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Internet of Things And The Environment

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**Introduction**

For a long period of time, the governments in the world and the environmental organizations have invested in the evaluation of the negative consequences of energy production and other technologies on the environment, especially the information and communication technology. However, the introduction of the so-called Internet of Things brings hope in providing a better and positive view of technologies that arguably would have a positive impact on our near future. Nonetheless, The new IoT technology creates a platform where in excess of 50 billion devices are expected to connect with each other in a formed wireless network by the year 2020.

Moreover, based on Techopedia “The internet of Things (IoT) is a computing concept that describes a future where everyday physical objects will be connected to the Internet and be able to identify themselves to other devices” (Janssen 2015.) The IoT needs 3 things to be implemented, first the object itself which can be any electronic devise, second, a sensor to be embedded in the device and finally a wireless network. Therefore, by embedding sensors and having a wireless connection IoT that can be used in many applications

Hence, the implementation of the Internet of Things will ensure that more than 50 billion devices will be connected to each other. However, this paper will evaluate whether the Internet of Things is a net benefit to the environment by focusing research on several overarching topics such as agricultural and waste applications of this technology.

**Benefits of IoT to the environment**

The Internet of Things (IoT) can first be evaluated through an assessment of energy use, energy consolidation, and the potential reduction of energy use through improvements to waste production and increasing efficiency. Thus, the Internet of Things and through the development of various technologies around it is believed to help in reducing the consumption of energy and the production of wastes through the use of the sensors. The Intel smart cities project is very viable as far as technology is concerned. The positive impacts can be witnessed in various cities such as Dublin, London and San Jose. Also, it is seen in the Masdar city located in the UAE, where it is likely to be the world’s greenest city, as a result the installations of the devices that use wireless transmission of energy achieve many sustainable advantages. For example, “there are no light switches or water taps in the city; movement sensors control lighting and water to cut electricity and water consumption by 51 and 55% respectively. Approximately 80% of the water is recycled and waste water is reused as many times as possible “ (Wallace 2014.)

The sensors of the IoT are widely different in terms of shape, size, and functionality. But, the basic forms of sensors usually involve a sensor in the form of a camera, light detector, humidity detector, clean water detector, and the most basic form a smart thermostat. These sensors are connected to wireless network, which on the other end connected to a data analysis application or computer on a remote side that can perform logic operations based on the data sent from these sensors. The computer analyzes the data sent from sensors and therefore send back instructions to be performed by those sensor devices though the wireless networks. Instructions such as, turn off the AC, or roll down the shades when in a building.

However, the major point is that these sensors are important in determining the threats that occur to the environment that would ultimately lead to pollution. The devices are interconnected to ensure that there is constant review of the situation of the environment thus affecting the people in it. The improvement of the living standards of people and the connection to user-friendly environment is the major reason why the Internet of Things was conceptualized. Therefore, the following are the positive impacts of the technology to the environment.

**Agricultural Importance**

One of the most important areas where this technology assists in the development of a friendly environment is on the agricultural sector. In this discipline, where fields are the new offices and data is driving the tractors there is an application of the precision agriculture technologies whereby the systems utilize the Global Positioning System network model of achieving and transmitting data (Castro & Misra, 2013). These systems enable the detection of agricultural requirement according to the timeline of agriculture of the users. For example, when crops require fertilizers they detect the urge and initiate transmission to the in-soil systems, which therefore apply the required amounts of fertilizers. The precision systems can also serve as weather predictors thereby helping farmers carry informed decisions on the expected outcomes, for example, in cases of extreme conditions of the weather which can lead to excessive distraction of crops.

Another case is found in lawn irrigation systems, which in case it rained that day the irrigation system measures the amount of water that penetrated the soil to see if there is a need to water the lawn or not, resulting in reduction of water consumption. Another usage is usually seen in food production and safety, where the IoT “has a system that monitors the various factors like shipping time, storage temperature and cloud based record keeping” (Mahendra 2015.) Allowing for minimization of food waste prior to shipping to consumers.

