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Green Internet of Things towards African Continent Smart Industrial Revolution

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ABSTRACT

Industrial development is an imperious for Africa to meet the objectives of African Union Agenda 2063 within a global economy constrained by climate change and driven by competitive supply chains and complex supply and demand dynamics so go to fourth industrial revolution is mandatory. The Fourth Industrial Revolution (4IR)characterized by the fusion of the digital, biological, and physical worlds, as well as the growing utilization of new technologies such as artificial intelligence, cloud computing, robotics, 3D printing, the Internet of Things, and advanced wireless technologies, among others has ushered in a new era of economic disruption with uncertain socio-economic consequences for Africa. Green industrial revolution in Africa could help to realize green internet of thing application. Targeted green industrial policies and investment in green industries can operationalize the structural change necessary for economic recovery, competitiveness, and new jobs in the content of Africa. The combination of an exploding population and rapid industrialization is putting enormous pressure on the earth's resources. So a growing awareness among enterprises that going green taking measures to reduce a company's carbon footprint, conserve resources, and protect the environment has an enormous side benefit. The necessities for environmentally supportable modes of production and a more efficient use of possessions i.e. Green Industry, is becoming increasingly evident. This is especially in the developing world like Africa. Energy awareness is a great way to achieve green IoT. When we make the users aware of their energy usage and current energy need, it will create appositive thinking toward saving energy. Due to that Awareness-Based approach is selected for the study because of making changes in people's attitude and behavior is not easily possible. It is highly subjective as well as key determinant factor for efficient energy usage.

Key words: Green Internet of Things, Industry 4.0, Africa, IoT, Artificial intelligence

1. INTRODUCTION

the Fourth Industrial Revolution (4IR)characterized by the fusion of the digital, biological, and physical worlds, as well as the growing utilization of new technologies such as artificial intelligence, cloud computing, robotics, 3D printing, the Internet of Things, and advanced wireless technologies, among others has ushered in a new era of economic disruption with uncertain socio-economic consequences for Africa[1]. However, Africa has been left behind during the past industrial revolutions. Internet of Things (IoT) connects everything in the smart world, and thus, energy consumption of IoT technology is a challenge and attractive research area. The motivation to study green internet of thing is for achieving low power consumption IoT and intelligent system for enhancing smart industry revolution. Green IoT (G-

IoT) consists of two aspects. The first one refers to scheming energy efficient computing devices, communications protocols, and networking architectures for interconnecting the physical world. The second aspect is to leverage IoT technologies to cut carbon emissions and pollutions and enhance the energy efficiency. There are many green IoT enabling technologies such as RFID, sensor networks, cellular networks, machine-to-machine communications, energy harvesting devices and communications, cognitive radio, cloud computing, and big data analysis .combining green-IoT with artificial intelligence for creating smart industry[2]. With the progress of these enabling technologies, green IoT poses a great potential to bolster economic and environmental sustainability. General impression of green IoT and recapitulate the principles of information and communication (ICTs) that enables the G-IoT for smart world with the integration of artificial intelligence. At the movement the Internet of Things (IoT) can support cooperation and communication between objects automatically. However, with the increasing number of involved devices, IoT systems may consume substantial amounts of energy. Thus, the relevant energy efficiency issues have recently been attracting much attention from both academia and industry. Green IoT (G-IoT) applications will produce new products, services and experiences that will offer many benefits to businesses, consumers and industries with minimum energy consumption. Generally green computing is the utmost requirement to protect environment and save energy along with operational expenses in today's increasingly ready for action.in general Green IoT can be defined as the energy efficient procedures (hardware or software) adopted by IoT either to facilitate reducing the greenhouse effect of existing applications and services or to reduce the impact of greenhouse effect of IoT itself. In the earlier case, the use of IoT will help reduce the greenhouse effect, whereas in the latter case further optimization of IoT greenhouse footprint will be taken care. The entire life cycle of green IoT should focus on green design, green production, green utilization and finally green disposal/recycling to have no or very small impact on the environment .Green IoT indicates energy efficiency in IoT. Internet of things is going to revolutionize the world as most of the things that we use in our day-to-day life will be a part of Internet soon. In order to realize IoT, objects will be attached to various types of sensors so that they can be tracked and controlled remotely. These sensors will collect information from the surroundings and transmit it through the Internet. Even though individual energy consumption of a sensor is comparatively less, due to the huge number of sensors, total energy consumption will be tremendous. Green IoT comprises methods for reducing energy consumption and how sensors can be efficiently used as an indication of energy conservation[3].

