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Evaluating the Emerging Economic Experiences in Using IOT to Solve Development Problems

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تقييم التجارب الاقتصادية الناشئة في استخدام إنترنت الأشياء لحل مشكلات التنمية

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Abstract:
This study investigates the complex relationship between abnormal network traffic indicators and system resource consumption, addressing the challenges posed by Distributed Denial of Service (DDoS) attacks and internal security threats. By analyzing comprehensive network data, including packet rates, bandwidth, memory, and processor utilization, the research demonstrates a strong positive correlation between captured packet counts and available bandwidth, while memory and processor utilization exhibit weak correlations with traffic volume, thereby complicating the differentiation between legitimate operations and malicious activities. To mitigate these vulnerabilities, the paper proposes a robust, multi-layered defense architecture integrating cloud-based protection services, rate limiting, load balancing, and artificial intelligence-driven anomaly detection. Comparative evaluations of leading mitigation platforms—namely Cloudflare, AWS Shield, and Azure DDoS Protection—are conducted across deployment layers, cost efficiency, and ease of use. The findings indicate that relying solely on behavioral analysis is insufficient for modern cybersecurity; real-time supervision, adaptive rule sets, and automated threat intelligence are essential to ensure uninterrupted service availability and enhance overall network resilience against sophisticated cyber threats.

Keywords: Distributed Denial of Service (DDoS), Network Traffic Analysis, Firewall Rules, Cybersecurity, Artificial Intelligence.

الملخص
تستقصي هذه الدراسة العلاقة المعقدة بين مؤشرات حركة مرور الشبكات غير الطبيعية واستهلاك موارد النظام، مع معالجة التحديات التي تفرضها هجمات حجب الخدمة الموزعة (*DDoS*) والتهديدات الأمنية الداخلية. ومن خلال تحليل بيانات الشبكة الشاملة، بما في ذلك معدلات الحزم، وعرض النطاق الترددي، واستخدام الذاكرة والمعالج، توضح البحث وجود ارتباط إيجابي قوي بين عدد الحزم الملتقطة وعرض النطاق الترددي المتاح، في حين يظهر استخدام الذاكرة والمعالج ارتباطات ضعيفة مع حجم حركة المرور، مما يزيد من تعقيد التمييز بين العمليات المشروعة والأنشطة الخبيثة. وللتخفيف من هذه الثغرات، تقترح الورقة بنية دفاعية قوية ومتعددة الطبقات تدمج خدمات الحماية السحابية، وتحديد

معدلات التدفق، وموازنة الأحمال، واكتشاف الحالات الشاذة المدعوم بالذكاء الاصطناعي. كما أجريت تقييمات مقارنة لأبرز منصات التخفيف—وهي *Cloudflare*، و*AWS Shield*، و *Azure DDoS Protection*—عبر طبقات نشر الخدمة، وكفاءة التكلفة، وسهولة الاستخدام. وتشير النتائج إلى أن الاعتماد على التحليل السلوكي وحده غير كاف للأمن السيبراني الحديث؛ إذ تعد المراقبة في الوقت الفعلي، ومجموعات القواعد التكيفية، وذكاء التهديدات الآلي أموراً أساسية لضمان استمرارية توافر الخدمة وتعزيز المرونة الكلية للشبكة في مواجهة التهديدات السيبرانية المعقدة.

الكلمات المفتاحية: حجب الخدمة الموزع (*DDoS*)، تحليل حركة مرور الشبكات، قواعد جدار الحماية، الأمن السيبراني، الذكاء الاصطناعي.

Introduction

The rapid changes that the world has faced in recent years have made digital transformation unavoidable, as these changes have proven the reality of the link between reality and the virtual world at all levels specifically economic development [1].

The head of the first pillars of development and progress in the basic sectors, such as education, industries, agriculture, and thus the economy, especially in countries that are still in the early stages of economic growth.

If we look at how IoT technology creates value from the perspective of professionals, we will see how it improves field productivity and reduces costs, especially those that require the interaction of IoT systems with the surrounding environment, such as homes, offices, and factories, and enables medical applications to monitor the human body.

Research in the development of Internet of Things technologies and applications still has some uncertainty and requires more in-depth investigation.

In fact, this is a clear indication of the need to conduct further studies in this challenging field to achieve significant and desirable results.

