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The Role of Artificial Intelligence in Waste Sector Management: The British Company Greyparrot & Saudi Experience Case Study

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Abstract: The topic studied the most prominent challenges of sustainable development, represented by the environmental challenge, which requires new methods to reduce the negative effects of various environmental factors.The research paper aims to highlight

how affect the most important applications of artificial intelligence the waste sector. For that, we choose the experience of the British company Greyparrot and the Saudi experience. It was found that both of them depend on smart applications and renewable energy systems, especially at the level of containers. The present study enhances the circular economy model (transformation, distribution and recovery), uncovering AI's role in waste management. Finally, we inspire managers with algorithms used for data-driven decisions.

Keywords: Artificial Intelligence; the British Company Greyparrot; Waste.

1. Introduction

Every year, millions of types of waste are disposed of, which pose a threat to the environment and human health if not properly treated, disposed of and recycled. This sector has witnessed many traditional methods, for disposing of and managing waste of all kinds, but these methods have witnessed a decline with the arrival of so-called artificial intelligence applications, which have entered the waste sector like many sectors. When we mention the term artificial intelligence, programming and digital come to mind. Many of us do not realize that this technology has a role in managing the waste sector, especially with the amount of waste generated around the world exceeding 2 billion tons annually, and this is accompanied by a steady growth in the population, which means that the amount will increase further in the coming years. Traditionally, the waste management process was largely manual and labor-intensive, but now, countries are turning to artificial intelligence in management and treatment processes.

The environmental challenge is considered the most serious and urgent, due to the large pollution of air, water and soil, which are the three main elements that make up the ecosystem, with the increasing phenomenon of global warming and climate change that the world is witnessing, which threatens the existence of... Man himself is on this earth, hence

the importance of using the latest technology to combat environmental pollution, in order to achieve the environmental sustainability that the United Nations seeks to achieve.

1.1. Research Problematic

Scientific and technological progress has resulted in the development of methods for treating and reusing electronic waste and making use of it in other fields. These methods and methods are considered environmentally friendly and work to reduce the damage resulting from the waste of technological developments. Artificial intelligence is considered the most prominent of these modern methods.

In order to be able to study this subject, we raise the following problem:

What are the applications of artificial intelligence in the field of waste recycling?

1.2. Study hypothesis

To answer the dilemma of the study, we suppose the following hypothesis:
Artificial intelligence (IA) uses many apllications and programms as e-cubes, new methods of collection and time manangement for managing the waste recycling

1.3. The importance of the study

The importance of the study is reflected in consideration of the latest problems raised globally related to many dimensions, most notably climate change and the need to preserve the environment from many factors. Waste is one of the biggest factors that pose a threat to the environment. The roads must be compensated for the traditional known to get rid of them or re -deprive them in other ways more effective, harmful and without negative side repercussions.

1.4. Research Aims

- Presenting the efforts made to develop artificial intelligence applications, and how it contributes to the management of this waste sector efficiently

- Highlighting artificial intelligence applications in waste management
- Extracting the most important results and lessons that can be used and applied for the Algerian economy

1.5. Study Approach

In this study, a descriptive and analytical approach was used, through the theoretical presentation of the various basic concepts associated with electronic waste, waste recycling, process and presentation of The British company Greyparrot case study.

2. Theoretical study

In this part, we will address theoretical concepts related to artificial intelligence, waste and waste management.

2.1. Artificial intelligence

This concept appeared for the first time in 1956 during the Dertmouth conference on artificial intelligence

- The process of developing programs and computer systems, to be able to perform tasks that usually require the human mind such as: visual perception, speech recognition, decision -making and translation (Alak & Dorid, 2022, p. 709)
- Artificial intelligence is the techniques that aim to reduce and eliminate routine works, as well as the lowest level functions (Kamish Khawla, 2023, p. 356)

2.2. Characteristics of Artificial intelligence

Artificial intelligence has a set of characteristics, that it acquired through and for the face of many areas unlimited, including: (Boubaha Souad, 2022, p. 90)

- Use it to solve the problems presented, complex cases and mysterious situations.
- Grant the ability to use thinking, learning, perception, acquire and apply knowledge, and use old experiences
- Raise the level of income and improve the standard of living.
- Increase growth rates and improve development indicators.
- Reducing cost and increasing efficiency.

2.3 Artificial intelligence level

Artificial intelligence is divided into three levels, classified as:

- Super artificial intelligence: It is used to describe the process of developing artificial intelligence where the machine's ability exceeds the ability of the human mind.
- Strong artificial intelligence: It is used to describe the process of developing artificial intelligence, where the ability of the intellectual machine is equal to the ability of the human mind.
- Weak artificial intelligence: It is considered narrow intelligence systems, has a specific intelligence that mimics the intelligence of the human mind in a specific and specific region.