2. RATIONAL OF THE STUDY

The combination of an exploding population and rapid industrialization is putting enormous pressure on the earth's resources. Then growing awareness among enterprises that going green taking measures to reduce a company's carbon footprint, conserve resources, and protect the environment has an enormous side benefit: It's also good business. Environmental issues plague much of the planet, but with the rapid proliferation of the Internet of Things (IoT), efficient, economical, and sustainable solutions are within reach. Due to that the study talks about approaches for implementing green IoT through awareness based approach. The conversation of huge

amount of data between IoT sensors connected device will create a big energy requirement. Energy efficiency of IoT devices is a great alarm as huge number of sensors may consume a lot of energy[4]. Green IoT implementation also possesses some challenges. For example making changes in people's attitude and behavior is not easily possible. It is highly subjective as well. Similarly, implementation of green RFID devices and green information communication devices also required some overhead expenses. A great deal of effort and teamwork is essential for the effective implementation of the green IoT scenario. While Industry 4.0 promises numerous opportunities for economic development, its further attainment impacts are largely doubtful. Industry 4.0 emerges aligned with the backdrop of pressing global challenges such as climate change, food insecurity, lack of energy access, water scarcity, environmental humiliation, loss of biodiversity and megatrends like population growth, urbanization and mass migration, as well as the new and constant conflicts and crises worldwide. Acknowledging the environmental and economic potential of green entrepreneurship, and recognizing the daunting challenges clean technology SMEs are facing, particularly in accessing early and growth stage financing, the recent report provides policymakers with a range of practical instruments that help support SMEs in clean technology sectors such as innovative finance, entrepreneurship and business acceleration, market development, technology development, and the legal and regulatory framework[5].So the study will answer the following questions.

1. How to change people's attitude about efficient energy usage?
2. Which type of technique is suitable for changing the perception of the society's energy usage?
3. Who is responsible for efficient energy usage?
4. How to aware the importance of green internet of thing for industry 4.0?
5. How to accept green industry in developing content?

3. RELATED WORK

There is a comprehensible intersection between the Internet of Things (IoT) and Artificial Intelligence (AI)[1]. IoT is about connecting machines and making use of the data generated from those machines. AI is about simulating intelligent actions in machines of all kinds. Data is only useful if it creates an action**.** Artificial Intelligence is all about making your system behave smartly according to human behavior, whereas IoT is all about the sensors of devices. Together they bring in a connected level of intelligence which will make computers smarter and not just devices that are interconnected. The influence of sensors and dealing out rise and their costs drop, those of us who study the "greening" of information and communications technology (ICT) are looking ahead to the challenges posed by artificial intelligence (AI)[6]. In the previous period digital technologies have spread more and more into mechanized and production progressions. Swift enlargements in the fields of Internet of Things, Big Data, robotics, block chain technology, sensors, artificial intelligence, augmented reality and rapid prototyping technologies have evidently transcended into the manufacturing industry[7]. This extraordinary occurrence often referred to as "the fourth industrial revolution" or "Industry 4.0" has gained significant momentum. Industry 4.0 could

fundamentally transform the way goods are developed, produced and enthusiastic, and stimulate the development of novel business models, services, and behaviors. While Industry 4.0 promises numerous opportunities for economic development, its further attainment impacts are largely doubtful. Industry 4.0 emerges aligned with the backdrop of pressing global challenges such as climate change, food insecurity, lack of energy access, water scarcity, environmental humiliation, loss of biodiversity and megatrends like population growth, urbanization and mass migration, as well as the new and constant conflicts and crises worldwide. Internet of Things (IoT) is an emerging thought, which aims to append billions of devices with each other. The IoT devices sense, collect, and pass on important information from their atmosphere. This exchange of very large amount of information amongst billions of devices creates a gigantic energy need. Green IoT envisions the concept of reducing the energy utilization of IoT devices and making the environment safe and sound[8][9].

The graceful city initiative is comprehensive and multidisciplinary effort to create an energetic and worldwide network of cities and to serve the peoples with smart devices (mobile, watches, computers).Enabling technologies like RFID, sensor networks, biometrics, and nanotechnologies are now becoming very common, bringing the Internet of Things into genuine implementations addressing varying applications, including smart grid, e-health, intelligent transportation, etc. Green networks in IoT will contribute to reduce emissions and pollutions, exploit environmental conservation and surveillance, and minimize operational costs and power consumption. The Green Internet of Things (G-IoT) is predicted to introduce significant changes in our daily life and would help realizing the vision of "green ambient intelligence"[10].