The speed and intensity of the rise of IoT technologies currently and according to the forecasts for the next ten years, with expectations exceeding $120 and $109 by 2021, with a compound annual growth rate of about 7.3% [2].

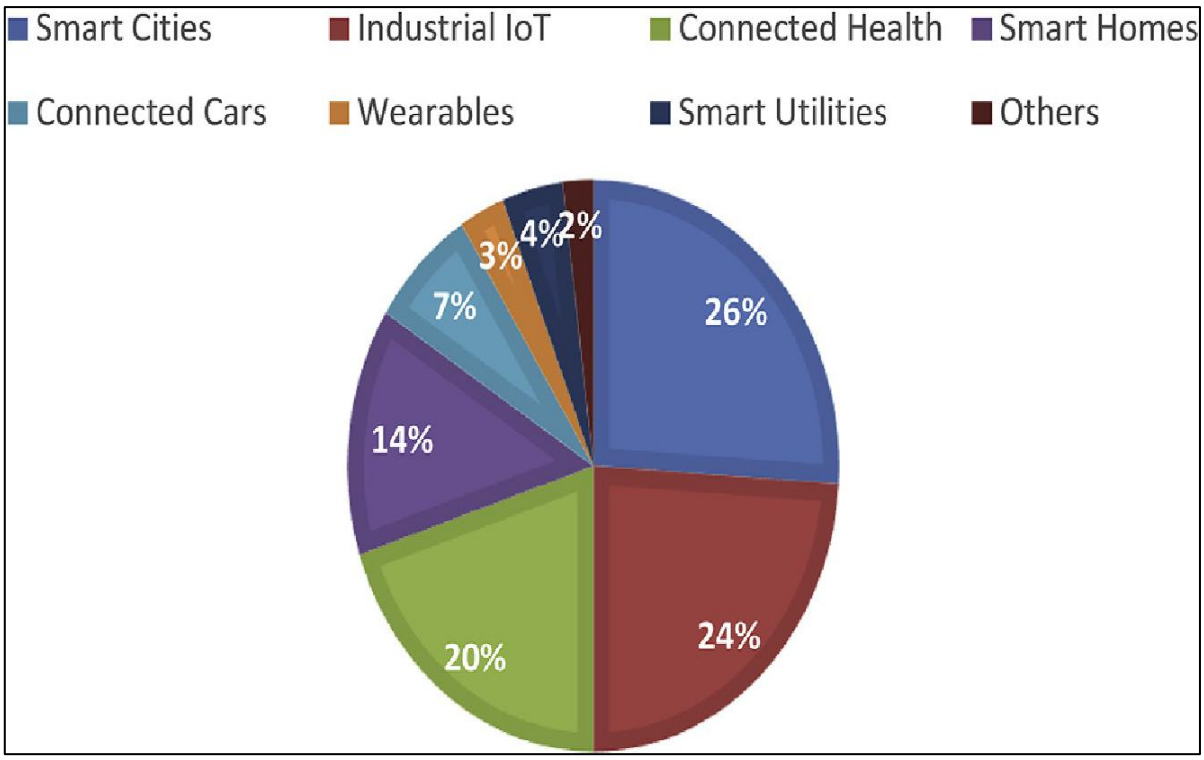

Figure (1): illustrates the overall current market structure of IoT technologies [2].

From the previous figure, we observe that smart cities dominate market attention.

Since the Internet of things depends on information technology and from an economic point of view it is linked to productivity with cost reduction, the economy after the Internet of things is witnessing an accelerated growth within innovations in entrepreneurship [1].

Hence the importance of this research due to the increasing important role of the digital economy, especially the digital transformation in general, is to foster and enable the use of the Internet of Things in all sectors and consider the results based on it and to summarize the scientific controls in this regard [2] [3].

This paper has been prepared to provide an overview of understanding the potential advantages of the Internet of Things and most of the major issues it faces in the economic and development fields. The paper is organized as follows:

An introduction to the Internet of Things and its domains in general, and especially the economy, while the next section studies previous studies on the subject, and a section on examples of the application of the Internet of things and finally the discussion and results.

Literature review

Application areas of the Internet of Things:

Numerous application domains exist in this field, each with distinct challenges and technical solutions. Figure 2 highlights the key areas [2].

