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Creating An Internet Of Things (Iot) And Sustainable Development Goals (Sdgs) Configuration For Developing Countries After Covid-19

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Abstract

The COVID-19 pandemic has seriously disrupted both personal and professional endeavors. The public health reaction to COVID-19 is being supported by digital technologies like the Internet of Things (IoT), which can have a big impact on achieving SDGs in developing countries. As a result, the study aims to investigate the fundamental relationship between IoT and SDGs while keeping the COVID-19 emergency in mind. Over the past ten years, the research was carried out by carefully choosing, reviewing, and synthesizing pertinent literature. According to the analysis, the COVID-19 situation has the potential to be one of the most significant factors influencing the adoption of IoT and the achievement of SDGs. This concept provides the ideal framework for digitization in a sustainable development plan to achieve particular targets while avoiding costly infrastructure costs and policy-related constraints. Then, it is investigated how the pandemic has caused new social and technological obstacles for the IoT4D. According to the study's findings, IoT4D should concentrate on using low-cost IoT devices for the SDGs that are most negatively impacted by COVID-19 in the future. After a thorough investigation, it was found that the Smart Internet of Things (IIoT) played a significant role in the pandemic's aftermath, particularly in the field of health. The suggested strategy involves a thorough examination of the new function of the IoT4D for accomplishing the SDGs in our irrevocably altered environment.

Keywords: Big-data, COVID-19, Digitalization policy, IoT, SDGs.

1. Introduction

The COVID-19 outbreak, which caught everyone off guard and unprepared, has had devastating impacts on people's professional and personal lives as well as the nation's economy. The frantic effort to stop the spread of COVID-19 from person to person has resulted in business closures and neighborhood lockdowns. The COVID-19 emergency is a serious threat to the world's socioeconomic system. There are signs that COVID-19 will have a more significant and enduring impact on the world economy than the global economic crisis of 2008–2009. [1] The research

indicates that because the epidemic is putting increasing financial pressure on all countries, the effects on wealthy countries would be felt widely. Alarmingly, developing countries are particularly vulnerable to the COVID-19 catastrophe, in part because of the lack of international funding needed to achieve the SDGs Figure 1. Additionally, emerging regions may encounter a dearth of readily available international assistance for biodiversity preservation and climate change adaptation.

[2]Currently, 700 million people practise open defecation, 802 million people lack access to clean water, 699 million people people live in extreme poverty, 799 million people are undernourished, and one in seven people in developing countries continue to live in areas with inadequate electric infrastructure. Therefore, achieving SDGs that are relevant to the aforementioned problems and essential for the overall pace of economic growth is crucial. The SDGs, which are based on the UN's 2030 Agenda and address social, economic, and environmental issues, made a beautiful comeback in 2015 as an unrivalled political agreement and policy direction for mending the sustainability gap. [3] The SDGs have laid the groundwork for efforts to build a sustainable environment that doesn't leave anyone behind. The latest epidemic-related catastrophe poses a serious threat to the implementation of the UN SDGs by 2030 as well as growth potential in the developing world.[4] Innovative frameworks to guarantee immediate socioeconomic support after the COVID-19 epidemic and sustainable growth toward the SDGs are indeed a major concern for developing nations.

Figure-1: SDGs

[5]However, amid the COVID-19 pandemic, digital breakthroughs and technologies have slowly come to represent humanity's bulwarks. Numerous nations have put modern digitalized defense methods into action in the fight against COVID-19. COVID-19's unmatched humanitarian and financial demands are driving the rapid development and adoption of innovative digital technology. The unmatched humanitarian and financial demands posed by COVID-19 are a significant motivator for the development and deployment of developing digital technology at a given scale and pace. [6]Digital tools, such as population surveillance, event identification, touch monitoring, and action evaluation based on mobility information and interaction with the public, are utilized to help the public health reaction to COVID-19 internationally. IoT-enabled or linked equipment or applications are employed for early

discovery, patient monitoring, and the adoption of established measures following patient recovery to reduce the potential spread of COVID-19. [7]The integrated role of IoT and related cutting-edge technologies can be a substantial advancement in efforts to manage the burgeoning pandemic. However, other experts continue to hold out hope that the developed world's IoT potential will significantly contribute to the achievement of the SDGs.