2.4. The concept of waste

There are many definitions that were given to the concept of waste:

- Waste is generally defined as all materials that cannot be used economically, and cannot be recovered, and cannot be reused at a time and somewhere (Ahmed Abdel Wahab, 1997, p. 33).
- The Algerian legislator in Executive Decree 06/104 has identified the list of waste, including dangerous, which includes electronic waste, and it was also classified by assigning a number of a symbol that distinguishes each type of waste from others, so that the first number represents the category that determines the activity or the way that resulted from the metaphor, in When the second number represents the section that determines the origin or nature of the metaphor, while the third symbol represents the definition of the variety to which the waste belongs (Executive Decree 06/10)

3. Practical study

According to the reports of the World Bank, humans produced about 2.24 billion tons of solid waste in 2020. This amount is likely to increase by 73 percent by 2050 to 3.88 billion tons.

This problem prompted all countries and international bodies to create technologies to get rid of these waste of all kinds, and with the technological development these technologies developed and new methods, including artificial intelligence applications, have evolved, which we will address in this axis.

3.1. Application of artificial intelligence in the waste sector

The role of artificial intelligence in the waste sector began with garbage bins, and companies working in this field are benefiting from Internet of Things (IoT) sensors in order to monitor the fullness of garbage receptacles, so that the cleaning team can:

- Empty it when needed, which allows improving waste collection methods.
- Knowing the appropriate timing for unloading, as it helps save time and effort.
- Reducing labor costs and fuel consumption for machinery.

Computer vision annotations and machine learning algorithms allow these sensors to distinguish between different types of waste while filling bins, and reveal their categories. Examples of this include:

- Smart containers developed by the Polish company “Bin-e”.
- Korean “E-Cube labs”.

These are containers equipped with optical scanners that identify and classify waste directly,using an internal camera attached to the treatment unit. These bins are often paired with an app that allows users to know the location of the nearest available bin, preventing the bins from becoming overly full.

When it comes to the role of artificial intelligence in automated waste sorting, it can be compared to traditional methods:

➢ Human labor sorts between 30 to 40 recyclable materials per minute, while smart machines can handle up to 160 materials.

Machines can work around the clock. Artificial intelligence is similar to its role in the manufacturing process, where items on a moving conveyor belt are scanned. The scanning process is done through cameras and analyzed by deep learning algorithms. After that, robotic arms pull the items from the conveyor belt. For further processing, which includes sorting items. Sorting and recycling plastic waste is the main bottleneck for most waste management facilities, because most recycling operations start with a unified system, which means that all recycling materials end up in the same bin. After that, the elements such as plastic, cardboard, etc. are separated. Artificial intelligence comes into play because smart sensors are superior to traditional optical sensors, as they can detect items made of different materials, as well as identify subtle differences between items of the same material, including those that are chemically contaminated, ensuring their purity from hazardous materials in the event of remanufacturing.

3.2. Greyparrot waste management experience

- **Definition**

Founded in 2019, a startup based in London aims to improve waste management. Its founders combine over 20 years of AI experience to combat the waste crisis. Greyparrot has been named: TechCrunch Startup Wildcard Disrupting SF. Various types of plastic boxes and trays (PET HDPE black trays).

- **Process of work**

Greyparrot can use a simple camera with a computer to sort waste in a fraction of a second.

There are many different use cases for this type of technology but it appears particularly promising in sorting facilities. These facilities actually use a ton of machinery to separate small and large objects, metals from plastics, etc. But many of them still rely on humans at the end of the process to catch the last remaining false positives

Although you can never sort everything with 100% accuracy you want to get as close to 100% as possible. Sorting facilities create huge cubes of PET plastic material and send them to countries on the other side of the world so they can turn the PET into something else.

In some cases, these cubes are not pure enough. For example, Indonesia regularly rejects containers of waste and sends them to the United States

With the final step of the sorting process. The product can be used to evaluate the purity of the conveyor belt to see if it is good enough. It can also identify problematic objects and give coordinates to a sorting robot so it can automatically pick up impurities. The startup has been testing its solution at facilities in the UK and South Korea. It has raised $1.2 million so far.

- **The evolution of the company (**https://www.greyparrot.ai, 2024, p2**)**

The founders of Grey Parrots technology work to develop this technology for the raison of the global waste crisis that drove them to support recycling with AI.

- 2019, Greyparrot takes centre-stage in San Francisco at TechCrunch Disrupt's Startup Battlefield.
- May 2020, Closed $2.2m in funding, and secure $2.2m in investment and a £500K grant.
- 2021, First commercial unit deployed: it deployed the first commercial Analyzer Unit in a UK recovery facility.
- 2022, Closed $11m in funding: Purpose-driven investors provide $11m in Series A funding.
- February2024, Global strategic partnership signed with Bollegraaf: Greyparrot signs strategic partnership with Bollegraaf, world's largest builder of recycling facilities, to transform global waste management with AI.
- Today identifies over 25b waste objects each year. Greyparrot Analyzer units are active in 50+ facilities across 20+ countries. It was the trusted AI partners for global waste leaders such as Veolia, Suez and Biffa.

