management means "management of various inventories in a production plant" or "the right size to provide internal services in order to achieve current and future business goals"; This is a type of process management; In practical use, a system incorporates external factors such as product availability, market dynamics, demand forecasting, and internal resource allocation; however, an IoT-based ML platform for waste management manages the dimensions of mapping and tracking quickly and in a timely manner. For Integrating all of these needs has very little interference with humans, and most activities are automated, using an intelligent device that can analyze image data and perform a small number of humans if necessary (Nird et al., 2017).

On the other hand, waste management is an important part of urban management, especially in the field of environmental protection; Sustainable tools should be sought to manage, reduce and reuse waste generated in cities; The right step in this direction is to bring technology into everyday urban management operations; The Internet of Things (IoT) has successfully penetrated business aspects of the field; As the impact of the IoT on the waste management industry increases, the future of recycling looks promising; IoT programs in waste management effectively improve urban operations; Predetermined paths and methods of waste collection have increasingly been replaced by active bins with sensors and waste management applications. The success of IoT applications involves the collection of large amounts of data in a timely manner and the distribution of that data to users' insights. Take action. With the advancement of sensor technology, a set of everyday objects are connected to the Internet to exchange information; The most common application of IoT in waste management operations today is to optimize the automatic route of waste trucks (Marques et al, 2019: Dubey et al., 2020); These trucks generally follow a specific route every day to collect garbage. Connecting to the Internet of Things can save the time and money of these trucks, IoT applications in waste management can improve this scenario by informing health workers, trash cans connected to the sensor and the Internet can provide information about the level Collect the charge, temperature, location, or any type of data that the sensors collect; Using a user interface that shows locations and full-level levels (Bakhshi, & Ahmed, 2018).

In the other aspect of problem definition of this research, Development management is a process that includes the social definition of needs and it is embedded in public action. Development management is more than policy implementation in a rigid sense. Rather, it involves activities that steer and facilitate intervention towards the identification and meeting of human need, Management development is important to use of the Internet of Things in

waste with an emphasis on smart cities which want to take a proactive approach to growth. Training opportunities resulting in a knowledge sharing in the smart cities, In the following some example clarified.

Examples of using the Internet of Things in smart cities

Solid waste production has increased dramatically in the last few years; Solid waste management is an important and challenging environmental issue in the world; hence, there is a need to create an efficient system that can eliminate this problem or at least reduce it to a minimum. Today, every government around the world is planning to build smart cities or try to turn existing cities into smart cities; the collection of solid waste is an important point for the environment and its impact on society should be considered in the infrastructure of smart cities. IoT technologies can effectively provide such services in smart cities (Medvedev et al., 2015).

a) Songdo South Korea

Songdo International Business District is a smart city originally built on 600 hectares of rehabilitated land along Incheon Beach, 30 km southwest of Seoul, South Korea, and connected to Incheon International Airport by a 12.3 km reinforced concrete highway bridge. Songdo is a smart city in South Korea that uses a combination of IoT and sensors to work with the waste management system. Songdo's goal is to recycle 76% of its waste by 2020 through a very good and convenient waste management system, which is connected to a truck-free waste management system. Self-contained waste bins are located in the city. Pneumatic pipes direct waste directly from the site into the underground network of pipes and tunnels, which is connected to a central waste treatment center called the "Third Zone Garbage Collection Plant." Waste is automatically sorted and recovered, buried, or incinerated for energy. Some of the reported significant benefits are greater energy efficiency and reduced landfill and energy costs (Hong et.al, 2014).

Figure 1: Songdo waste management tools to Development management

B) ISB Global smart buckets in the UK
Using sensors installed on each bucket, the collection and synthesis of cloud-based data and an intelligent application has created a network of connected devices for effective waste management; Their system records information such as weight, volume, costs, number of trucks and stores all information (Lv et al, 2016).