[8] In actuality, the main forces influencing the culture, climate, and economy are sustainability and digitization. The intersection of the two fields reveals excellent but underutilized opportunities for fostering a shift toward phases of sustainable development. Digitalization-related sustainability challenges, however, are still unresolved.

[9]The COVID-19 pandemic is now in progress, and it is yet too early to assess the full impact that developing technology has had on the pandemic response. Despite having pandemic response assistance tools, IoT-based developing technologies are not a panacea. To resist the UN's planned SD aims, digitalization was, however, the least exciting sustainability-oriented shift. Few studies have addressed the connection between digitization and the SDGs, making it an important yet underappreciated area of study. [10]Innovative research typically focuses on structuring ICT's dedication to monitoring SDG metrics inside stand-alone "for-good" efforts in certain realms, rather than understanding the role of IoT advantages in connecting the intricacies of the 2030 Agenda. On the other hand, some recent study has successfully systematized the relationship between the COVID-19 emergency and the development of new digital technologies. However, only a small number of experts have taken into account the potential of IoT via the pandemic lens for accomplishing SDGs in emerging regions.
[11] By 2050, two-thirds of the world's population will live in cities, creating significant infrastructure and resource management issues (such as a lack of freshwater and food, rising global temperatures, and energy concerns). Resource management in urban and rural communities has a lot of promise to be resilient, sustainable, and informed thanks to the IoT's integrated sensing and communication capabilities. The fundamental ideas of sustainable community development are covered.
[12] examines the findings of an exploratory study of the most recent studies on production systems based on Industry 4.0. Data from earlier studies by BCG, Capgemini, CompTIA, Deloitte, Globant, MHI, Omdia, and PwC were gathered and replicated for this study. Regarding the relationship between cognitive decision-making algorithms, Internet of Things smart devices, and long-term organisational performance, we conducted analyses and generated projections.

2. Methods

2.1.IoT for Sustainable Development Goals

IoT is a contemporary standard modification in the digital sphere. Through the Auto-ID Centre and other associated industry analyst publications in 2003, the idea of IoT first gained a lot of popularity. Some claim that Kevin Ashton came up with the phrase "Internet of Things" for the

first time in 1999 while thinking about logistics management. Based on the shape of the object and the ease of human ability, there have been numerous items or artifacts connected to the internet for a variety of applications since the beginning of the IoT development. The IoT concept put a lot of emphasis on combining several processes, including processing, networking, sensing, and recognition. It leads to significant technological advancements and value-added services that personalize users' interactions with various "things." Content, Convergence, Computation, Collections, Connectivity, and Communication—the six C's—allow for a great deal of diversity in the way that things and people can be connected without any hiccups for artifacts. Again, the Internet Architecture Board (IAB) describes IoT as follows:

" IoT refers to a trend in which numerous embedded gadgets use the internet protocol's communication capabilities. Many of these targeted gadgets, often known as "smart objects," are not directly operated by people but rather serve as parts of buildings or automobiles or are dispersed across the environment.