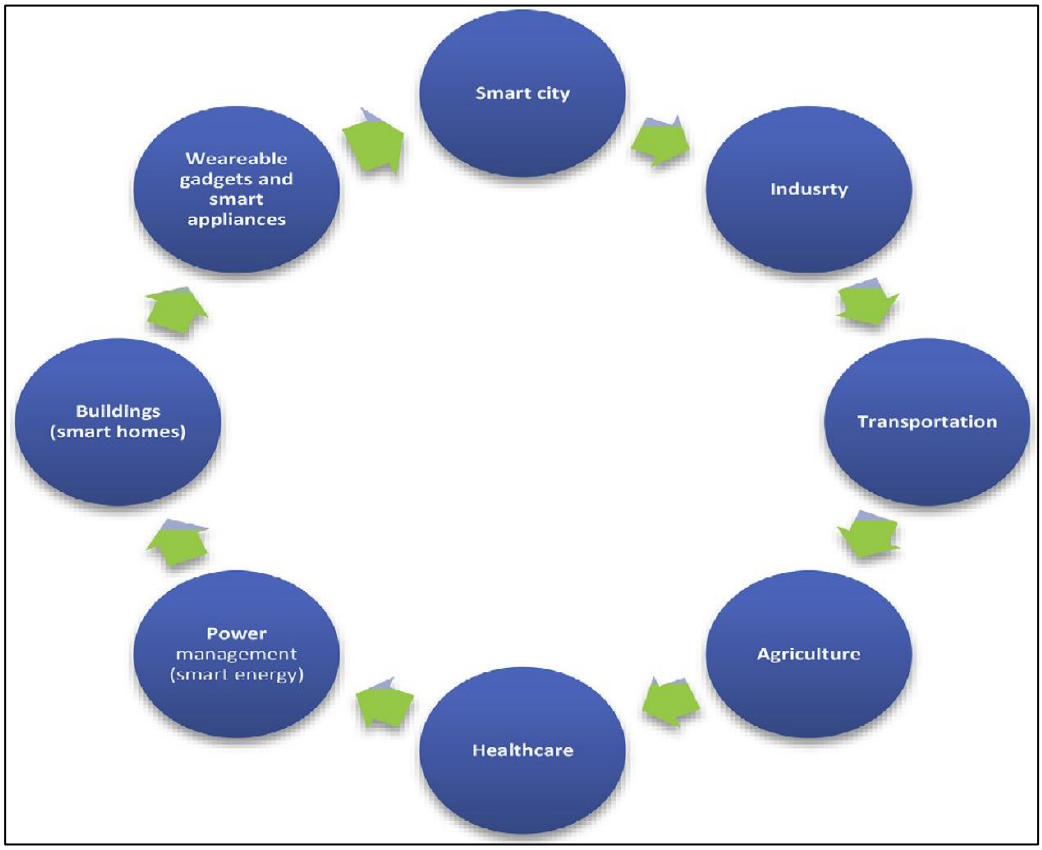

Figure 2 depicts the most important areas of IoT technologies.

Internet of Things in Power Industry (Nepal):

Nepal is a developing country that relies on hydroelectric power to produce its energy needs. Hydroelectric power plants depend on geographical location, water availability and plant efficiency.

One of the most important factors that determine the efficiency of the plant is identifying faults, troubleshooting and the speed of repair, these elements can be facilitated by Internet of Things. This paper studies the current practices and application of the Internet of Things in the energy sector in Nepal.

In addition to the effects of the Internet of things on distributed generation systems and large and medium power plants [4].