The IoT is smooth the progress by using various technologies to sense, collect, store, act, and process, infer, transmit, generate notifications of/for, manage and analyses data. The combination of evolving technologies for information processing and dispersed security, e.g. AI, IoT, DLTs and block chains, brings new challenges in addressing distributed IoT architectures and distributed security mechanisms that form the foundation of improved and, ultimately, entirely new products and services[11]. New systems in the IoT that use smart solutions with embedded intelligence, connectivity and processing capabilities for edge devices rely on real-time analysis of information at the edge. These new IoT systems are moving away from centralized cloud-computing solutions towards distributed intelligent edge computing systems. Traditional centralized cloud computing solutions are perfect for non-real-time applications that require high data rates, huge amounts of storage and processing power, are not strict to very low latency, cost money and can be used for heavy data analytics and AI processing jobs. On the other hand, distributed edge solutions introduce computations at the edge of the network where information is generated and are perfect for real-time services, since they exhibit very low latency (in the order of milliseconds) and can be used for simple ultra-fast analytics jobs. The collection, storage and processing of data at the edge of the network in a distributed way contributes also to the increased privacy of the user data, since no personal information is stored in backbone centralized servers and each user retains the full control of his data[2].

Internet of Things (IoT) is a solution enabler for several rationalized applications, from marine

monitoring to outer space investigation. However, difficult operations (such as device interconnection, data transmission and service optimization) will consume substantial energy in contrast with the limited energy storage of IoT devices. To improve architectural sustainability and eventually decrease systemic cost, the energy efficient (green) design of IoT has become more prominent. In particular, with the continuous penetration of advanced information and communications (ICT) technologies (such as VR/AR, UAVs, and automobiles), our smart world is being surrounded by big IoT data that craves energy-efficient caching, computing, networking and securing. Some emerging techniques (e.g., edge computing, SDN/ICN, artificial intelligence) are thought to have promise with novel approaches to overcome the sustainability limitations of current IoT systems. However, fully utilizing these techniques from communication, data processing, and computing etc., to improve the energy efficiency of IoT still faces many fundamental challenges[12].

3.1. Overview green internet of thing

The Green Internet of Things (G-IoT) is predicted to set up significant changes in our daily life and would help in realizing the vision of "green ambient intelligence." Within a few years we will be surrounded by a gigantic amount of sensors, devices, and "things," which will be able to communicate via 5G, act "intelligently," and provide green sustain for users in running their tasks. These latest smart objects will also be context-aware and able to perform certain functions autonomously, calling for new forms of green communication between people and things and between things themselves, where power consumption is optimized and bandwidth utilization is maximized. This development would be relevant not only to researchers, but also to corporations and individuals alike. It is hence the aim of this special issue (SI) to focus on both theoretical and implementation aspects in green next generation networks or networks that can be utilized in providing green systems through IoT enabling technologies [13].

Automation, artificial intelligence (AI) and the improvement of the "Fourth Industrial Revolution" are acute everything from automotive, garment and electronics manufacturing to business processes, logistics and healthcare. The benefits, in terms of efficiency, productivity, speed and agility, are undoubted. These innovations could make products safer, increase industrial productivity, shorten global supply chains and make public services more personalized, predictive, and participatory, as citizens both provide and benefit from increasing data flows around public services. However, as with all technological change, their impact will be shaped by choices and the ends to which they are put. Just like nuclear fission could create civilian energy or military weapons, these innovations could have a wide range of applications and impacts both positive and negative. The transformative potential of technology in production systems is widely recognized, even while the precise configuration and extent of the possible transformation remain unknown. Trends towards higher levels of automation promise greater speed and precision of production as well as reduced exposure to dangerous tasks for employees. New production technologies could help overcome the stagnant productivity of recent decades and make way for more value-added activity. The extent of automation is, however, causing significant anxiety about issues of employment and inequality[14][15].

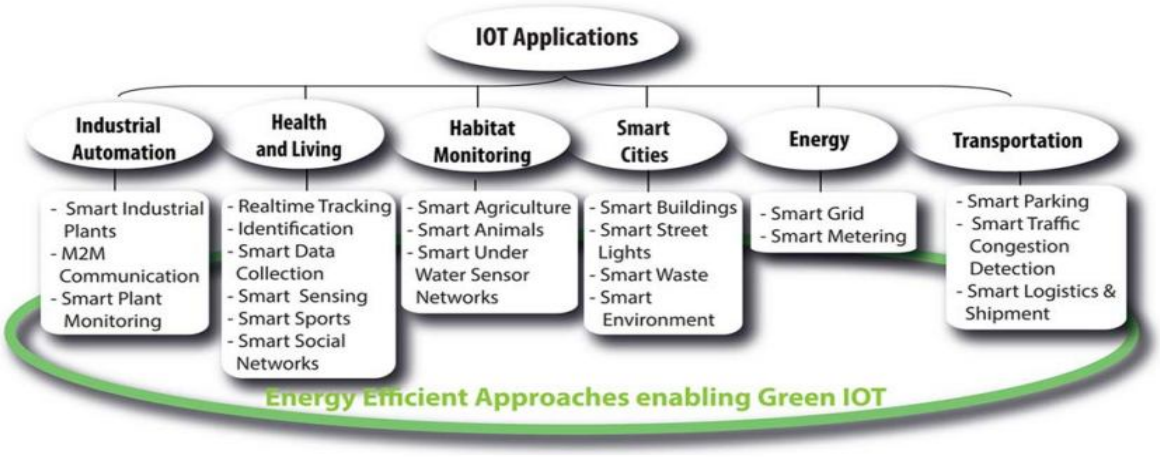

Figure 1: Green IoT Application[16]

3.2. Energy-Efficient Smart Industry in Africa

The manufacturing industry is at present witnessing the fourth industrial uprising, better known as Industry 4.0 where the 'real' and the 'virtual' world are to be seamlessly connected giving increase to what are known as cyber-physical fabrication systems. As a result, the conventional manufacturing processes are undergoing an enormous transformation which will change the way companies approach manufacturing[1].