Figure 2: An image of waste management tools by ISB Global smart buckets

C) Examples of using the Internet of Things in smart cities (Case study: Polish company Bin)
Divides the ability to identify and sort waste into four categories: glass, paper, plastic, and metal by integrating inputs from hardware units (sensors) into applications, the company can allow health departments to better analyze waste patterns and obtain permitted optimization paths, as well as encourage citizens to change their waste disposal habits (Giacobbe et al., 2016).

Figure 3: An image of waste management tools by Bin

D) Examples of using the Internet of Things in smart cities (Case study: Bigbelly in collaboration with the Downtown Alliance)

Smart trash cans have been turned into free Wi-Fi hotspots to test the design. Solar energy provides the power to compact the trash so that each trash can increase its internal volume., The Big Belly garbage management company has equipped two smart trash cans in downtown Manhattan with wireless Internet, each providing speeds of 50 to 75 Mbps per second. That's enough speed to download an HD movie in 9 minutes or upload 200 photos in 27 seconds, Big Bell has now applied for a loan from the mayor of New York to dispose of Wi-Fi bins in service-deprived neighborhoods. The company also plans to launch more pilot programs this year and use more smart bins in the fall of this year with the approval of the board of directors, as well as other cities in North America that will soon have garbage bins equipped with the Internet. They will be wireless, powered by solar panels, and equipped with sensors that measure the fullness and unpleasant odor of the bin and inform garbage collectors when to proceed. Empty bins, some other types of smart garbage bins, as soon as they are full, can compact the garbage. Adding Wi-Fi to the smart trash on the streets will no longer allow skyscrapers to block wireless internet signals. So citizens will have access to the Internet in blind spots, the energy required by the trash can will be supplied by solar panels, they will also be equipped with sensors that measure the fullness and unpleasant smell of the trash and will inform the garbage collectors what Time must empty the bins, some other types of this smart garbage bin, as soon as it is full, compact the garbage. Adding Wi-Fi to the smart trash on the streets will no longer allow skyscrapers to block wireless internet signals; therefore, citizens will have access to the Internet in blind spots (Castro Lundin et al., 2017).

Figure 4: Bigbelly waste management tools in collaboration with the Downtown Alliance

Existing and conventional methods for using the Internet of Things in waste management in smart cities (Comparative conclusion)

These methods are categorized as follows (Pardini et al., 2019; Van et al., 2018; Sarchiki et al., 2018); Siriavanshi et al., 2018; Aleyadeh and Taha, 2018; Marques et al., 2019):

- ✓ Smart bin: intelligent waste management system
- ✓ Smart city waste management using GSM
- ✓ Garbage collection and smart garbage based on IoT
- ✓ Intelligent waste control and disposal system using the Internet of Things
- ✓ Intelligent garage monitoring system for waste management
- ✓ Intelligent garbage collection system in residential areas
- ✓ Intelligent waste monitoring system using IoT
- ✓ The role of modern technology in helping municipal waste management
- ✓ Intelligent and wireless waste management
- ✓ Trash monitoring system using integrated technologies
- ✓ A versatile, scalable, intelligent waste system based on embedded devices with limited resources
- ✓ Attractive citizen waste management system with IoT capability
- ✓ Smart bin: Intelligent waste warning and forecasting system using machine learning
- ✓ Equal intelligent waste management system

The role of smart technologies in urban waste management

Intelligent technologies can be effective and enhance every aspect of urban life, including waste management. Installing small Internet of Things (IoT) sensors in the trash can send information about when these tanks will be filled, garbage collection and disposal (landfill). (Waste, incineration and recycling plants) must be interconnected, these sensors provide information to optimize the performance of vehicles to optimally collect and dispose of waste, this system allows urban management in areas that are difficult to access, Optimize and also collect at a time of day when traffic is less; In addition, intelligent waste management devices can be integrated with other intelligent solutions such as traffic control to increase productivity.