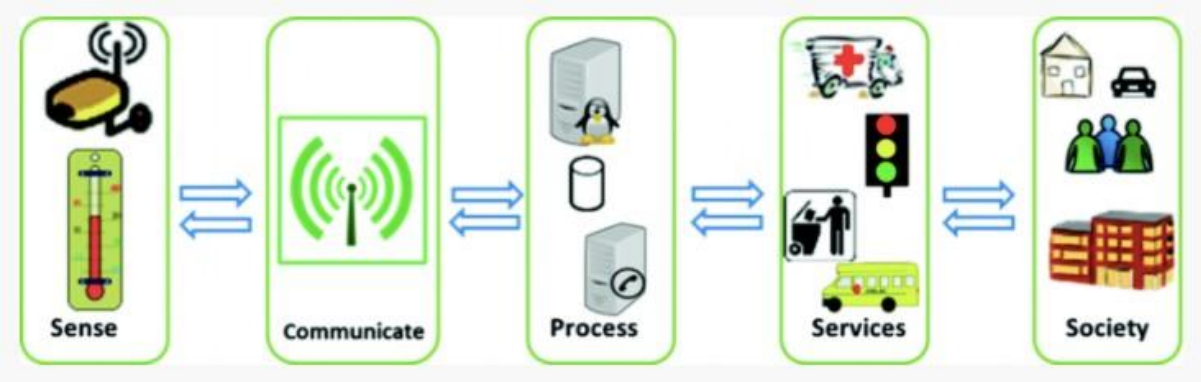

Fig. 2: IoT configuration

Here, the varying interpretations may be a cause of misunderstanding in the discussion of IoT issues, particularly in discussions between stakeholder groups or market categories. For the objectives of our article, the terms "Internet of Things" and "IoT" refer generally to the deployment of network networking and computing capabilities to structures, devices, devices, and artifacts that are not typically known to be computers. Such "intelligent or smart devices" have access to remote data storage, interpretation, and administration capabilities, and require little human intervention to produce, distribute, and absorb data. However, IoT elevates Web 3.0 to a new level by enabling seamless connectivity for anyone and anything at any time, everywhere. It enables the creation of new value-added solutions by dynamically combining different types of capabilities including networking, sensing, actuation, data processing, etc.

Greater and more sustainable growth in poor countries will be made possible by IoT. It would be a mistake to undervalue the possibility of industrialized nations having a far stronger and more significant impact given the enormous potential of the IoT for both economic and human growth. These places are excellent for fostering IoT creativity since they offer a variety

of new and untapped applications for the technology because of the issues facing the developed world. IoT not only fosters commercial growth but also significantly advances social, economical, and cultural advancement. IoT projects have started to be established in recent years, especially in India, for usage in developing nations. Here, a lack of resources suggests that in a developed world setting, easier, more affordable alternatives could work better.

2.2.THE NEW IoT4D SCENARIO AFTER COVID-19

2.2.1. THE IoT4D'S NEW CONTEXT AND POTENTIAL SINCE THE COVID-19 OUTBREAK

The SDGs are frequently connected; frequently, difficulties related to one aim's problems are remedied by addressing concerns with a different objective. The UN Global Goals were mapped to IoT industries in the paper "Harnessing the IoT for Global Development", which was produced jointly by the ITU and the UNESCO Broadband Commission for SD (Table 2). The UN SDGs are discussed in the paper "Opportunities and Challenges of the IoT. for Global Advancement to Achieve the SDGs." Because they were the 5 areas with the most possibility to be addressed utilizing the IoT, IoT Sectors 1–5 which is shown in Table 2 were utilized for their study. These five sectors also contained SDGs 2, 6, and 7, three significant targets that collectively make up the energy, food nexus, and water, a common indicator for gauging development. many SDGs are impacted by

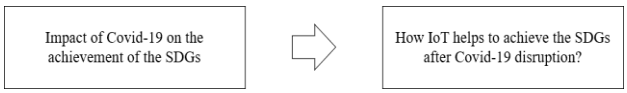

FIGURE 3. the IoT uses

TABLE 1. Keyword search outcomes utilizing the most popular repositories

Keyword	Results by database			
	Google Scholar	ScienceDirect	Scopus	IEEE Xplore
Internet of things for development covid	24,800	1,669	2519	71
Internet of things for development coronavirus	19,800	754	1382	22
IoT Sustainable development Goals covid	9,620	292	202	5
IoT Sustainable development Goals coronavirus	9,620	125	102	2
IoT developing countries covid	7,990	534	356	10

