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Research on the design of green and low-carbon food packaging based on artificial intelligence technology

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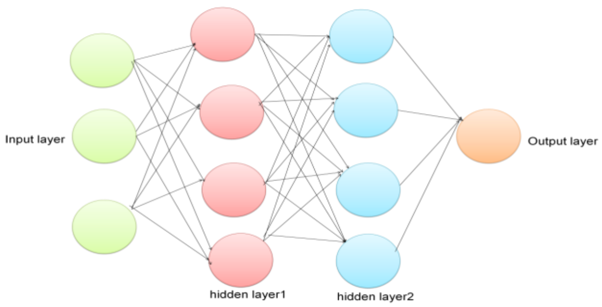
Graphical abstract



Abstract

An economic system focused on low energy usage, low pollution, and low emission is known as a "low-carbon economy". The concept of environmentally friendly and low-carbon food packaging architecture directs practice growth and reform in accordance with the customer's green psychology. As the primary benchmark for packaging concerned with designing practices, it uses the green conceptual design of contemporary eco-environmental preservation and other meaningful reforms. It is significant need to mix people's developed green psychology with this issue in order to discover a solution for green packaging design. The design and use of eco-friendly and low-carbon food packaging is covered in this research. With the implementation of wireless sensor network (WSN) and Artificial Intelligence (AI) technique, it accomplishes the fusion of market and ecologically responsible design, enhances production effectiveness and product usage. The confidence weight information choice technique is used to determine the type of smart energy-saving packaging, and the fundamental element is that the energy usage vector is formed by an Artificial Neural Network (ANN). Packaging makers must reevaluate how design and the environment interact, eliminate packaging design pollutants, make environmental protection their top concern, and develop a design idea that complies with ecological ethics for the long-term profit of human survival. Environment, politics, economy, and social factors all play a role in how the food system functions and are influenced by them. Compared to traditional techniques for monitoring the environment We use wireless sensor networks to keep an eye on the agricultural environment because they have three key benefits: (1) There is no need to lay wire; (2) the system is only implemented once; (3) the nodes are dense; (4) collected data has good precision; and (5) sensor nodes with a specific calculation and storage capacity, enabling collaboration among nodes, are perfect for unsupervised monitoring system. The incorporation and handling of product packaging data is made possible by smart packaging technology, which is essential in the creation of low-carbon food packaging and helps customers understand product choices.

Keywords: Food packaging, energy-saving, wireless sensor network, green and low-carbon emission, artificial intelligence (AI), artificial neural network (ANN)

1. Introduction

According to the World Meteorological Organization's (WMO) assessment "The State of the Worldwide Climate in 2018," the average worldwide temperature in 2018 was 0.98 0.1C higher than it was before industrialization. According to the "World Meteorological Organization Greenhouse Gas Bulletin in 2018," 2017 witnessed record high levels of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These figures were 146%, 257%, and 122% higher than their pre-industrial averages, respectively (Sun, 2017). Despite the rising significance of renewable energy sources, China is still responsible for 28% of world carbon dioxide emissions. In terms of the global problem of climate change, China has three key objectives: Carbon dioxide emissions are expected to peak around 2030 and then fall by 60-65% per unit of GDP (Gross Domestic Product) in 2030 compared to 2005, and account for around 20% of primary energy usage by that year (Katrin *et al.*, 2019). China's major sectors account for a significant share of the country's overall terminal energy consumption and carbon emissions. The packaging industry's contribution to climate change through carbon emissions is one such example. With a total output value of nearly $1.9 trillion, the domestic packaging business was among the top 15 most valued in the United States in 2017 (Biganzoli *et al.*, 2019). Despite contributing just 2.44 percent of GDP in 2009, the packaging sector was responsible for 2.74 percent of the country's carbon emissions, or 306 million tons. Numerous environmental problems, such as clogged landfills, emissions of greenhouse gases and litter contamination, are directly caused by food packaging. The environmental issues surrounding packaged foods and its effects on the environment are mainly focused on how it is discharged into the environment. Carbon emissions from the packaging industry are predicted to grow as demand for packaging across sectors rises, notably owing to China's rapid expansion of express commerce (Department of Energy Statistics, 2019). Although low-carbon packaging has been on domestic packagers' minds for some time, little study has been conducted on the subject. According to surveys of Chinese businesses and a study of the current literature on low-carbon packaging, the great majority of existing research focuses on relatively broad subjects such as packaging materials, packaging equipment, and various stages of the packaging life cycle (Sun *et al.*, 2016). A novel framework for the food business, carbon free food innovation utilises little energy and produces little pollution. The practicality of global low-carbon packaging has been tested by researching a wide range of commodities and activities, including beverages, tomatoes, materials, transportation, supply networks, and waste management. Nonetheless, this degree of data openness seldom meets the high expectations (Nian and Wang, 2012). The wine glass inspired the creation of two additional kinds of containers. Three designs are assessed in terms of carbon emissions and overall cost in contrast to the current packaging standard, with the best one selected. By detecting energy emission reductions, CO_2 removal, assisting in the development of more environmentally friendly transportation networks, monitoring deforestation, and forecasting extreme weather, AI has the potential to speed up global efforts to protect the environment and conserve resources.