The Internet of Things can also be found to be very beneficial in climate control of greenhouses. For example, applying various sensors in greenhouses can monitor temperature, humidity, light intensity, and soil moisture. Moreover, these sensors can then be linked to “systems to trigger alerts or automate processes such as water and air control. They can also be set up to look for early signs of pests or disease.” (Haung 2014)

**Air-Monitoring**

Air-monitoring sensor devices help in detecting air quality and levels of noise in the atmosphere. They thus initiate the improvement of quality of air, which reduces the rate of contraction of respiratory diseases. The type of devices that monitor vehicles in the highways help in reducing air pollution as they reduce the congestion levels thereby emission of vehicle wastes by idling engines when congestions are limited.

Internet on things does a major role of regulating the emissions in the atmosphere which deplete the ozone layer paving way for eased penetration of toxic radiations into the atmosphere and abnormal gradients of temperature rise globally. Although this effect of carbon emission and global warming seems unsustainable due to the established infinite rate of the emission globally, the use of sensors can achieve high benefits. The major point of this discussion concerns the reduction of carbon emissions, hence reducing the effects caused by global warming. The technology introduced by the Internet of things ensures that different energy sources can be utilized instead of carbon sources. A good example of emission detection technology is the air quality egg, a network sensor that collects data in areas it is placed in, that concerns with the levels of NO2 and CO concentrations in the atmosphere (Krupitzer, 2014.)

This is important because the air quality data collected by the government is likely sampled from far away and then applied to individuals on a regional level. However, this is not very useful from the standpoint of trying to understand or change the local dynamics of pollution that affect people in their homes. The Air Quality Egg is a sensor system designed to allow anyone to collect very high-resolution readings of NO2 and CO concentrations outside of their home. These two gases are the most indicative elements related to urban air pollution that are sense-able by inexpensive, DIY sensors.

**Clean Water**

Water is essential in the environment; water is life. As a matter of fact, clean water is required by living organisms, especially humans and other animals that live in large water bodies. The Internet of things therefore helps in the management of water in the environment, especially in the urban regions. They reduce the cost of cleaning up water by use of low cost water monitoring device that encodes and outsources mass viable data and automatically initiate the cleaning process (Adler, 2015).

The technological water grid device can detect the leakages in water distribution systems and enable self-maintenance of the systems, hence preserving the natural water sources like lakes and rivers from over exploitation and mass wastage. For instance, the introduction of the smart pipes of water helps in reducing the leakages thus preventing water wastage. These pipes contain sensor nodes whose energy has been improved, therefore a wireless sensor network is established; this strategy is being initiated in the United Kingdom (Sadeghioon, Metje, Chapman & Anthony, 2014). The same situation occurs for the leaks in oil and gas pipes, which then can be universalized for any type of pipes around the world resulting in increased resource management.

**Waste management**

The current amount of wastes produced by households is close to 1.3 billion tons, and is expected to rise up to 2.2 billion tons by 2025. Hence, there has to be a way of improving collection of wastes and the management it. Internet of Things has been instrumental in the management of wastes in urban areas. Technology is required in the reduction of wastes in the environment by producing signals on the increase amounts of waste. For instance, there are litter bins known as Big Belly that are important in reminding the authorities related to waste management. The litter bins are solar powered that receives trash and other wastes from the homes, which make them efficient and environment friendly.

In addition, it is able to conduct trash compaction to ensure that more wastes are placed in it. When they are full, the sensors are able to create signals to the waste management crews who will then be able to empty the trash. Another important aspect of these garbage bins is that they are able to reduce the amount of trips required by the trucks the waste collection companies have, resulting in less carbon dioxide emissions. In short, the introduction of these garbage bins allow for more trash to be collected dynamically or at a go, hence less bags and less truck trips will be needed to perform such a regular task. This reduces the use of plastics in the environment, and burnings of fossil fuel, thus reducing the overall pollution.