The internet makes the world as a small township where things are connected to each other and with the world via inclusive communication networks using (TCP/IP) protocol. The things include not only communication devices, but also physical objects, like cars, computer, and home appliances, which are controlled through wireless communication networks. The internet has changed drastically the way we live and interact with each other in every situation spanning from professional life to social relationships. Smart connectivity of the existing networks and context-aware computation using system resources is the substantial part of the internet of things (IoT). Therefore, IoT is everything around us which should be communicated ‘‘anytime, anywhere, any media and anything". The Internet of Things helps providers deliver reliable, fair-priced services and products. IoT connected devices and machines predict problems before they occur. Distributed grid resources like solar and wind are integrated through IoT. And behavior data such as that collected from smart homes improves convenience and security, and informs progress of modified services[17][18].

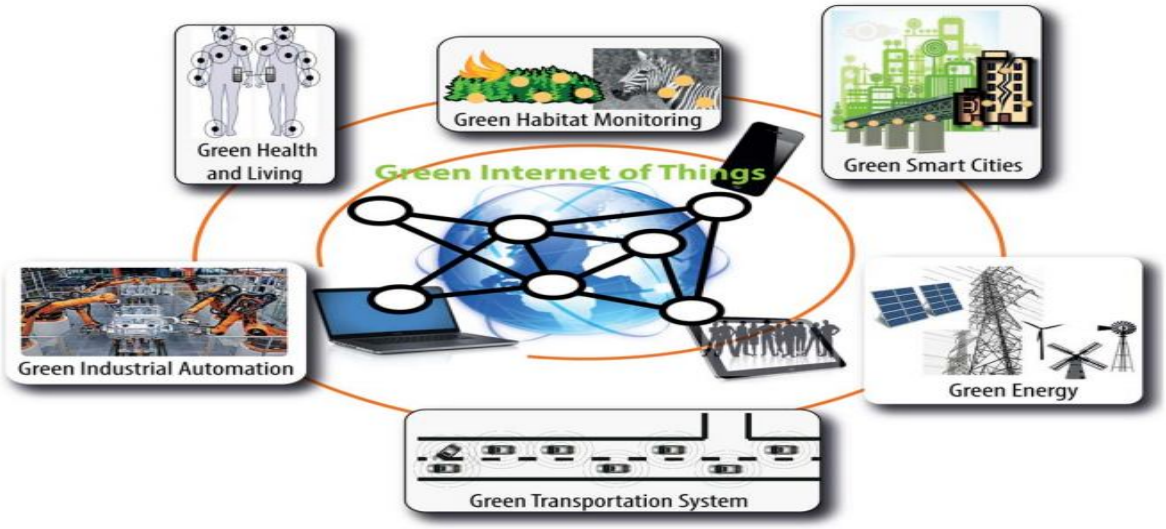

Figure 2: Green IoT for smart industry[16]

3.3. The 4th Industrial Revolution in Africa

The Fourth Industrial Revolution (or Industry 4.0) is the continuing automation of traditional manufacturing and industrial practices, using modern smart technology. Large-scale machine-to-machine communication (M2M) and the internet of things (IoT) are integrated for increased automation, improved communication and self-monitoring, and production of smart machines that can analyze and diagnose issues without the need for human intervention. It's a technological revolution, encompassing numerous innovations and creating new market dynamics. Inside factories, information technologies, communicative sensors, IIoT (Industrial Internet of Things), simulation software tools, information-processing software, management software, and the highest-performance machines are gradually making factories increasingly agile, efficient and competitive.