When evaluating the carbon emissions and costs of various product packaging alternatives, having simple access to a full data set and a basic calculating approach is beneficial. When we speak about low-carbon packaging, we mean a reduction in carbon emissions throughout the whole packaging process, not just one part of it (Song *et al.*, 2012). It is critical to include the whole packaging life cycle when computing carbon emissions, from raw material acquisition and processing through package production, transportation, and waste treatment (Shi *et al.*, 2012). Materials selection, raw material gathering and processing, structural design, package production, logistical transit, and disposal are the six pillars of the packaging life cycle. Although there are many stages in a package's life cycle, material choice and structural design have the biggest impact on costs and greenhouse gas emissions. These nodes' low energy use and, by extension, minimal carbon emissions are noteworthy (Xu, 2018). Everything else follows from this core material decision, including raw material selection, structural design, manufacturing process, and ultimate disposal. The structural design determines the volume, shape, and form of the packaging, which influences its mobility and ease of handling (Sun, 2012). We've made it a priority since then to analyze the whole product life cycle, including how much energy is required and how much CO_2 is created (from sourcing and processing raw materials to making and transporting the packaging, to finally disposing of the product). Corrugated board is affordable, recyclable, and very cushioning, making it an excellent choice for packaging small and fragile things. Corrugated board is often used for wine glass packaging because to its low cost, high recycling rate, and little environmental impact. Three main factors—quality, productivity, and costs—have an impact on the overall production costs of packaging. These three elements are all crucial and should be considered throughout the entire process, from designing to printing to converting to packing.

Rapid urbanization has badly degraded the natural ecology on which people depend, raising concerns about an imminent ecological disaster. A "low carbon economy" is the most effective framework for managing energy usage, pollution, and emissions (Zhang, 2013). Product protection, printed markings, perceived value, and use are all factors in packaging design. This stands with the agricultural and industrial revolutions as one of the biggest breakthroughs in human history. Furthermore, it is China's only viable long-term economic development plan. Economies, cultures, and communities are all experiencing major transformations. Because of advancements in packaging technology, even common things may now be displayed in a visually appealing manner (Zi, 2010). Green mindset among consumers reveals how views have altered as a consequence of today's severe ecological environment. The green movement is on the increase, urging a cultural transition toward greater environmental responsibility. As a consequence of this new way of life, people's essential necessities will change. The ultimate benefactors of excellent design are people (Cui, 2010). A successful layout will consider the goals and needs of its target audience. The package design industry has started to incorporate sustainable development approaches in this era of low-carbon living. This is the first thing that springs to me when I think of packing. Designing for sustainability demands the use of cutting-edge resources and methods to reduce energy consumption, waste, and inefficiency while boosting productivity and beneficial environmental impact. It's a safety net for companies who want to build their brands, increase sales, and expand production by improving the packaging of their goods (Qi *et al.*, 2021). Furthermore, a company's marketing mix is incomplete unless the packaging technique for each product is considered. The present period of fast commodity economy expansion has resulted in excessive commodity packaging, putting tremendous strain and stress on the environment and society as a whole, as well as substantial resource waste. As a result, research is being carried out to rapidly enhance energy-efficient packaging design (Ouyang and Shen, 2017).

