A REVIEW ON APPLICATIONS OF GREEN COMPUTING WITH BOTS FOR ENVIROMENTAL SUSTAINABILTY

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Abstract:
Nowadays, green computing focused on minimizing the impacts of information technology on the environment. Sustainability aimed at assuring to present and future generations the capability to satisfy their own need. This green computing is applicable for ensuring sustainability in different fields. It tends to minimize the environmental impact of technology and energy consumption, waste and fostering sustainability. By integrating green computing in artificial intelligence, green robots came into existence. This review article highlights the application of green computing for managing sustainability in pollution, energy consumption, agriculture and ecosystem.
Key Words: green computing, information technology, green robots, sustainability.

I .INTRODUCTION

Green Computing and Green IT is the ability to use computing resources in a manner that is both environmentally beneficial and long-term sustainable. This review highlights the notion of Green synchronization, which includes less consumption of dangerous resources, maximizing of energy efficiency throughout the lifespan of the item, promotion of recycling, and/or industrial waste and obsolete product biodegradation [1]. Today, ICT (Information, Communication, and Technology) plays a critical role in any organization's success and is becoming more and more prevalent. In addition, the demand for energy is growing at a rate roughly 12 times faster than the global demand for energy [2]. When it comes to global electricity consumption, 6 percent of the ICT sector is accounted for by network devices, computers and peripherals and data center's [3]. Carbon dioxide (CO_2) is emitted into the atmosphere by electricity generation, computers and their peripherals, network devices, & data centers. 2 percent of the world's CO_2 emissions are attributed to ICT. For example, whether intentional or unintentional, these can cause a variety of environmental harms that contribute to the global warming crisis. As a result, in order to save our planet, the idea of Green Computing is urgently needed, that will make an efficient plan to reduce heat generation, saving electricity, and reducing the carbon footprint of network devices, computers and their peripherals, data centers, and so on to make a greener and more sustainable environment. As a result, we need to educate people about how ICT can save the environment by implementing Green Computing in their systems. It's only a matter of time before energy and carbon emissions become a major concern in this age of computers, gadgets, and electronic devices.

In the year 2030, the world's energy consumption will almost double as a result of the ICT industry's 20 percent annual increase in consumption [4]. Though computer design has progressed tremendously in terms of performance, efficiency, capacity, and other metrics, it hasn't progressed at all from a green perspective. Green computing is all about making the most of computers & computing in a way that reduces their environmental impact.

It is possible to use resources effectively, efficiently, and sustainably with minimal or no environmental impact by following the following 4Gs of Green Computing. Using computers or other communication systems in an environmentally friendly manner is a priority for G-1. Refurbishment and reuse of old computers, as well as recycling unneeded computers and electronic equipment, should be the goal of G-2. Efficient and environmentally friendly design of numerous components such as servers and cooling equipment is essential in G-3: Designing of Green Environmental impact shall be kept to a minimum or non-existent throughout the production of diverse electronic components, computers, and associated subsystems (G-4) [5]. Artificial intelligence, block chain, or the Internet of Things (IoT) are all being used to combat climate change in a more urgent manner than ever. Our struggle against climate change can benefit from the help of green robotics as well. There are already a number of robots under development that can assist protect the environment in a variety of ways, including battling wildfires, managing waste, and cleaning the oceans or other water bodies. Besides these technologies, green computing plays a greater role in maintain sustainability in different fields. This paper reviews the application of green computing for sustainability management.

II. APPLICATIONS OF GREEN ROBOTS FOR ENVIRONMENTAL SUSTAINABILITY

Human activity has caused the world temperature to reach its highest point in the last 4000 years. If we don't take action fast, this could lead us down a path of self-destruction. The availability of cutting-edge technology can aid in reducing the effects of climate change and simplifying our attempts to sustain ourselves [6]. There are many environmental-friendly chores that can be automated with green robots, which can be done quickly and without exhaustion.
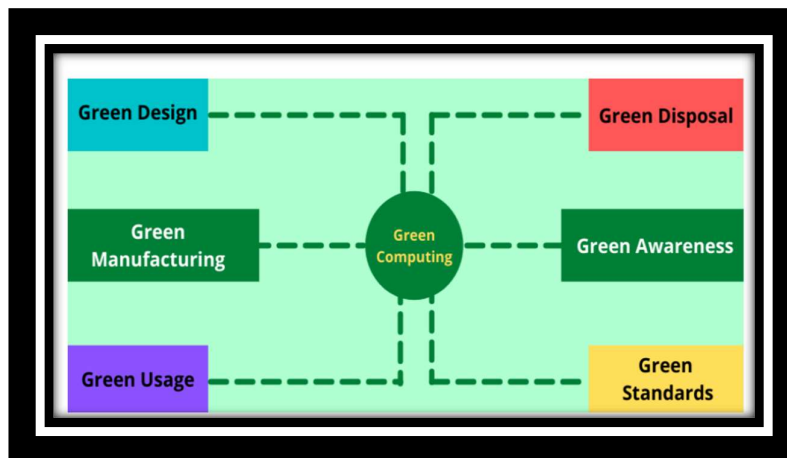