3.4. Green Industry in Africa

The necessities for environmentally supportable modes of production and a more efficient use of properties i.e. Green Industry, is becoming increasingly evident. This is especially so in the developing world like Africa, which has the unique opportunity of avoiding the environmental pitfalls that the developed world has fallen into in the course of its industrial development; it can use past experience to build a Green Industrial infrastructure at the very outset. Some scholar provides an insight into how an increased focus on Green Industry for sustainable industrial development in Africa and transition countries can contribute to the attainment of global Sustainable Development (SD) objectives. The concept of ‘sustainable industrialization’ is now integral to the UN’s Sustainable Development Goals. However, there are no historical examples or current models to emulate. Scholarly analyses of putative initiatives to green industrialization, especially in developing countries, are few and limited. For example in Ethiopia, one of the world’s poorest nations, where an ambitious Climate Resilient Green Economy (CRGE) strategy has been created, alongside a multi-sectorial Growth and Transformation Plan (GTP), to leapfrog

environmentally unsustainable development and bring the country to middle-income status by 2025.Structural transformation in Africa's economies remains the highest priority, and industrialization is the top strategy for achieving it in practice. Achieving the African Union's Agenda 2063 and fulfilling the Sustainable Development Goals will demand a major re-design of growth strategies across the continent. The big opportunity for Africa in 2016, as a latecomer to industrialization, is in adopting alternative economic pathways to industrialization. This requires governments to take on-board the drivers, challenges, and trade-offs in pushing for a greening of industrialization and to build them into the vision and route-map for action. Seizing the momentum of the Paris Climate Agreement and the SDGs provides the ideal timing for such a shift in economic strategy.This is why the ECA has seized the opportunity this year to herald the era for Africa to pursue a different pathway to industrialization, in short, one that enables the region to green its industrialization. In so doing Africa will pursue its development agenda along a pathway that ensures that economic growth is truly sustainable and inclusive through green jobs and positive spillovers. It is this new niche that we recognize as a winning formula, a "no regret" option FOREWORD xvii Greening Africa's Industrialization that will secure Africa a central space in the world economy. Such a transformation will make significant productivity gains in rural areas with vibrant hubs of agri-business and linkages to industrial activity. Through case studies this report Greening Africa's Industrialization: Economic Report on Africa 2016 shows that there is good news on greening industrialization in Africa. A number of countries have already put in place policies and regulatory frameworks for green industrialization. A good number of enterprises are taking the lead to implement green measures, driven by legal requirements and opportunities for economic returns on their investments, as well as the need for a long-term sustainable business model. But more need to follow suit, and this report is an entry point for shared learning and the replication of good practice on how we develop a low-carbon pathway[20].

Figure 3: Green industry concept[21]

4. METHODS TO REALIZE GREEN IOT

Green IoT is a solution to many of the challenges caused by IoT.This section describes different methodologies to make IoT green. One of the studies categorizes these methodologies as software-based methodologies, hardware-based methodologies, policy-based methodologies, awareness-based methodologies, etc. Policies and strategies based on real-time data obtained from sensors can support green energy concept to a great extent. The insight drawn by processing the data obtained from IoT sensors can be best utilized to create energy usage policies. Efficient policies need to be implemented in different stages like energy data collection, information processing, service delivery, etc. Changing practice toward saving energy is another approach to save energy. By making positive changes in energy usage of user great deal of saving can be achieved. Behavioral changes can be achieved by making the user aware of the need to save energy. Awareness movement plays a vital role in making behavioral changes. Awareness-based approach also can contribute a lot to save energy. Following section describe awareness-based energy-saving methods in detail.

4.1. Awareness-Based Approach toward Green IoT

Energy awareness is a great way to achieve green IoT. If we make the users aware of their energy usage and current energy need, it will create appositive thinking toward saving energy. Since the result of energy campaign is very much subjective based on the attitude and culture of people, proper planning is very much necessary in the way of organizing the campaign activities. Smart meters will provide readings which can be utilized to display the current consumption volume and future trends. Some of the strategies for creating energy awareness are discussed here. Africa's leading economies are increasingly looking to wind energy to power homes. It's part of a trend towards varying forms of clean energy across the continent. South Africa, the continent's most

advanced economy, is a clear leader in renewable energy policy and projects. Kenya is also a major leader and opened Africa's largest wind farm last year and is on course to soon be able to claim 100% renewable energy from a range of sources including geothermal and solar. Investment in clean energy in sub-Saharan Africa jumped to $7.4 billion in 2018 up from $2.3 billion in 2017. South Africa accounted for $4 billion of investment driven by a major onshore wind project in 2018. Clean, renewable energy is being adopted across sub-Saharan Africa boosted by policy incentives, backing by donors to overcome the lack of local finance and developing de-risking mechanisms for reluctant governments. The awareness based approach simple framework is as follow in the following figure.