2. Intelligent packaging

Intelligent packaging has grown rapidly since the turn of the century, and it is currently regarded as one of the world's top 10 most significant economic enterprises (He and Min, 2017). As the economy, science, and technology continue to expand at a rapid rate, modern commodity circulation is becoming increasingly dependent on improvements in packaging technologies. This illustrates that the package design effectively meets the targeted aims of improving the aesthetic value of the packaging, raising the value of the commodities, boosting profits, facilitating consumer purchase decisions, and exhibiting the businesses' cultural preferences (Jeong *et al.*, 2017). It improves market and green environmental protection design, forecasts design futures, and boosts product efficiency via the use of artificial intelligence. People's food preferences are influenced by economic factors like income and food prices. Additionally, the cost of food prevents families with low incomes from making healthier food choices. The word "low-carbon" may refer to either a specific course of action or a specific figure for a carbon intensity index, with the former stressing a more deliberate approach to change. The increasing popularity of low-carbon lifestyles may reflect rising social, economic, and cultural standards (Lin *et al.*, 2021). A company's packaging approach may have a significant influence on its marketing outcomes and market standing. Packaging today reflects the ever-increasing number of brands and product varieties on the market. More care is being placed into product packaging, yet it is more difficult for people to discern what's inside. The phrase "intelligent packaging technology" refers to the technique of accentuating a product's unique traits via the incorporation of electrical components into the box or the product itself (Poelman *et al.*, 2016). Customers' green mindsets may give information into how to design more energy-efficient packaging. Its core design concepts for use in packaging are based on the green design concept of modern ecological environment preservation. Intelligent packaging technology enables the monitoring of product packaging data, which is crucial for the producti of carbon-light product packaging (Jiang *et al.*, 2021). The components of an energy-efficient package were created with the purpose of limiting negative impacts on both the natural environment and human health from the start. Energy-efficient packaging is often referred to by these phrases since it is safe for both people and the natural environment. Culture serves as both the noumenon and the premise for designers working in current marketplaces, while life itself acts as the compass (Altmann and Petzold, 2016). Every design should prioritize efforts to create packaging that does not hurt the environment or waste resources. People frequently confuse the terms "energy-saving packaging" and "greening of packaged products," leading them to believe that packaging made of degradable materials. Packaging always has a little bit of a company's personality to it (Wang *et al.*, 2019).

The team's capacity to comprehend its consumers' intangible aspirations is a big selling factor. This theoretical framework is used to examine potential customers' activities. The total visual presentation of a product is referred to as packaging design (Sharma *et al.*, 2018). The effect is intended to arouse the viewer's visual intuition. Visual communication and the packaging industry are inextricably interwoven. To remain relevant in today's market, businesses must develop unique packaging that expresses their beliefs and objectives. The company's products will stand out from the competition due to the packaging's eye-catching design and appropriate reflection of the brand's ideals (Béné *et al.*, 2019). Things may be the end output of package design, but people are its inspiration and drive, and linking connected things with humans as their major body is critical. It employs a holistic approach to analysis and observation in order to foster development that is in tune with nature and recognizes the human-machine environment as a linked and interacting whole (Bourguet *et al.*, 2013). The selection of raw materials is the first step in designing ecologically friendly packaging. Before establishing the structural design of packaging in a way that maximizes resource utilization, it is essential to research the product's content and other aspects. Outside packaging of items is the finest area to show the connotation concept of package design put into effect from a business viewpoint. As a result, it is more important than ever to strengthen the practical elements of package design by referring to eco-friendly psychological ideas. It is allowed and recommended to utilize as little material as possible for packing as long as the key functions (transportation and safety) are met (Calçada *et al.*, 2019). Furthermore, we must be strict and cautious in how we package things. It is critical to consider the environmental effect of packaging materials during manufacture and disposal. The utilization of a bold color palette makes this package stand out. According to color psychology, different customers may react differently to items of various colours. The color scheme is an important consideration in the package design process. If complex technological methods are implemented, the performance of the standard express package may be significantly enhanced. Green consumers want firms to approach their packaging with the same concern for sustainability as they do their goods. That is, the package design asks you to abandon the usage of fancy colors and patterns that you were previously utilizing to boost the visual appeal of the packaging and instead focus on the fundamentals (Ceschin *et al.*, 2016). As seen by the development of people-centered goods such as smart packaging, science has come a long way in the pursuit of a more compassionate society. We live in a society that values individuality and flexibility, and identities may and do alter over time. It is critical to decrease the amount of cardboard and other waste generated while creating packaging. China has a greater sense of urgency when it comes to the food supply because of its 1.4 billion people. However, it only has 9% of the world's arable land and 6% of the freshwater supply, making maintaining food security a difficult task for the nation. Knowing the size module of the paper and establishing a realistic estimate of the paper-to-use ratio are both critical when designing the structural structure of a package (Chan, 2018). When setting your paper in type, pay particular attention to imposition and continued imposition to ensure best readability. Show the customer both the exterior and interior of the items. People deal with a wide range of events and emotions due to the many methods in which they may express themselves. Superior package design, like product packaging services, should be adapted to the target market's needs. Because client preferences are likely to define the future of intelligent product packaging, package producers would be well to take them in mind while developing new designs. Because recycled materials lack the durability and aesthetic appeal of virgin materials, researching their specific features is critical for improving their visual appeal (Clune *et al.*, 2017; Zhang, 2022). To make a picture more flexible and customizable, common ways include breaking it into lines, points, and faces. This strategy, which may be more successful than traditional photography in grabbing buyers' attention, is especially well-suited to seducing those seeking to spend a substantial amount of money on luxury things. In today's competitive business world, every company's successful marketing strategy must include a focus on eco-friendly packaging. AI can also cut emissions by improving supply chains through better demand forecasting (to combat overproduction) or effective goods transportation (such as shortening delivery times and minimising energy use).