2.3.WATER, SANITATION, AND HEALTH

Two SDGs—SDG3 and SDG6—in the IoT area "Health, water, and sanitation" are closely related to the COVID-19 pandemic. Despite significant disparities in the exact components of the targets, the research evaluated show that SDG3 has been the most adversely impacted by the COVID-19 epidemic. Health facilities are seeing the COVID-19 pandemic's most overt effects, which poses a threat to SDG3. Hospitals and other health facilities are frequently at capacity and unable to treat everyone who needs it. Additionally, people who require medical attention attempt to avoid visiting hospitals out of concern that they might contract the infection there. The level of death could be high due to the inadequate infrastructure and equipment in underdeveloped healthcare systems. Children and Women are among those most impacted by COVID-19, according to the UN's "SDGs Report 2020." In 2020, there may be tens of thousands more unanticipated maternal fatalities and hundreds of thousands more deaths among children under the age of five due to disruptions in the health and vaccination programs and also limited resources available for diet and nutrition. There have been more complaints of domestic violence against women and children in several nations. The COVID-19 pandemic has shown how important sanitation, sufficient access to safe drinking water, and hygiene are for preventing the spread of diseases (SDG 6). Developing nations are particularly susceptible to pandemic outbreaks because they lack secure access to sanitation and clean water. With limited exceptions, the COVID-19 epidemic is anticipated to reduce global water sector investment.

2.4.AGRICULTURE AND LIVELIHOODS

Three Global Goals—SDGs 1 through 8—that are negatively impacted by COVID-19 are included in the IoT sector called "Agriculture and Livelihoods" [18], By 2021, a total rise of 150 million people is anticipated, which will have a direct impact on achieving SDG1. The World Bank's

"Poverty and Shared Prosperity 2020" report lists COVID-19, armed conflict, and climate change as the three challenges that have the greatest current and potential future impact on global poverty. This study suggests that between 87 million and 117 million individuals could fall back into extreme poverty as a result of the pandemic in 2020. Between 23 and 35 million more individuals may fall into this group in 2021, raising the overall number of those living in extreme poverty to 95 to 149 million. Estimates of extreme poverty around the world before and during the COVID-19 epidemic are shown in Figure 4. Following the COVID-19 pandemic, previously secure individuals may experience a shift in circumstances due to decreased wages, a lack of social security, and increasing prices. They now run the risk of going hungry and living in poverty. The severity of acute hunger around the world is detailed in "The Global Report on Food Crises 2020." 265 million people are now expected to experience serious food shortages this year, according to the "UN World Food Program," which will hinder SDG2's fulfillment. Regarding SDG8, the COVID-19 crisis's increased unemployment and underemployment mean that an estimated 1.6 billion already vulnerable employees in the gig economy—roughly half of the world's workforce—may be adversely impacted.

FIGURE 4. COVID-19's effects on global extreme poverty

2.5.EDUCATION

The COVID-19 epidemic affected around 1.6 billion children in more than 190 nations across all continents, resulting in the biggest disruption of educational systems in history. 94% of kids around the world have been harmed by the school and educational center closures and up to 97% of them are in low- and lower-middle income nations. 370 million kids lost out on essential school meals in 2020. Many kids who were in school before the COVID-19 outbreak are unable to complete their education because they do not have access to the internet and computers at home. Before the start of COVID-19, between 2015 and 2020, the total amount of funds required for poor countries to meet SDG4 by 2030 remained constant. The amount of money now required each year to achieve SDG4 by 2030 has grown from 299 billion to 498 billion.

The IoT presents special prospects for the educational system, enabling students to participate

in classes virtually and preventing the development of COVID-19.