In the future Greyparrot also has other ideas for use cases. For example, you could imagine embedding Greyparrot technology into a smart bin to automatically sort waste from the beginning. You can also use Greyparrot at reverse vending machines and credit your account when you return plastic bottles.

3.3. Saudi Arabia's experience in applying artificial intelligence to waste management

Due to rapid industrialization, high population growth, and fast urbanization, waste management is a top priority for Saudi Arabia, where more than 110 million tons of waste is generated on an annual basis.

According to Saudi Arabia's National Center for Waste Management, the environmental degradation caused by solid waste in 2021 was estimated at $1.3 billion. Nearly half of the total waste comes from three major cities: 21 percent from Riyadh, 14 percent from Jeddah, and 8 percent from Dammam. Most landfills in Saudi Arabia are on the brink of reaching their capacity. Saudis make heavy use of disposable products, notably single-use plastics. Recycling is limited. The majority of municipal waste is disposed of, untreated, in landfills, while some is incinerated. Once the landfill sites are full, the land typically cannot be used for other purposes. Landfills in Saudi Arabia are usually not engineered to limit their harmful effects. According to the former CEO of the Saudi Investment Recycling Company, most of the country's waste is currently being landfilled at an average of $1.87 per ton.

Saudi Arabia is considered one of the countries that seeks to achieve high rates of introducing artificial intelligence applications, similar to many European and Arab countries, where we will present the country's efforts in the field of artificial intelligence applications.

Saudi Arabia is using smart waste containers connected to the Internet and powered by solar energy throughout the country in an important qualitative shift in the field of environmental preservation, as this came after the signing of the "ORBITS BUSINESS GROUP" company, a Saudi company specialized in providing energy efficiency solutions and energy applications. Renewable, environmental solutions and smart homes. An exclusive agency contract with the American company HMC-TECH, to provide smart container service

These containers were designed and manufactured by the Korean company E-Cube Labs, which specializes in creating waste container solutions. These containers are also equipped with wireless internet service, run on solar energy, and are equipped with sensors to monitor and measure the level of waste and report on the container when it is full, so that the work team can Cleaning includes emptying the container when needed.

These solar panels provide the energy needed to operate the compressor, allowing these containers to be able to compress the waste eight times to reduce its size. He explained that the container's connection to the Internet allows communication with the people surrounding the container's spatial scope by informing them of its location for unloading.

It is considered a step forward in the field of innovation in providing environmental solutions, as it contributes to providing an ideal harmony between efficiency and public service.

4. Results and discussion

E-waste, or waste electrical and electronic equipment, is the fastest-growing waste stream globally, with an estimated 62 billion kilogrammes produced in 2022 alone

But the phones, tablets, laptops and other gadgets we discard contain valuable metals and minerals, collectively worth $62.5 billion each year.

With currently only about one-fifth of the world's e-waste recycled, a World Economic Forum report underscores the need for systemic change to encourage industries to embrace the circular economy.

The mission of the company was to use AI to significantly improve recycling efficiency and decrease the environmental impact of waste by:

- supporting waste professionals in their effort to sort and recover more material.
- It guides packaging producers and brands in their effort to design more recyclable products.
- informing regulators in their effort to craft targeted, impactful, and practical resource policies.

5. Conclusion

Waste management has traditionally been a largely manual process. However, artificial intelligence, machine learning, computer vision, robotics, etc. technologies have allowed to reduce the need for manual labor, reduce costs, and increase efficiency. With the burdens resulting from a growing population and the exhaustion of landfill sites, smart waste management becomes a must. Smart technologies could help address issues of waste disposal and create a healthy environment, as well as changing the way other types of waste are managed, as is the case with companies like StartRocket and Greyparrot, which plan to use laser cannons, arms and claws. Robotic applications aim to remove space debris or space junk, but the methods for applying this type of technology remain under discussion.

Artificial intelligence has the potential to accelerate global efforts to protect the environment and conserve resources by monitoring air pollution and energy emissions, helping develop transportation networks, monitoring deforestation, and predicting extreme weather conditions. He explained “the great potential inherent in using machine learning and artificial intelligence to collect and analyze Data to help combat climate change, as machine learning can be used to improve methods of generating energy and regulate the process of demand for it, with a focus on the use of renewable energy, in addition to deploying sensors and smart meters inside buildings to collect data, monitor, analyze, and improve ways to use energy inside buildings.”

The importance of using artificial intelligence lies in preserving environmental diversity, as artificial intelligence connected to satellites can detect changes in land use, monitor vegetation and forest cover, predict natural disasters, monitor and analyze their effects, and can monitor alien (invasive) species of organisms that may threaten "A specific environmental area such as ecological reserves can be identified, tracked, and eliminated all using machine learning."

The activity of the English company GREPARROT and the Saudi experience in partnership with an American company in applying artificial intelligence in the field of waste management were presented.

Suggestions:

- Working to develop sorting techniques through applications of artificial intelligence in other types of waste, such as medical and electronic waste.

- Benefiting from the experiences of the leading countries in this field and projecting them onto Algeria in line with the available resources.

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