3. Materials and method

Food package architecture that saves energy involves incorporating the designing principles of health, security, and ecological preservation into the designing approach and applying them to the design, i.e., designing the product's contents using substances that aren't harmful to the ecosystem. Some individuals also refer to energy-saving packaging as environmentally friendly or ecologically packaging, meaning it is safe for the environment and people's wellbeing and can be reused and renewed. Taking culture as its noumenon, living as its base, and modernism as its direction, contemporary package design is a design profession. Boxes or other containers that hold specific numbers of primary packages are considered secondary packaging. Pallets and big shipping containers for storing and warehousing are examples of tertiary packaging. Each level of the three types, which each represent a different scale, is used to transport goods from the production line to the consumer. Green, energy-saving, and ecological conservation should be the goals of energy-efficient package design, and the potential for resource waste and ecological contamination should be eliminated from the outset of the packaging architecture process. Each type of packaging requires numerous resources to produce it, including energy, water, chemicals, petroleum, minerals, wood, and fibres. Its production frequently results in wastewater and/or sludge with harmful pollutants as well as air emitted greenhouse gases, toxic substances, and particulate matter. However, Wireless sensor network plays a greater role in transforming data and energy to a greater extent. Food packaging that uses less energy is frequently mistakenly thought of as making packaged goods more eco-friendly, and packaging made of materials that can be recycled is incorrectly referred to as using less energy. Meanwhile, it is ignored whether the manufacturing, utilize, and reprocessing of processed goods will result in resource and energy waste. The enterprise's essential culture and emotion are present in the packaging. This distinct advantage places it first when customers are making goods purchases since it can identify psychological demands rapidly. Figure 1 depicts the theoretical model of consumer behavior purpose.

The term "packaging design" describes the design that sets goods distinct. In actuality, it relates to a visceral intuition. Visual literacy and packing are closely related to one another. Manufacturers must take consideration to visual language layout and demonstrate strong visual impacts in need to create an effective package design using Wireless sensor network (Wang *et al.*, 2022). A business brand's package design has to have distinctive and individual character traits if it is to survive in the fiercely competitive marketplace. The data provided by the package will have a significant visual impact and clearly represent the company's values, which is similar to giving the company's goods a distinctive brand identity and boosting customer internal identification (Sheng *et al.*, 2022). The area of package architecture is a representation of reasoning about the interaction between environment, culture, and humans. It strives for the coexistence of humans and nature, sees the human ecosystem as a connected system that interacts with itself, and approaches problem-solving and studies through a holistic lens. The selection of raw resources is the first factor that must be taken into account when designing energy-efficient packaging. To optimize the use of resources, the commodity composition and other factors must be thoroughly investigated and proven. Based on this, the structural architecture of the package design must be developed rationally and technically.