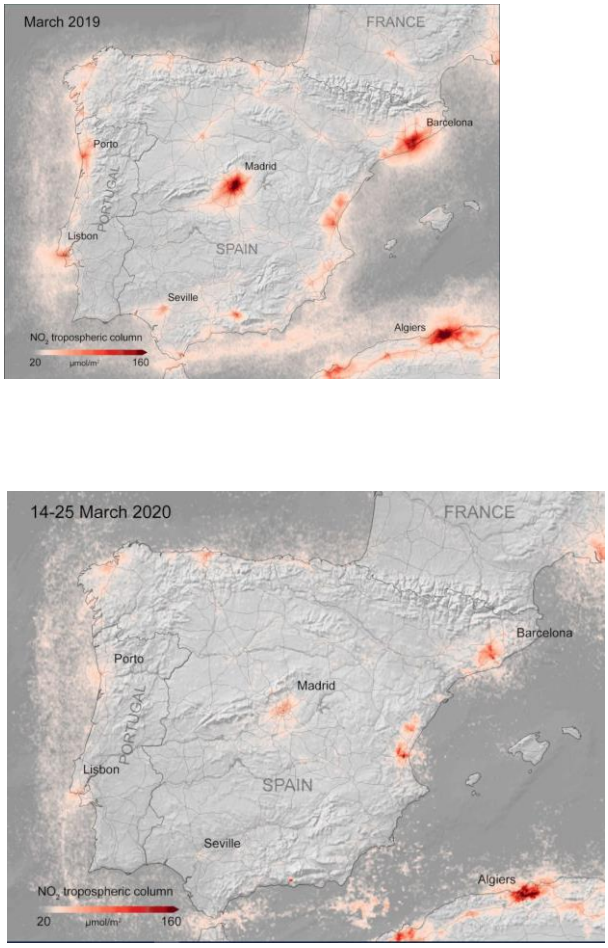

FIGURE 5. Copernicus Sentinel-5P satellite data regarding lockdown

Students can access more and more data through the IoT at any time and from any location. management systems, administrative management, monitoring, and others are the different IoT application categories. The smart education system at "The International School of Innovation" in Lebanon incorporates cameras and sensors to improve learning and the educational environment as a whole. Finding patterns that influence student performance in particular topics, providing learning statistics, such as a learning goals matrix for lagging pupils, and emotion recognition and monitoring were all done using the internet of things (IoT). As students attend several classes throughout the day, happiness could be monitored.

2.6.CONSERVATION AND ENVIRONMENT

Consumer need for online purchasing and home delivery has increased as a result of quarantine rules, and both the amount of organic and inorganic trash produced by houses has increased. Also on the rise is medical waste. Plastic face masks, gloves, and hand sanitizer bottles from COVID-19 have been found on streets, beaches, and oceans. Hospitals in India produced 240 metric tonnes

of medical waste per day on average at the height of the outbreak, which was six times as much as they produced before the crisis. Additionally, even though there is no proof that COVID-19 is still present in drinking water or wastewater, numerous countries' treatment facilities have tightened their disinfection protocols to stop COVID-19 from migrating via wastewater.

2.7. IMPLICATIONS OF THE COVID-19 PANDEMIC ON THE IoT4D'S DIFFICULTIES

Before the COVID-19 outbreak in 2020, identified the difficulties facing IoT4D in achieving the SDGs by 2030. The writers divided problems into five categories: technological issues, environmental issues, social issues, policy issues, and financial issues. These problems still exist, and some of them have gotten worse. The COVID-19 pandemic's consequences have led to the emergence of new challenges.

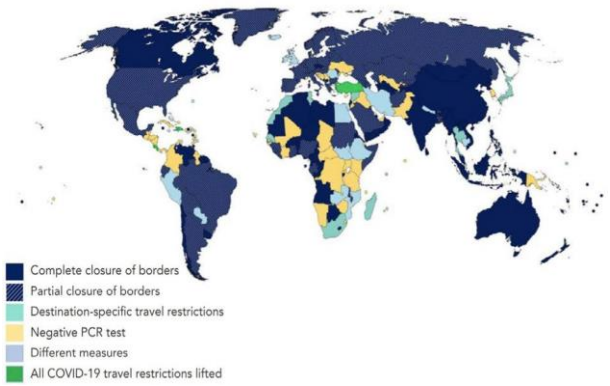

FIGURE 6. Destinations with travel restrictions

2.7.1. New profile of poor people

The "Poverty and Shared Wealth" report by world Bank, which examined data from the World Development Database, claims that the COVID-19 epidemic is altering the demographics of those who live in poverty. There are important differences between the new poor that the COVID-19 pandemic may have created. According to this research, the most of the newly poor will live in countries that already struggle with high levels of poverty, but middle-income countries would be severely hit, hosting more than 75% of the newfound poor. Large segments of the extremely poor were rural before COVID-19. However, there is a good chance that those who become poor due to COVID-19 do so because they reside in densely crowded urban areas that encourage the spread of the virus. Many of the newly impoverished work in industries like manufacturing or construction, which are badly impacted by the pandemic's mobility constraints and lockdowns.