Waste management and use of IoT in metropolises

Garbage disposal is a major challenge for metropolitan areas. Today, government offices in smart cities such as Singapore, Dubai, Hong Kong, Amsterdam, Stockholm, Tokyo, Melbourne, Seattle, Chicago and Seoul are putting a lot of pressure on technology to adapt to every aspect of their cities. Have. The process of waste disposal in many of these cities has become a very smart practical management activity, today waste management in smart cities is a combination of devices or sensors that generate millions of data; The data obtained is entered into a cloud platform and prepared through a complex analytical framework for analysis and then reasonable and workable conclusions for service delivery to citizens. The whole process is done without the slightest human intervention. The most common use of the Internet of Things in waste management is route optimization, which reduces fuel consumption while emptying garbage bins in the city. The most popular and practical smart waste management solutions include endpoints (sensors), gateways, IoT operating systems, and web and mobile applications (Rybnytska et al, 2018).

Intelligent disposal of waste materials with IoT applications

Undoubtedly, you know that proper waste management is one of the most important parts of municipal management, which has a great impact on maintaining environmental health. However, all government, service and public systems must seek ways and technologies to reduce the production of recyclable waste and prevent the production of non-recyclable waste. Therefore, it is best to use the knowledge that people and students have to introduce new technologies into the urban management operations system, in this regard, using the new technologies of the Internet of Things industry, to great success in the waste management and recycling system, because IoT schemes in the waste management system has dramatically improved urban operations. These programs have eliminated the old methods of waste collection and instead use the latest technologies in the world, new programs to replace waste management (Murugaanandam et al., 2018)

One of the most effective uses of IoT in waste management systems is to optimize the automatic route of waste trucks. In this way, special trucks travel a certain route daily to collect garbage and avoid wasting extra time and money; As we mentioned at the beginning, today trash cans are connected to the sensor and the Internet, and through this, they get information about how much the bin is filled, where it is housed, and so on. Using these links, which indicate the location of the bins, the garbage collection machines are present at the site in a prioritized manner and proceed to clean up; one of the effective steps taken in this field is the use of digital tanks for automatic adjustment of waste classification. These bins, which have the ability to detect and sort waste into four categories: glass, paper, plastic and metal, were built by a Polish company called Bin. Even electronics that contain valuable materials such as gold, silver, platinum, etc. can be recycled and reused, such as raw materials such as iron, aluminum, and copper. This also makes it possible to recover e-waste and valuable resources (Kumar et al, 2016).

Among the ultimate goals of using IoT applications in the municipal waste management system is the possibility of complete separation of waste, the possibility of maximum waste recycling, cost reduction, saving time and providing better services to citizens (Liegeard, & Manning, 2020).

Components of intelligent waste management algorithm based on Internet of Things

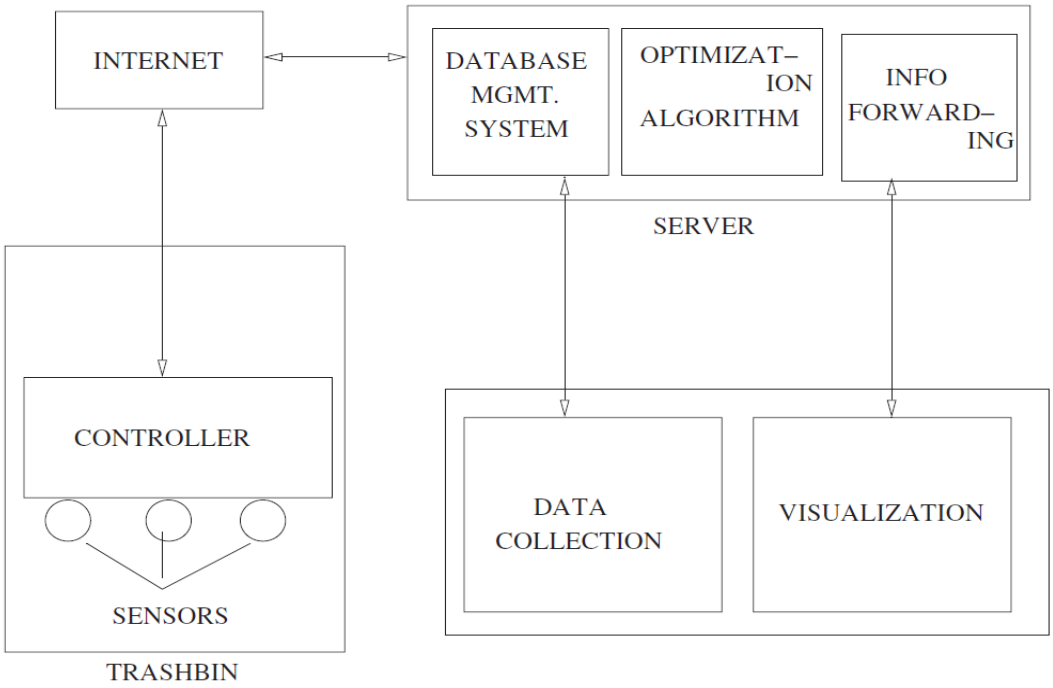
Inputs:

- ✓ The amount of waste generated
- ✓ The amount of waste embedded in IoT-based devices;

- ✓ Capacity of trash
- ✓ The nearest neighbor shortest path algorithm to find optimized items or optimized paths

Output: Optimized routes for visiting and discharging identified waste.
In other words, this algorithm is also schematically plotted as follows (Shyam et al., 2017):

Figure 5: Intelligent waste management algorithm based on the Internet of Things



Equivalent solutions of IoT in waste management
Combining radio frequency identification technology, regional mobile network and GIS, can play an important role in optimal waste management, this system by combining electronic knowledge and telecommunications, in addition to increasing the speed of waste collection from the city, by identifying and separating Waste will allow them to be recycled better. Finding a suitable place to bury waste is costly, time consuming and difficult due to its high sensitivity. The selected sites, in addition to providing technical and economic issues, must also meet all environmental standards. One of the best ways to optimally locate landfills is to use the GIS system, along with all these technologies wherever there is talk of a mechanized system. , GS1 can also have a solution along with RFID, internet and other related issues (Adam et al., 2018; Misra et al., 2018).

2. CONCLUSION AND SUGGESTIONS:

The land population is moving towards the urban areas that make up smart cities (SCs). Waste management is a component of SC. The realization of the IoT-based smart city depends significantly on many short and wide communication protocols to be able to transfer data between devices and internal servers. The most prominent short wireless technologies include Bluetooth, Wi-Fi, WiMAX and IEEE 802.11p, which are primarily used in smart metering, electronic surveillance and vehicle communications. With the help of the Internet of Things, various programs and devices can interact and talk with each other and even

humans through an Internet connection. The Internet of Things is a new technology that is useful in order to achieve a large number of digital devices with several capabilities of measurement, activation and computing with the Internet, so it offers new services in the field of a smart city. One of the applications of the Internet of Things in the field of household waste collection is smart trash (Mirchandani et al., 2017).

Waste management is the technique of processing solid waste and providing logical solutions for the use of objects that do not belong to the waste. Due to this, waste can be used as a valuable resource. Waste management makes it possible to use goods and materials that we can simply look at as an economic resource. Researchers have found that waste management has been analyzed for more than a century and forty years. There are eight basic approaches to waste management strategies, each of which is divided into different categories, which include waste recovery and use, animal nutrition, recycling, fertilization, fermentation, landfilling, incineration and use. Soil (Malapur & Pattanshetti, 2017) fortunately, the IoT can assist with any of the waste management steps.

In line with the issues raised, the following suggestions are provided:

- ✓ Proper waste disposal and management can be done by applying the 3R – Reduce, Reuse and Recycle. Reducing means lessening the amount of trash/garbage produced. Reusing refers to using materials more than once while recycling means creating new material or product out of trash/garbage.
- ✓ Embedding the IoT in waste management systems improves resource productivity, tracking and measurement. The IoT also acts as a response mechanism (for waste management and reporting) to municipal waste management.
- ✓ Installation of tracking systems for people and waste machines with an accuracy of less than one meter in different spaces
- ✓ Equip IoT teams with hardware kits to produce prototypes
- ✓ Utilization of this technology in creating a connection in the logistics of waste bins from origin to destination

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