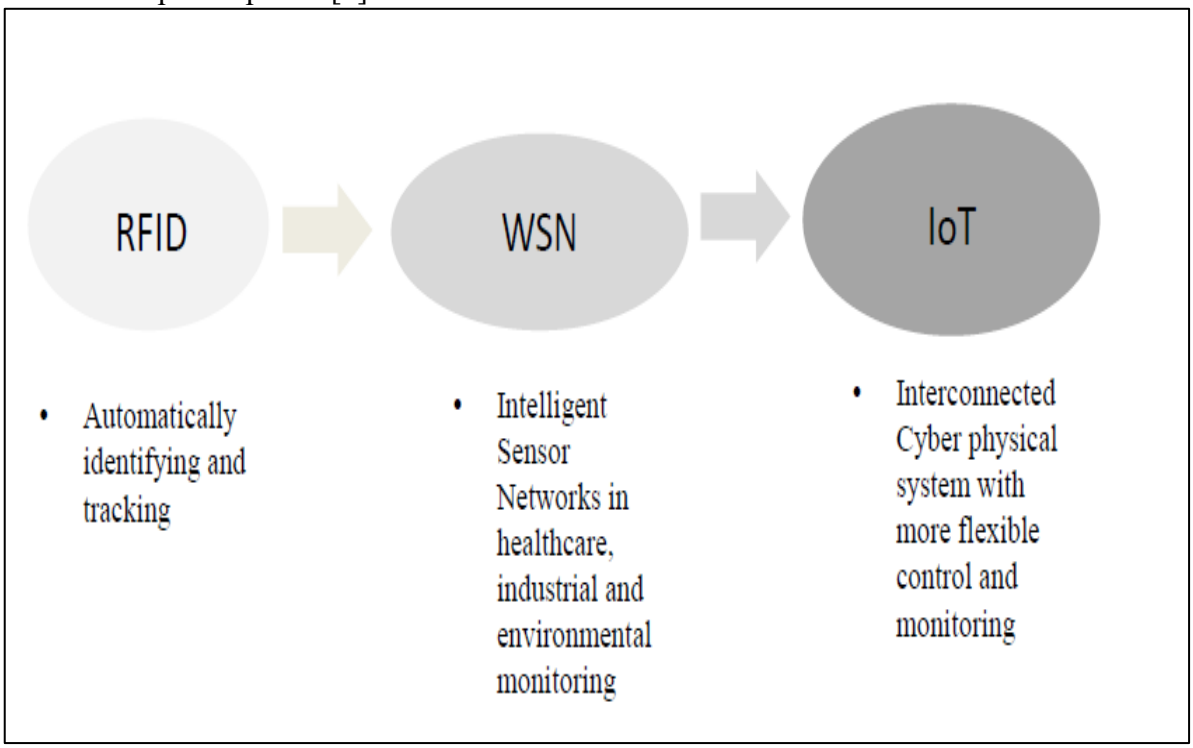

Figure 3 Historical Development of Automation Technology

The development of interest in process automation has limited human intervention in systems to avoid risks and increase productivity. As a result of this development and as a result of technological transformations, wireless automation has reduced human intervention in many systems and the use of the Internet of things to facilitate their operation. Figure (3) illustrates the historical development of automation technology [4].

As a successive development of electronic control, metering and monitoring, smart grid technologies have appeared, whereby the smart grid creates a two-way interaction between the consumer and the utility service company and thus electricity and information can be exchanged. It consists of communications, controllers, computers, and new technologies and tools that work together to make the network more efficient and dependable, improving the speed of error detection and allowing the network to self-repair and can be redirected and switched to another source without the intervention of technicians. This will improve confidence in the electricity supply and reduce susceptibility to natural disasters or attacks.

The interconnection between physical objects over the Internet (Internet of Things) has played an explicitly crucial role in the development and improvement of existing systems and procedures. Given the interdependence of physical objects such as public transportation, power grid operations, and monitoring, the Internet of Things (IoT) enhances (Supervisory Control and Data Acquisition) SCADA systems in the automation sector by introducing remote sensing and control facilities, and the use of IoT has helped minimize people in a hazardous work environment.

Work is currently underway to enhance IoT-based systems in some current industries to take advantage of advanced and reliable technology. In Nepal, traditional electromechanical energy meters are being replaced by advanced IoT-based metering devices to ensure better service as well as cost-efficiency in door-to-door meter reading and revenue collection through various meters. Time-varying energy sources and integrated dynamic loads require

the operation of smart grids in Nepal. As a pathway to smart grids, infrastructures such as distribution automation system and smart metering system are now deployed [4].

The Internet of Things and the circular economy:

This research discusses the circular economy, which is an economic system that focuses on minimizing the extraction of natural resources, reducing waste, and renewing natural systems, in which raw materials, components and products retain their value for as long as possible, and renewable energy sources are utilized [5].