2.7.2. limits on travel

As a result of the COVID-19 pandemic, worldwide tourism will return to levels last seen 30 years ago in 2020. The COVID-19 pandemic has caused 118 destinations to temporarily or permanently close their borders, according to the United Nations World Tourism Organization's

(UNWTO) "8th Travel Restrictions Report" published on December 20. (1st November 2020). The distribution of locations with travel restrictions is depicted in Figure 4. Travel restrictions have an impact on more than just tourism; they also affect how humanitarian aid is delivered, how humanitarian programs are developed, and how quickly cooperation projects can move forward.

2.7.3. reduction in development finance

"Financing for Improvement in the Era of COVID-19 and Beyond," a report by the United Nations, According to, the COVID-19 pandemic will cause financial flows in emerging nations to drop by up to 45%. This jeopardizes years of progress made toward achieving the

TABLE 2. Before the COVID-19 outbreak, IoT challenges in underdeveloped countries were highlighted.

Category	Challenge	Details
Technical	Design requirements	The design requirements of the IoT applications for developing countries commonly have different requirements and technological frameworks.
	Lack of research	Low publications rate in peer-reviewed journals.
	Simple and cost-effective technology	Solutions may prove more suitable in a developing country context.
	Lack of modern infrastructure Internet connectivity Power supply	Lack of local cloud computing infrastructure.
	Lacking local IoT expertise	
	Harsh environmental conditions.	
	Rural-urban differences.	
Policy	Security and privacy	There are enormous differences between rural and urban areas in the developing world with the 85% of poor people living in rural areas.
	Absence of standards	Need of including security in the design of the IoT projects.
	Government regulations	Developments with no standardization sometimes results as designed products that operate in disruptive ways on the Internet
Financial conditions	Lack of financial systems	Government regulations to protect data access and use increase the consumers trust in the IoT devices.

The SDGs, which include eradicating poverty, promoting pay equity, improving nutrition and health, and increasing literacy rates, advance the internet by about 30%. The peaks in Internet connectivity throughout March and April were paired with alterations in behavior and traffic flow to indicate decreases in internet speed. Particularly so and to a greater degree in nations. According to experts, the overall traffic growth will continue.

2.7.4. 5G DEPLOYMENT

IoT and 5G are the two primary players in the post-COVID-19 era. The solutions they provide for battling the epidemic can be found in fields including contract tracing, self-isolation and telemedicine, retail, supply chains and online education, factory automation and smart manufacturing, media and e-government, entertainment, and e-tourism. However, the proposed technologies' ability to be adopted quickly is constrained by the lack of widely accessible 5G communication networks.

2.7.5. Concerns over 5G technologies

The IoT cannot fully expand without the 5G network. It encourages cellular operations, which is linked to IoT security and lessens network problems. False information relating 5G to COVID-19 has been widely disseminated online during the COVID-19 outbreak. Reputable organizations like the ITU and the GSMA were compelled to publish official letters stating unequivocally that the assertions relating 5G technology to the spread of COVID-19 are completely unfounded. However, during the epidemic, anti-vaccination, anti-5G protests, and destruction have all been stoked by conspiracies involving 5G and COVID-19.

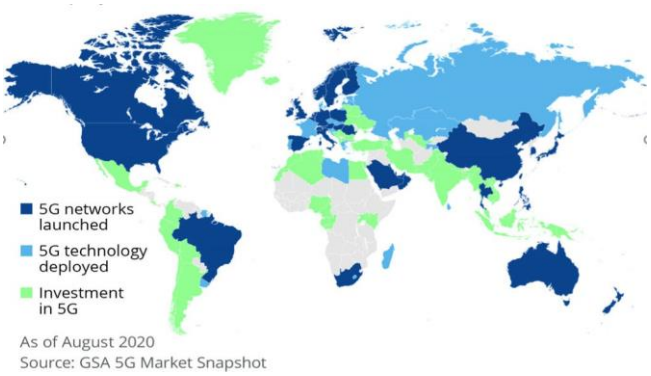

FIGURE 7. 5G network

2.7.6. EDUCATION GAP

The demand for a digital education transformation has been made clear by COVID-19. The digital education gap is wider in the poor world since there are fewer options for access to computers and mobile phones there. Because not all students from disadvantaged backgrounds own laptops and smartphones, policies should focus on supplying the necessary technology. In addition, governments must make sure that the internet is accessible in rural areas so that distant populations can participate in the educational process.