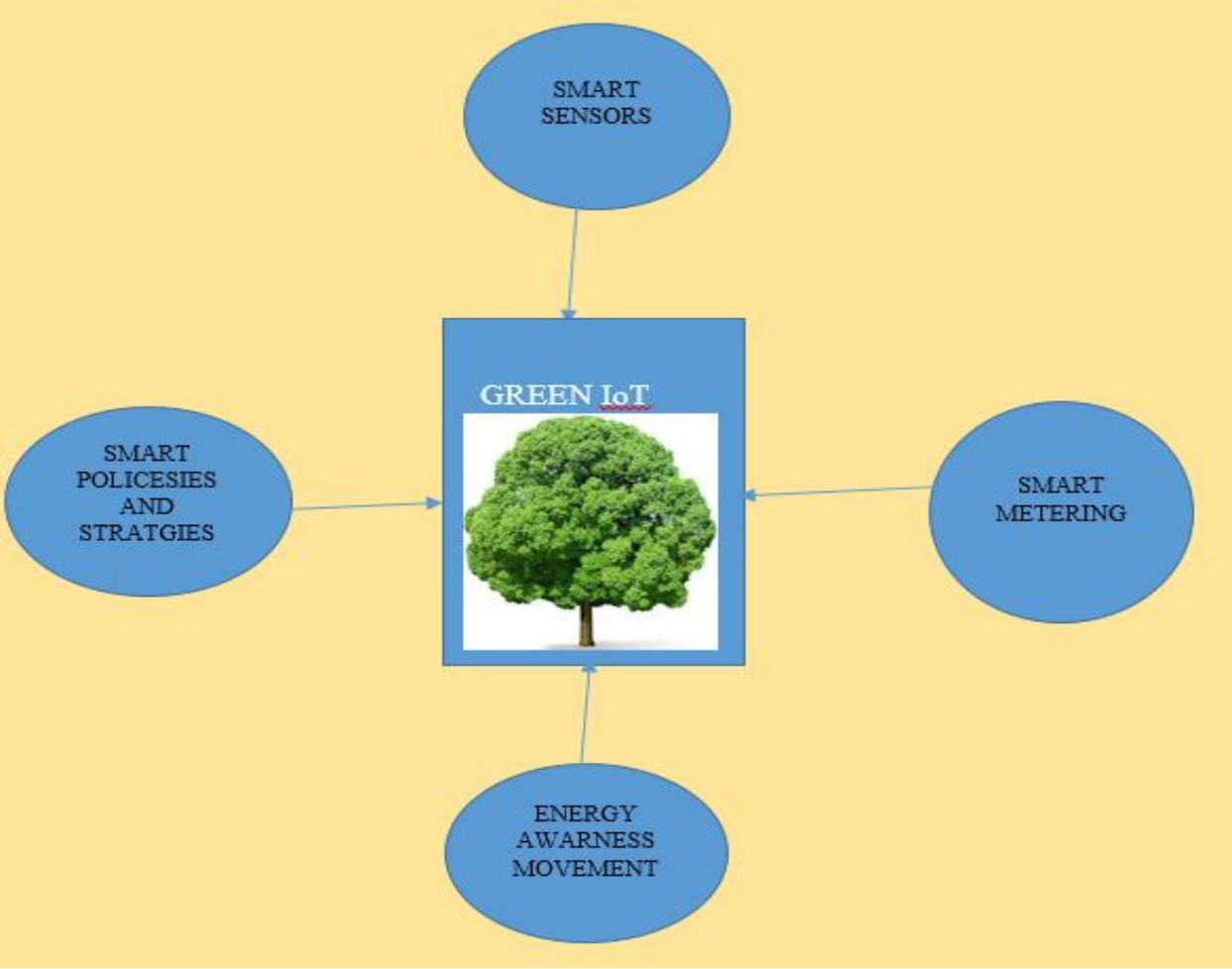

Figure 4: Awareness-Based approach for efficient energy usage.

4.2. Energy Awareness Movement

Energy awareness operation is a way to create awareness among users and motivate them toward saving energy. Energy awareness operation is defined as a properly planned, synchronous set of activities leading to create awareness among the energy users regarding the need of saving energy. Readings from IoT sensor-enabled devices can be recorded and displayed to create awareness about current consumption and predict future energy needs. It will create a clear picture among users regarding the need

to save energy and reduce consumption. The main steps involved in awareness operation process are planning the operation, identifying the prospective audience, collecting real-time data, creating operation materials by properly utilizing the data, identifying strategies for delivering operation, conducting the operation effectively, and finally analyzing the results. The figure below shows the detail.