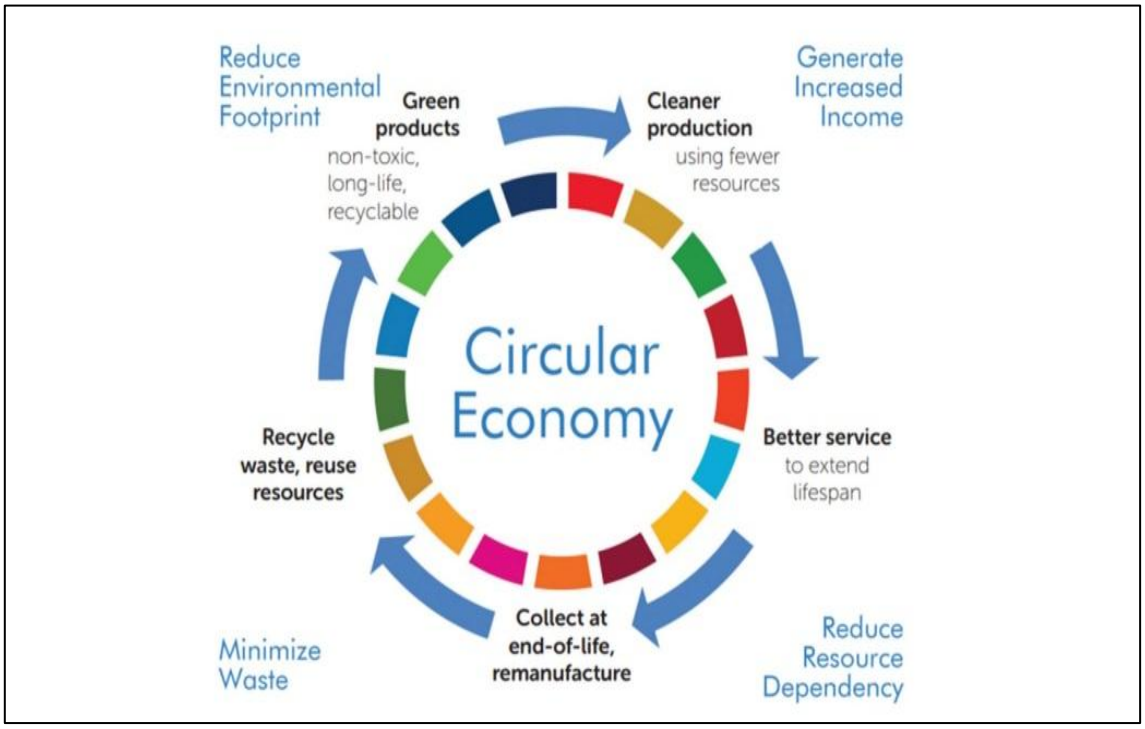

Figure 4 Components of a typical circular economy

It is defined as an economic system that represents a shift in the way human society relates to nature and aims to facilitate sustainable development through its implementation at the micro and macro levels. Global environmental companies are keen to become proactive in their endeavors to establish cleaner manufacturing technologies and adopt circular economy principles aimed at maintaining the value of materials for as long as possible while supporting waste reduction.

Technology is the basis for the development of the circular economy, as it allows the generation and processing of data and information required for circular business models to meet the complex requirements of circular supply chains. This requires finding ways to interconnect and communicate between physical entities, which is facilitated by the Internet of Things. The Internet of Things also enables these goals through automatic and remote monitoring of resource efficiency during harvest and production, providing big data that enables targeted analytics. Big data (that is, the analysis of large data sets with new computerized methods to discover patterns and trends) that can ensure that the implementation of civic education concepts is technically and economically viable. In a special study, it is found that simply using big data does not overcome the challenges companies face in transitioning to a circular economy, and this is especially true when making products “smart” poses additional privacy and data security issues [5].

This study aims at two goals, namely, the methodological review of previous academic work and the detection of promising research areas. The period of analysis covered by this research

extended from 2007 to mid-October 2021. In the outcome of this study, it confirmed that recognizing the need to transition to a circular economy worldwide plays a pivotal role in this transformation.

Despite the growing academic interest in the Internet of Things, the interaction between these two phenomena has remained unclear, requiring systematic analysis to extract valuable research insights [5].