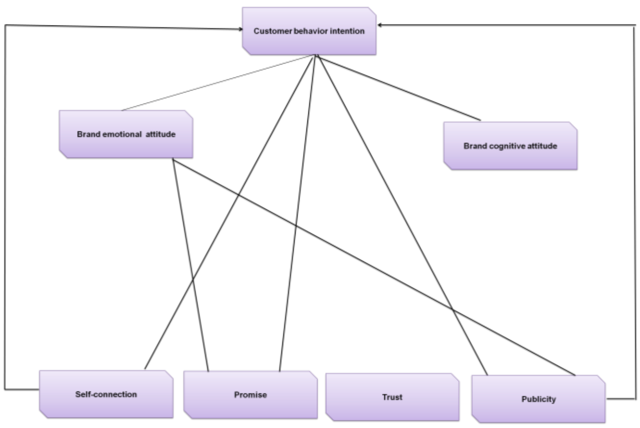


Figure 1. Consumer behavior purpose

The assurance weight information selection method is employed for the determination of the kind of intelligent energy-saving packaging, and the power consumption vector G is assumed to be formed by the ANN as the underlying premise. The architecture of ANN is depicted in Figure 2.

Its competence using wireless sensor network of weight vector for smart energy-saving packaging is $[Z_{1i}, Z_{2i}, \quad ,Z_{mi}]$.

Next, the concurrent combined effect of the subnets is N_n=[NN_1,NN_2, ,NN_n]. This results in the formation of the power utilization matrix G=[G_{1i},G_{2i}, ,G_{mi}] and the competence weight matrix z, and the assignment of the competence mixture to each subnet in sensor networks, namely in equation 1 and 2.

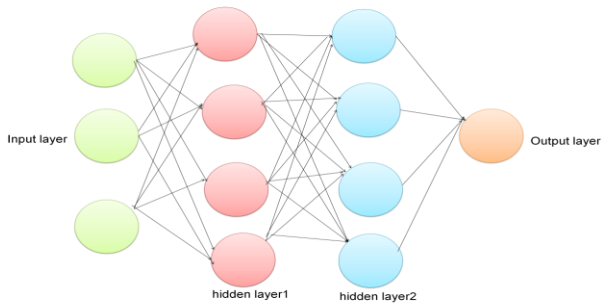


Figure 2. Architecture of ANN

$$G = \begin{bmatrix} g_{11}\, g_{12} \cdots g_{1m} \\ g_{21}\, g_{22} \cdots g_{2m} \\ \cdots \\ g_{n1}\, g_{n2} \cdots g_{nm} \end{bmatrix} \quad (1)$$

$$z = \begin{bmatrix} z_{11}\, z_{12} \cdots z_{1m} \\ z_{21}\, z_{22} \cdots z_{2m} \\ \cdots \\ z_{n1}\, z_{n2} \cdots z_{nm} \end{bmatrix} \quad (2)$$

The fusion outcome of determining the packaging design using Wireless sensor network is defined in equation 3.

$$Y = G.R \quad (3)$$

As a result, the possibility that the ith energy usage will occurred is in equation 4:

$$g_i = g_{il} z_{li} + g_{i2} z_{2i} + \ldots + g_{in} z_{ni} \quad (4)$$

The judgment integration outcome for the two sub-networks is as follows in equation 5:

$$g_i = g_{il} z_{li} + g_{i2} z_{2i} \quad (5)$$

When $g_{il} < 1, z_{li} < 1$, so $g_{i1} > g_{max} = g_{il} z_{li} 1$ it can be decreased in equation 6.

$$g_{il} > g_{max} = \max\{g_{il} z_{li}, g_{i2} z_{2i}, \ldots, g_{in} z_{ni}\} \quad (6)$$

The result may be represented as follows in equation 7:

$$Y = \max\{g_i\} \quad (7)$$

It is also conceivable to raise the energy usage for any blending result gi that is greater than a certain criterion. This idea enables the energy usage monitoring of intelligent energy-saving packing. Consumers' green philosophy is the practical application of going back to the core of packaging design, which is the main idea behind going back to the core of packaging design using AI with wireless sensor network is mentioned in equation 8.

$$F(x,y) = f_0(x, y) = f_j(x, y) + \sum_{i=1}^{j}(g) \quad (8)$$

We should examine energy-saving package design from the core of the design idea in order to better grasp it. Reducing packaging essentially lowers the utilization of packing waste products, but it also lowers the advantages to power and content resources.