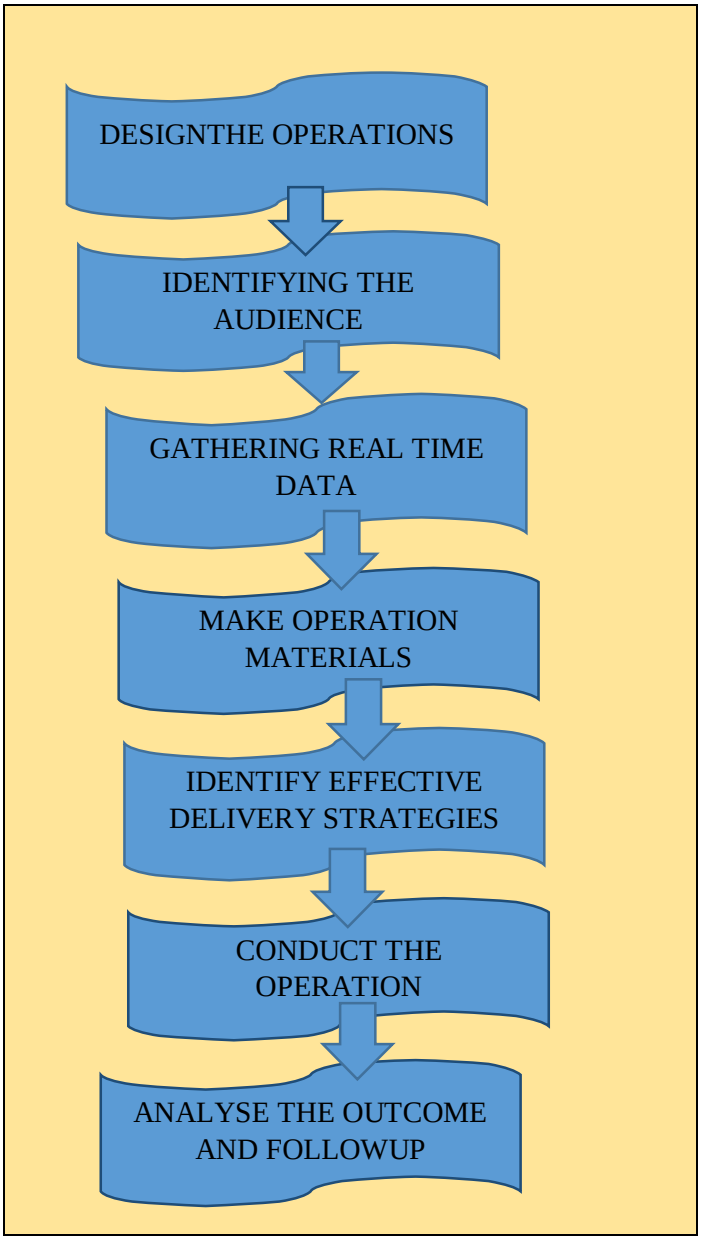

Figure 6: Steps involved in Energy awareness movement

4.3. Smart Energy Meters

It is a planned system designed to eradicate human involvement in the electricity system. IOT (Internet of things) is the network of physical things with electronics software, sensors, and connectivity to enable objects to collect and exchange data. IOT

based automatic meter reading is the technology of automatic collecting data energy meter and transferring data to the server for billing process and if there is any tempering then also detectable. The internet connected to meter collect the data and display data on the LCD by which we can read and understand the things that are going on the system. The data is received by the internet and whenever a key is pressed microcontroller send SMS through the internet to the transmitter to get the reading of the meter. It is difficult to manual reading and calculating bill of individually. This will help for the proper and accurate reading of billing process. By taking all these features that can be done by IOT based smart energy meter easily[22].

A smart energy meter is an electronic device that records consumption of electrical energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing Smart meters enables two-way communication between the meter and central system. Utilities are one of the electrical departments, which install these devices at every place like homes, industries, organizations, commercial buildings to measure the electricity consumption by loads such as lights, fans, refrigerators and other appliances. Energy meter measures the voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.

4.4. Smart policies and strategies for green industry

Greening the economy, transforming it to ensure environmental sustainability, is becoming increasingly urgent at the current rates of natural resource depletion. It is, however, a goal which will require enormous investment. A green economy is increasingly accepted as a key driver in tackling climate change, poverty, pollution, health and any number of critical goals to improve life for this planet and its people. Bold words, but current report shows that it is within our grasp to turn them into action. Restructuring industrial systems needs a diverse, cross-sector approach[23]. By moving beyond traditional industrial policies to a framework that encompasses environmental and energy policies.

4.5. Smart sensors

Smart sensors are defined as sensors equipped with signal conditioning, embedded algorithms, and digital interfaces. A smart sensor may also include a number of other components such as transducers, amplifiers, excitation control, analog filters, and compensation. It is important to recognize that a smart sensor has also been called an intelligent transducer with the terms also expressed as a smart transducer or intelligent sensor. In contrast to a dumb sensor, the smart means that the unit is more than a basic sensing (or transducing) element. The “more than” aspect was quite variable but ranged from signal conditioning to the ability to easily interface to a microcontroller unit (MCU) or other system components. Intelligence implies but did not necessarily require some computational capabilities. Semiconductor-based sensing (transducing) elements (including pressure and temperature) with their inherent capability to integrate additional circuit elements were the initial targets for increasing amount of sensing system functionality. However, the ease of adding an MCU into the form factor potentially made any sensor a smart sensor[24].