In another study of the circular economy centered around the mapping of science that focuses on "case studies" or "use cases" on the relationship of the Internet of Things, where the academics emphasized that there is a deep link between the Internet of things and the circular economy and that this field deserves more comprehensive studies in the context of the manufacturing industry. On empirical research on case studies with the Internet of Things working in favor of the circular economy is still limited; Fourteen papers were identified in the WoS database in the context of the manufacturing industry [6].

The implications of Digital Transformation on Enhancing Economic Growth in Egypt:

This research studies the application of digital transformation mechanisms and the resulting beneficial role in promoting economic growth in Egypt. It seeks to achieve other goals, which are:

1. Studying the character and importance of digital transformation.
2. Analyzing the most important factors and drivers of the success of digital transformation strategies.
3. Determine the nature of the obstacles facing the implementation of digital transformation.
4. Studies of the implications of applying the mechanisms of digital transformation on economic expansion.

This research dealt with the analysis of digital transformation and economic growth data from 2010 to 2020 in four previous studies in Arabic and three studies in English. The study made a comparison between the digital economy and the traditional economy and found the difference in the speed of technology-dependent economic growth with the need to provide the foundations for the success of digital transformation from improving and developing infrastructure technology and the expansion of Internet services to all regions and cities within the country, The study discovered several requirements to ensure the success of the digital transformation, the most important of which is the change of teaching and learning systems and the interest in establishing and maintaining the infrastructure of digital communications and ensuring its management. It is also necessary to invest in the digital economy in a way that can assess the digital gap between Egypt and the developed world [1].

It also showed a positive correlation between the application of digital transformation and the promotion of economic growth in Egypt. The study recommends the need to spread technical literacy, provide Internet service for all, and focus on technical research and development for the purpose of narrowing the digital gap.

The Socio-Economic Impact of Internet of Things towards Smart Cities:

This paper sheds light on the architectural layers and application areas that are the basic components of the Internet of Things, highlights the main challenges and problems related to the development of the Internet of Things, and presents related works in terms of benefits and socio-economic impact related to the Internet of Things. It is expected that the various fields and the smart environment in which these applications are developed and their impact on human life globally will progress. In terms of home life, health, and the environment, IoT applications can be categorized into three areas: the industrial field, the smart city field, and the health well-being field. All fields aim to enrich the standard of daily life and thus will have a significant role in the economic and social effects. The research also summarized the

challenges facing the Internet of Things, and they can be summarized in the following points [7]:

1. Data sharing among complex event systems and various network elements.
2. Efficient integration and interaction adjustment of uncertain information.
3. Service customization in the dynamic systems environment.
4. Information confidentiality
5. Objects protection and security
6. Data confidentiality and encoding
7. Network protection

This study summarized the benefits and impact of the Internet of Things and found that the economic benefit compatible with the Internet of things will be great and the return on investment is enormous, as the total GDP of the United States is expected to increase by 2-5% by 2025 with accelerated productivity growth in terms of job creation and alleviation of employment Poverty Intensity .The study will help formulate the IoT theoretical model that will be used to develop IoT complex event service discovery platforms and systems within smart cities[11].

In many developing Countries, IOT application have played Important role in achieving Sustainable Development goals. By this application, the governments in these countries have gotten valuable data about very important Issue which related to communities and one of these Issues is state of water resources in term of use, management and wastewater. Some evaluation conducted in Africa showed that 30-40% of pumps were nonfunctional in rural regions and the families have funded difficulties to obtain clean water. The Concerned authorities have successfully implemented IOT technologies in various projects to solve this problem. For instance, in Bangladesh, 48 arsenic sensors were installed to monitor the quality of clean water and water pollution prevention In China, monitoring the water quality has been successfully achieved in Jiangsu province by using a wide range of IoT sensors located at key points of the distribution network [10].

Also in India, by using system like A clever low-cost reverse osmosis system, coupled to smart controllers, allows clean water to be efficiently distributed to rural areas , as well as monitoring and guarantee the quality and quantity of water supplied in real time [11]

The technologies of IOT and its application played important role to improve the healthcare of communities in developing countries which they have Suffering from increase mortality rate of children and the rate of women died due to complications of pregnancy and childbirth. These problems come because of healthcare services' weakness.