Figure 1: Green computing

2.1 Fighting wildfires

Approximately 100,000 wildfires occur in the United States each year. Wildfires have also become more commonplace in recent years. Wildfires are well-known for the devastation they cause to a variety of plant and animal species. It is well proven that it has a negative impact on human health & infrastructure. Firefighters could save their lives by using robots to tackle wildfires more rapidly [7]. Wildfires can be contained with the help of robots equipped with fire extinguishers & water pushing agents. It is possible for these robots to be equipped by GPS technologies, computer vision, thermal sensors, and artificial intelligence. These technologies enable remote operation of the robot, which is capable of detecting and extinguishing flames effectively. It is possible to utilize these robots in areas that are inaccessible to humans or places where human lives are at risk. Search and rescue operations can benefit from robots equipped with robotic arms and video sensors, which can aid and save rescue animals caught in wildfires. As a result, robots can be an excellent substitute for people in high-risk operations related to wildfires. Aside from being efficient, they are also capable of saving precious human lives [8].

2.2 Waste management

Environmentally friendly methods must be used to manage human consumption as well as the amount of garbage that is generated. Robots are already being employed for simple tasks like vacuuming, cleaning, mowing, and sorting rubbish by kind [9]. Household waste can be collected by garbage pickup robots equipped with GPS and artificial intelligence (AI). Additionally, these robots are able to gather data from sensors attached and use AI algorithms to decide the best waste pickup route and method. As a result, the use of resources is minimized, which has a positive impact on the environment. Using robots for garbage treatment and recycling is an example of advanced waste management technology. It is possible to reduce CO_2 emissions related with waste management & waste treatment by automating the processes involved. Automated sorting systems can assist reduce the amount of waste that is burned by identifying things which can be recycled or reused in the future. Even sorting waste products can be done more rapidly and cost-effectively by robots than by people, lowering the amount of energy and resources required.

2.3 Restoring ocean health

Oil drilling and other human activities on land, as well as industrial effluents and water, have wreaked havoc on our oceans. The BP oil disaster in 2010 demonstrated that oil / gas activity are a major source of water pollution. If a leak occurs, robots can be deployed to minimize the damage. There already exists a robot that can harvest energy from ocean bacteria and swallow it. There is no need to worry about the robot running out of juice in a matter of months. There are many ways that a robot can help lessen the environmental impact of oil spills, including removing contaminants from rivers and oceans. Biodegradable materials are the only present constraint of these robots. There are efforts on to build robots built entirely of biodegradable materials so that they have no negative environmental impact. They can then be used in large numbers to purify all of Earth's waterways [10]. It is possible to employ robots to gather rubbish from our rivers and lakes as well. It is possible to collect plastic garbage from the ocean floor using robots that float on the surface of the water or from the depths of the ocean using robots.

When compared to human waste collectors, robots can be far more cost- and time-effective. Because of this, it is only a matter of time before their use becomes more widespread.

III. GREEN ROBOTS FOR SUSTAINABLE AGRICULTURE

The use of robots in agriculture can improve the environment. They can be used to measure the concentration of chemicals in the ground. The most productive amounts of chemical and organic fertilizers can be identified through data analysis [11]. Planting, seeding, and watering can all be automated with the help of other robots. With help of robots, these jobs may be completed in a short period of time. Additionally, robots may be utilized for harvesting crops since they have sensors & computer vision that allow them to decide the best time to harvest. There are several uses for robots in livestock farming, such as milking cows and maintaining a herd of domesticated cattle.

3.1 Robots for sustainability

However, robots alone cannot save the planet, but they can assist us in our efforts toward a more environmentally friendly future. The usage of robots in conjunction with other cutting-edge technologies will assist us in our attempts to be more environmentally friendly [12]. Businesses who have already invested in robotics technology should deploy green robots as soon as possible, since they will not only assist their own bottom lines, but also help save the world. It is also possible for governments to help companies that are creating and using green robots. As a result, the technology will become more viable, businesses will be able to use it more frequently, and they will be able to flourish.

Growbot prefers to plant mature trees rather than seeds since existing trees have a better chance of thriving in their new environment. A total of 4,500 Growbots will be produced by Stewart and his colleagues to aid in the recovery of forests all over the world [13].

3.2 Robots Help Farmers Survive Droughts

Our food supply is affected by climate change. This is especially true in impoverished countries and rural locations where food imports are difficult to get. According to Megan Treacy of Tree hugger, robots can follow plant growth using AI sensors or monitors & learn which varieties survive and thrive under tough settings. Farmers can use this data analysis to select plants that have a better chance of succeeding, so reducing their losses while providing food for their neighbors [14].

3.3 Robots Can Grow Like Plants

The Plantoid Project is a group of scientists dedicated to studying the natural world by creating artificial plants that behave and perform like their real-life counterparts. Plants filter air, water, or other substances that are present in their surroundings, and scientists have learned that this is the most effective strategy for studying the environment [15]. Because of the little 3D printer built into the root system of their robot plant, scientists can better study the soil to which plants are exposed.