2.7.7. INTERNET WASTE

The COVID-19 epidemic has brought attention to the reliance on ICT infrastructure and connection, and overall need and use have grown. The rapid expansion of the IoT has had a negative effect on the environment because of infrastructure devices like energy consumption from production and use, co2 emission from power distribution machinery, water usage for coolers, waste from electronic and electrical devices, and a lack of raw materials. Due to a lack of facilities for proper waste planning, a lack of legislation specifically dealing with this fresh kind of waste, and the absence of any structure for the take-back of end-of-life products or the application of elongated manufacturer obligations, developing countries face greater challenges than industrialized nations.

3. Issues with IoT Adoption in Developing Areas

In underdeveloped nations, infrastructure for adopting sophisticated technologies is sometimes very inadequate or nonexistent, and there is relatively little investment in public or private study and development. Utilizing simple, affordable technology to achieve high IoT proliferation in poor nations is one of the main factors. Numerous studies have looked at how the Internet of Things (IoT) spread throughout the developed world by highlighting the difficulties it faces in reaching the billions of people who reside in developing countries in order to spur sales growth and societal advancement.

The main issue with IoT when it has been activated by power is internet availability. The IoT necessitates flawless and enough connectivity between each thing. To ensure seamless communication, you need a strong power supply, a steady supply of backup networks, and secure, adaptable architecture. Installing a hybrid backbone across the nation that can be sufficient to permit IoT in these countries to compromise with the issues and foster maximum utility for end users is the key difficulty here. Another significant issue in developing countries is the lack of technically skilled people as a result of the constant maintenance, upgrades, and feature verification required for IoT networks. On the other hand, data centers that are grouped and run on electricity that is extracted can ensure the quality and dependability of the electricity in developed countries. Energy production is currently challenging because the electrical industries are some of the most severe in an economy. This intensifies the acute pressure on financial resources.

4. In Developing Regions, IoT and Sustainable Development Goals (SDGs)

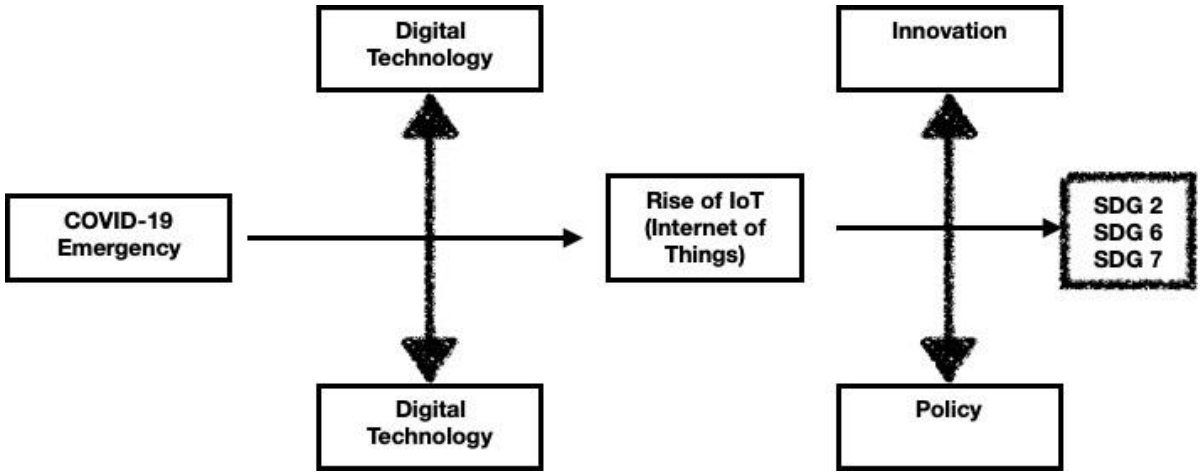

Figure-8: the accomplishment of the SDGs with a focus on the Internet of Things

In its resolution 70/1 from 2015, the UN General Conference announced the SDGs, with 2030 specified as the planned year of completion. Universities, governments, and the private sector have all contributed to the determination of these priorities. Included are the three cornerstones of sustainable local development. The widely recognised standard approach for accomplishing the goal of sustainable community development is to follow the SDGs. In order to maximise social and sustainability implications, these criteria are essential to the entire IoT idea. It may be possible to meet some of the most pressing social, environmental, and economic needs as a result of the COVID-19-induced IoT output.