This may effectively minimize the energy supplies lost during the manufacture and transport of materials, conserving energy and providing businesses with positive economic advantages. The architectural function of energy-saving package design should first completely evaluate its viability; that is, the packaging design must concentrate on making the operation of product purchases, distribution, and preservation easier, with the addition of certain "green" components. Reduce the amount of package design, emphasize the clear, vibrant, and organic qualities of product packaging, and create a straightforward design concept that also satisfies the demands of contemporary people who want a quick and precise new rhythm of life. The criteria for packaging materials, which should fulfill the parameters of minimal ecological pollution, recyclable, and self-degradation, primarily represent the features of low pollution.

4. Result analysis

The results were analyzed in this section. The existing techniques were used to comparison. The techniques are machine learning (ML) (Kumar *et al.*, 2021), Cognitive Big Data Analysis (CBDA) (Yaxin *et al.*, 2022) and Internet of Things (IoT) (Li, 2021).

4.1. Innovative design

The improved designs are neat, clearer, and more recognizable, which may leave an even greater impact and inspire the creativity in viewers. Innovative package design is a positioning strategy that often satisfies the long-term packaging needs of the majority of society's citizens. In order for the developed food packaging to have a larger usage area, designers must create precise marketing strategy and crowd positioning prior designing food packaging using wireless sensor network. The packaging may be reused after it has served its purpose with the correct care. Figure 3 depicts the innovative design of proposed and existing methods. It shows that the innovative design is better in the proposed method.

4.2. Pollution

The term "pollution" is used to describe the introduction of harmful substances into a natural environment. These hazardous compounds are called pollutants. Both natural and artificial processes can generate pollutants. Human actions, including the discharge or waste of factories, may also contribute to their spread. Pollution not only slows down economic growth and greatly accelerates climate change, but it also exacerbates inequality and deprivation in both urban and rural areas. The regeneration and utilize of food packaging garbage must be a progressive part of the management plan as low-carbon concepts are promoted and the low-carbon industry grows. To do this, we must start with the construction of the food packaging mix proportion, lower the layout ratio as much as we can, and manage the plot ratio in accordance with the properties of various items. Table 1 represents the pollution rate in numerical representation form. From Table 1, we can observe that the proposed model AI-WSN has less amount of pollution rate than existing models.

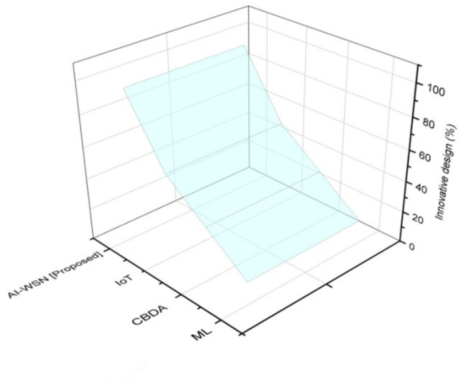


Figure 3. Innovative design

Table 1. Pollution rate of packaging design using wireless sensor network

Models	Pollution
ML	91%
CBDA	90%
IoT	91%
AI-WSN	70%

In the modern world, energy-saving food packaging design involves not only that designers adhere to product packaging specifications, but also reduce volume adhering to the functional specifications of food packaging, and effectively produce the straightening effect intended. AI-WSN's food packing pollution is low than that of the conventional systems. The proposed and existing techniques pollution is contrasted in Figure 4. The environment is negatively impacted by polystyrene, particularly when it is puffed. Polystyrene is lightweight, which increases the likelihood that it will end up in landfills or as litter because recycling it in conventional systems is difficult, expensive, and sometimes even impossible.

4.3. Energy consumption

Since energy is a necessary component of many manufacturing and consumption processes, it is a major driver of industrial development. One of the most crucial elements for commercial growth is energy. The most crucial role of packing is to properly safeguard the integrity and quality of goods while reducing loss during product transit. Agricultural crystal protection makes use of this characteristic and performance more often. If these agricultural goods can be safeguarded more effectively in a low-carbon economy, both product loss and carbon emissions may be decreased. This can be done through transforming and innovating packaging technologies using wireless sensor network. Its main attraction as a food packing design is its economical attraction. Therefore, it's essential to emphasize the uniqueness of food package design and fully exploit the financial advantages of packaging that saves energy. Utilize recyclable or reusable packaging materials. The materials can be used again for a variety of things, like storing office supplies in cardboard boxes that were left over. This aids in cutting down on waste and avoiding pointless product purchases. To put it another way, efficient ecological administration, other factors, and designs for food packing that save energy should all be considered. All the energy required to carry out an activity, create something, or just occupies a structure is referred to as energy consumption. The food packaging design uses less energy due to AI-WSN. Figure 5 compares the energy consumption of the suggested and existing strategies.