In these nations, children under the age of five die at a rate more than fifteen times higher than in countries with well-established healthcare systems. In 2017, approximately 5.4 million children under five lost their lives, with two-thirds of these deaths occurring in sub-Saharan Africa [17]. This mortality rate could potentially be reduced by half if adequate interventions were provided [15]. Moreover, in 2015, the estimated number of women who died in developing countries due to pregnancy-related complications was around 303,000 [16].

By enhancing healthcare management in developing countries, the number of fatalities could be significantly lowered [16]. The implementation of IoT in healthcare enables remote monitoring, personalized healthcare, integration of medical devices, and even treatment of illnesses [12], thereby facilitating these countries' progress toward achieving sustainable development goals. Utilizing IoT applications in healthcare within developing nations also allows for effective monitoring of the vaccine cold chain. For instance, in Haiti, healthcare workers are employing smart thermometers to more accurately track vaccine distribution and storage [9]. IoT technologies are additionally being applied to tackle urgent challenges in humanitarian response, such as the Ebola outbreak in West Africa [14].

Developing countries seek to attain sustainable development goals by overcoming illiteracy in their communities.

In Mali, Niger, or Chad, more than 50% of the youth population faces the highest level of illiteracy among young people.

Also, other developing countries in Southeast Asia are affected by the illiteracy phenomenon among young people [18].

Kim et al. [39] stated that low-cost, mobile learning technology has the potential to facilitate personalized and exploratory learning through a child-centered approach in poor areas.
In Burkina Faso, IoT applications have been used to support Higher Education by the Higher Education Support Project, which established a new Virtual University to diversify the models of higher education delivery [19].
The developing countries' economies have been strongly impacted by climate change and natural disasters.
According to the World Bank, climate change could result in extra poverty for at least 100 million additional people by 2030 [20].
The changing climate is going to impact all countries, and it is having the highest impact on poor communities with the fewest resources [21].
The poor are affected by natural disasters [22]: of The developing countries' economies have been strongly impacted by climate change and natural disasters.
According to the World Bank, climate change could result in extra poverty for at least 100 million additional people by 2030 [20].
The changing climate is going to impact all countries, and it is having the highest impact on poor communities with the fewest resources [21].
The poor are affected by natural disasters [22]: of the 30 countries most vulnerable to natural disasters and a changing climate, 26 are least-developed countries.
Most deaths and people affected by natural disasters take place in the developing world: from 1991 to 2005, around 90% of deaths as a result of disasters and 98% of the population affected by disasters were living in developing countries [13].
IoT systems have been used to address air pollution problems by scaling up their air quality forecasting system.
A network of sensors is spread in a large city like Beijing, so it provides accurate predictions of air pollution rates in different zones.
Another important application of IoT technology in natural disasters is tsunami detection.
In India, Pakistan, and Oman, notable IoT applications are the Tsunami Early Warning Systems installed [23].
IoT systems have sent early alert messages to notify about predictable tsunamis, and they are very effective compared to other detection systems.
Thus, they could avoid destruction. Systems generated by IoT technologies are going to decrease the likelihood of losing human lives and damaging infrastructures due to this type of disaster [30].

Conclusions and Discussion.

As demonstrated by the findings of the studies discussed in this paper regarding the Internet of Things and economic growth and development, the interconnection of physical objects through the Internet (IoT) has played a crucial role in enhancing existing systems**.**
The Internet of Things has now emerged as a global paradigm capable of significantly transforming multiple sectors and facilitating operations in energy, remote sensing, and automated control functionalities.
Furthermore, IoT has attracted considerable attention from researchers in recent years due to, such as the necessity to transition toward a circular economy and its integration with IoT, which observed outcomes in turn supports the creation of safer, cleaner products, services, and processes.
In addition, it emphasizes promoting the efficient utilization of resources and energy while addressing the need to minimize waste and protect the environment**.**
Overall, most prior studies highlighted the importance of developing the necessary competencies, standards, and information capabilities within companies and governmental

organizations to support digital transformation strategies, thereby enhancing economic and service development. Sustainable development goals can only be achieved through IoT if its foundational infrastructure is available within the country, maintained and continuously improved, with comprehensive monitoring of all networks and systems to ensure proper workflow management.

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