5. CONCLUSION

Because there is not enough international recognition to ensure that the UN's Sustainable Development Goals (SDGs) are being met, the underdeveloped world is particularly prone to COVID-19 epidemics. The worst pandemic of this century to date is COVID-19. The COVID-19 pandemic's aftereffects now pose a threat to the SDGs' progress. All of the SDGs were impacted by COVID-19, but following a thorough examination of the research, it was determined by the studies that SDG3, SDG4, and SDG8 had been most adversely impacted. The potential for IoT to combat COVID-19 in underdeveloped nations is higher and more important than in wealthy nations. COVID-19 has created new difficulties. On the one hand, there are brand-new social issues that need to be addressed: the poor population is changing, countries are providing less funding for advancement, millions of trips have been impacted by travel bans, and people are concerned about the implementation of 5G and the safety of IoT data. On the other hand, technological difficulties including a lack of digital connectivity frequently prevent IoT4D solutions from being deployed quickly. The future of IoT4D in the context of COVID-19 is shown through the application of low-cost IoT to the SDGs that are most impacted—education, health, and employment. In order to address the COVID-19 epidemic in underdeveloped countries, high-performing, low-cost IoT devices with integrated OSHW platforms were developed. The Smart Internet of Things, a different IoT4D application that combines IoT and AI, has emerged as a major player in the wake of the pandemic, particularly in the health industry.

Reference:

1. Durst, Miriam. "Internet of things-enabled smart governance and the sustainable development of innovative data-driven urban ecosystems." Geopolitics, History, and International Relations 11.2 (2019): 20-26.
2. Buntak, Krešimir, Matija Kovačić, and Maja Mutavdžija. "Internet of things and smart warehouses as the future of logistics." Tehnički glasnik 13.3 (2019): 248-253.
3. Puri, Vikram, et al. "A hybrid artificial intelligence and internet of things model for generation of renewable resource of energy." IEEE Access 7 (2019): 111181-111191.
4. Alreshidi, Eissa. "Smart sustainable agriculture (SSA) solution underpinned by internet of things (IoT) and artificial intelligence (AI)." arXiv preprint arXiv:1906.03106 (2019).

5. Messner, Dirk, et al. "The digital revolution and sustainable development: Opportunities and challenges-report prepared by the world in 2050 initiative." (2019).
6. Andreopoulou, Zacharoula. "Internet of Things and food circular economy: A new tool for Sustainable Development Goals." Internet of Things and food circular economy: a new tool for Sustainable Development Goals (2017): 43-49.
7. Hanson, Kobena T., and Korbla P. Puplampu. "The Internet of Things and the sharing economy: Harnessing the possibilities for Africa's sustainable development goals." From Millennium Development Goals to Sustainable Development Goals. Routledge, 2017. 133-151.
8. Biermann, Frank, Norichika Kanie, and Rakhyun E. Kim. "Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals." Current Opinion in Environmental Sustainability 26 (2017): 26-31.
9. Barbier, Edward B., and Joanne C. Burgess. "The Sustainable Development Goals and the systems approach to sustainability." Economics 11.1 (2017).
10. Nilsson, Måns. "Important interactions among the sustainable development goals under review at the high-level political forum 2017." (2017).
11. Asma, Samira, et al. "Monitoring the health-related Sustainable Development Goals: lessons learned and recommendations for improved measurement." The Lancet 395.10219 (2020): 240-246.
12. Fullman, Nancy, et al. "Measuring progress and projecting attainment on the basis of past trends of the health-related Sustainable Development Goals in 188 countries: an analysis from the Global Burden of Disease Study 2016." The Lancet 390.10100 (2017): 1423-1459.