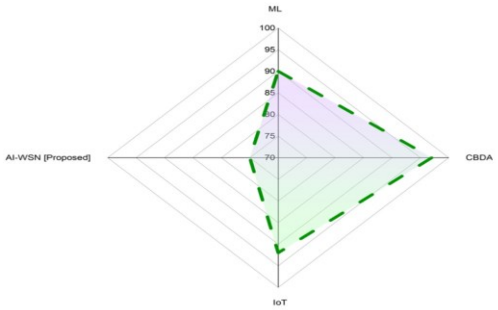


Figure 4. Pollution

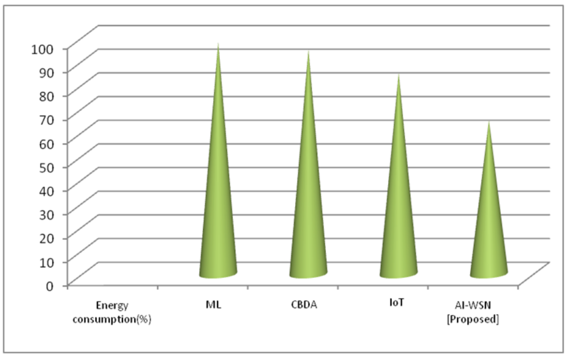


Figure 5. Energy consumption

Table 2 describes the energy consumption rate of energy saving food packaging using wireless sensor network with AI technology. It can be observed that AI-WSN has required less energy for packaging design. Hence, the proposed model is defined as energy saving model.

Table 2. Energy consumption

Models	Consumption rate
ML	92
CBDA	85
IoT	78
AI-WSN	69

4.4. Computation time

Computation time is the total amount of time required to perform a computation (sometimes known as "running time"). Computing time is inversely proportional to the number of pattern implementations when calculations are represented as a sequence of regulation deployments. The AI-WSN takes less time to calculate package food than older systems. The proposed and existing techniques computation time is contrasted in Figure 6.

Table 3. Computation time

Models	Consumption rate
ML	60
CBDA	54
IoT	43
AI-WSN	20

Table 3 represents the computation time required for calculating package food. It is observed that the proposed model need less time for managing packaging design foods.

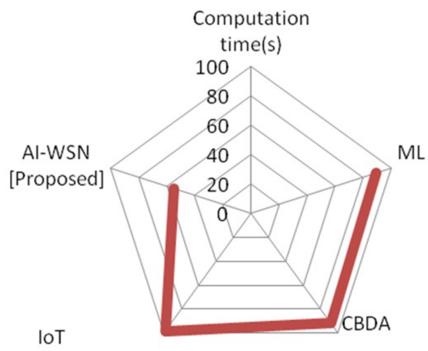


Figure 6. Computation time

5. Conclusion

A "low-carbon economy" is one that reduces carbon dioxide emissions, pollution, and energy consumption. Growth and change in the industry are guided by the notion of eco-friendly and low-carbon food packaging architecture, which is designed to appeal to consumers with a "green" mindset. It employs the green conceptual design of modern eco-environmental preservation and other relevant changes, and it serves as the key benchmark for packaging concerned with designing practises. In order to find a solution for green packaging design, we need to combine the issue at hand with the developed green psychology of the general public. This research discusses the creation and implementation of carbon-neutral and environmentally friendly food packaging. It relies on AI with wireless sensor networ technology to improve product utilisation, boost production efficiency, and bring together commercial and environmentally responsible design. Fundamentally, an Artificial Neural Network creates the energy usage vector, which is utilised to select the type of smart energy-saving packaging. Hence, the proposed model has provided an high accuracy of 97.6%. Smart packaging technology allows for the incorporation and management of product packaging data, which is crucial in the development of low-carbon food packaging and aids customers in making informed product selections. Through this research the people can try to avoid six different types of food packaging right away. Plastic containers, black plastic food containers, individually packaged vegetables and fruits food satchels, pizza packets, instant coffee, and capsules are just a few examples.

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