IV. GREEN ROBOTS FOR SUSTAINABLE ECOSYSTEM AND RENEWABLE ENERGY

4.1 Humanoid Robots Dive to the Bottom of the Ocean

For Evolving Science, Stanford Robotics Lab has developed a humanoid robot called Water One that can explore the ocean & collect samples like a diver [16]. To begin with, Ocean One was designed to monitor the Red Sea's deep coral reefs. These corals are vital to the health of the ocean, but they are located far from where humans can access them. An autonomous robot was needed to collect samples without disturbing the reef and study deep-water species in their habitat. SCUBA-like arms, depth sensing and touch feedback are included in Ocean One's design, and it can withstand significant depths. The robot has since made its way across the globe, allowing us to learn about the oceans without causing any harm to them [17].

Even while some underwater robots are humanoid, they are not all the same size or shape as human beings. Founded in 2011, Aquabotix is a firm that develops underwater vehicles for research and development. It specializes in swarm robotics, which are several small robots that may be operated by a single operator. Swarm robot submersibles offer a wide range of advantages when used in conjunction with each other:

- The area covered by a swarm of robots is greater than the area covered by a single robot.
- The overall research plan is unaffected if one or more units are damaged.
- The cost of deploying a dozen swarm bots is less than the cost of deploying a single main robot platform.

Compared to a single robot (or even a diversified team of researchers) in marine biology, swarm robots can collect significantly more data and a more diverse set of data sets. As a result of this, scientists can better understand the ocean or how to preserve it [18].

4.2 Robots Harvest Wave and Solar Energy

Our dependence on fossil fuels like oil must be reduced in order to combat climate change. Robots are being used by developers to help collect and use renewable energy in a variety of sectors and settings. The Liquid Robotics Wave Glider is an excellent example. It resembles a surfboard, but it contains built-in solar panels that harvest energy from the sun as it passes over the ocean. Propulsion and battery recharging are the primary uses of the energy stored on board. In order to provide a complete picture of global climate change, the Wave Glider can be used to gather high-resolution carbon dioxide samples in problematic places.

4.3 Robots Eat Water Pollution

The University of Bristol has developed a "Row-bot" that consumes water pollution and converts it to electricity. This technology was recently covered by the Permaculture Research Center in Australia. The boat's motor is powered by microorganisms that the robot eats. It's essentially the same as a whale shark feeding on krill and to use the energy to travel through the ocean [19].

4.4 Renewable Energy Sector

Utilization of solar and wind energy is becoming increasingly popular. The use of robots in renewable energy production, particularly in solar energy, can reduce the complexity of the procedures involved. A solar cell's output power is determined by the amount of solar energy that reaches the solar cell's surface. In order for the cells to provide the best results, they must be placed in the right environment. A buildup of dust on the solar panels might result in a decrease in power generation. If the solar farms are located in high-dust locations like Africa or South Asia, they must be cleaned continuously. When the dust layer covering the cells rises over acceptable limits, robots can take over and clean the solar panels automatically. As a result, the solar panels are able to produce the most power and generate the most energy possible [20]. A robot with integrated solar panels is another useful robot application in the solar energy field. Rather than relying on an external power source, this robot can create its own electricity while performing activities such as monitoring or cleaning.

V. GREEN COMPUTING MOBILE APP

BreadCrumbz is a simple Android app that allows users to build maps of locations using the GPS and camera on their devices. You might think of it as a hybrid between traditional map making and the more recent trend of dynamic photo geo tagging. Users may even easily share their maps with other individuals through the application. Using the BreadCrumbz app, you may explore maps and discover new places by following the trail of breadcrumbs. It's much easier to locate landmarks and prevent getting lost thanks to the incorporation of images in the maps. In addition to searching the most efficient routes, you can also log pedestrian-friendly routes on the maps. Even if you're out in the woods, you can make use of it to guide others on the same route. BreadCrumbz can help you get to your destination faster and use less fuel by eliminating the guesswork involved with navigating [21].

VI. MERITS

The green computing has significant advantages as follows,
Because of the lack of petroleum derivatives in power plants and transportation, reduced energy consumption by green registering developments results in minimal emissions of carbon dioxide.

- Reducing the amount of energy needed to produce, use, & dispose of products results in less waste.
- Saving energy and resources saves money.
- Green processing entails a shift in government policy that encourages recycling by individuals and businesses and reduces energy consumption.
- Reducing the risk of cancer, nerve damage, or immune system reactions to computers is a primary goal of this effort [22].

VII. CONCLUSION

Green computing is an environment friendly approach to computing. It uses computing devices, IT resources with less power and disposing the parts appropriately to protect our environment. It helps in developing a sustainable business process and promotes environmental initiatives to develop a better future. However, the implementation of green computing in

organization incurs high cost but many high tech firms prefers green computing for reducing manpower.

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