5. DISCUSSION

For environmentalists and development experts, green is not just a color it also refers to activities that

benefit the environment the careful use of the earth's finite resources. Africa's policy wonks are already on the green movement, having identified "green industrialization" as the Holy Grail of the continent's socioeconomic transformation[25]. They believe infusing green initiatives into value-chain activities during the sourcing and processing of raw materials, and the marketing and selling of finished products to customers can cure economic stagnation. Industrial development is an imperious for Africa to meet the objectives of Agenda 2063 within a global economy constrained by climate change and driven by competitive supply chains and complex supply and demand dynamics. Indeed, accelerated and profound economic structural transformation, through reallocating economic activities from less productive to more productive sectors for sustainable and inclusive growth, is the only means to address chronic poverty on the continent[26]. African industrialization has to focus on the regional market through increased trade before it extends to the global supply chain, with special emphasis on agro-processed products and value addition to mineral exports[4] .Conflict, poverty, environmental disruptions and a growing population all contribute to the region's inability to feed itself. Africa can learn from the experiences of the *Green Revolution,* set into motion by the US in the 1960s. The initiative was launched in response to major famines and food crises in the 1940s and 1950s. It was a complex exercise which demonstrates the power of science, technology and entrepreneurship in solving global challenges. Recent estimates show that African countries spend some $30 billion a year to import processed food. This trend can be reversed through value added agro-processing, creating countless jobs, especially for our growing youth population. How should Africa pursue its industrialization? Many pathways exist, but as a latecomer it can learn from others' experiences while defining and designing its own pathway based on its own realities and learning from history and the experiences of other regions to leapfrog traditional, *carbon-intensive* methods of growth and champion a low-carbon development trajectory or *green energy*. The continent can take advantage of new innovations, technologies and business models on a pathway that uses our natural resources optimally and efficiently as inputs to an industrialization process powered by our endowments of clean sources of energy[5].African countries must take advantage of "new innovations, technologies and business models that use natural resources optimally and efficiently," notes the 2016 ECA economic report.As green entrepreneurship and green markets emerge in Africa, governments throughout the continent will need to develop supportive policies at two levels to sustain and encourage them. First, governments must implement pricing policies and regulations that create appropriate market incentives for green processes and products. These include, for example, incentives for more efficient energy and water use. Without such incentives, private green demand will be less than socially desirable due to environmental market failures. Second, governments need to strengthen firm capacity, performance and entrepreneurship, taking into account the very different features of the various major types of firms that exist in the industrial sector of most African economies. Of these types, typically three prevail: elephants or a small number of large formal firms that dominate their sectors; gazelles representing about 10-15% of all micro, small and medium enterprises (MSMEs) with relatively high productivity and capacity to grow; and survival

entrepreneurs or other MSMEs with very low productivity and growth capacity[27].

6. CONCLUSION

Leverage technologies refer to cutting carbon emissions and enhancing the energy efficiency through awareness. Due to green ICT technologies, green IoT becomes more efficient through reducing energy, reducing hazardous emissions, reducing resources consumption and reducing pollution especially developing country like Africa. Today, the effect of data on physical objects is especially seeming through the continued rise of IoT. Less seeming, though, is how this new landscape is ushering in a new era of physical production and how manufacturers should correctly position themselves to utilize the technology in order to improve operations and fuel growth without consuming energy in Africa. The marriage of processes technology with information technology is giving rise to what's called Industry 4.0. Industry 4.0 (or SMART manufacturing) is the use of digital information to drive the physical act of manufacturing. This new state of connectivity means the possibility of smarter supply chains and more efficient end-to-end processes[28].Inherent within manufacturing is the process of information creation, communication, and action. Technological advancements promise to change the world, but the African continent is not yet ready for it, say experts. … "Failure to recognize and capitalize on Fourth Industrial Revolution opportunities, conversely, will impose considerable risks on African stakeholders, "warns Brookings. Africa are seeing economic progress and regional integration that could support the spread of transformational technologies such as artificial intelligence or the internet of things. Yet a deep lack in digital skills, coherent leadership and basic infrastructure could make the continent miss out on a major industrial revolution this time with dire consequences, experts warn. Because of the fourth industrial revolution is characterized by a fusion of the digital, biological and physical worlds, where artificial intelligence, cloud computing, robotics, 3d printing, the "internet of things" and advanced wireless technologies see increased development worldwide. This revolution promises to bring about transformative changes that Africa cannot afford easily due to different reasons like skilled man power, capital, and lack of awareness. Then creating awareness for policy makers and any responsible body is the first task. The study is tray to show the framework of efficient energy usage in Africa.

Abbreviation and acronyms

G-IOT (Green Internet of things),microcontroller unit (MCU),Climate Resilient Green Economy (CRGE),machine communication (M2M), Artificial Intelligence (AI),Information Communication Technology(ICT) ,Fourth Industrial Revolution (4IR),Growth and Transformation Plan (GTP).

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