**Shortcomings of the Internet of Things**

The high number of Internet of Things applications discussed earlier could lead someone to have a biased opinion at first, because they are all in favor to provide better solutions to the environment. However, by exploring the technology more and analyzing it with an open mind it becomes clear that the IoT has some major shortcomings. The first major shortcoming is a system security issue, because these devices require a wireless network and an analysis application installed on a computer, tablet or a smartphone, this adds a vulnerable aspect of the IoT. Internet hackers from all over the world will able to hack any system out there that manages a powered IoT application, specially those installed in an exposed area to the public, such as traffic lights, street lightings and so on. A hacker can install another sensor on those devices or hack the operating system behind it and from there it will allow hackers to manipulate the functionality of those IoT applications. For example, one would turn all the streetlights on despite being in the daylight, or one would turn all the public irrigations system on for hours before it becomes obvious they are being hacked and require a manual maintenance. These scenarios are just the least damages hackers can do that lead to waste of natural resources.

The second challenge is energy consumption. According to Advanced MP Technology, IoT networks require giant data centers to process and support their needs. As a result, the energy consumption by the data centers is massive. The resources needed to produce that energy will add a massive burden to the environment. “Although big data centers are trying to use as little energy as possible, it’s still going to affect the energy sector as a whole. In addition, the energy and resources used to manufacture hundreds and thousands of new devices is another source of energy consumption caused by IoT.” (MP Tech, 2016)

In Addition, “there was already 53 million metric tons of e-waste disposed worldwide in 2013.With the speed of IoT development, the number is expected to accelerate.” (MP Tech, 2016) E-waste is an issue that many countries are taking time to deal with. However, with the emergence of the Internet of Things, there is a tendency of manufacturing devices that have problems in terms of life span (Finley, 2014). Many companies or even the other non-governmental organizations have some strategies by which they reduce electronic wastes through recycling. However, the issue of long life spans would improve the production of electronic wastes (Sankar, 2014). This is a challenge especially for many companies since they are focused on manufacturing products that may not meet the standards of the life cycle of products. They are more interested in producing gadgets and selling even the older versions to the clients. A common scenario that is not obvious is the well-known Tesla example and whether buying a new Tesla is better than buying an old nonelectric car, which turns to be having the old car is more sustainable.

**Verdict**

Since there are around 5 billion broadband users today “the wireless industry accounts for around 2 percent of all carbon emissions.” (Lynley, 2011) These measures account for the entire cycle of a device life, from manufacturing, to usage, and disposal. This show that the increase of wireless usage and manufacturing of devices is inevitable. However, based on the discussions concerning both the positive and the negative impacts of the Internet of Things on the environment, it is important to note that the assessment proves that the technology is beneficial to the establishment of a safe environment. Moreover, the integration will lean more towards the positive impact if the IoT focuses on improving the environmental issues by designing the applications to serve towards helping in the reduction of the environmental pollutions.

The technology has also an opportunity where it can at least bring equilibrium by the automation of various appliances including traffic lights, home services, and manufactures, resulting in a huge reduction of electricity usage. However, looking the 2 percent of all carbon emissions that is by itself significant, and it raises the question whether there would be a net carbon saving as a result of a working Internet of Things or would the gains be wiped out by the energy use of the infrastructure and the need to keep all that data somewhere? This question has to be the focus of researchers, because at this point there is not enough research to place a clear win for the technology.

**Conclusion**

The Internet of things is a subject that has drawn lots of interests from all sectors of the economy. However, it has elicited much debate concerning its impacts on the environment. There are both positive and negative effects of this technology, and they are all discussed in this paper. The major advantage is that there are sensors that are able to provide information about the threats faced by the environment. However, there is a difficult task of reducing the negative impacts, especially that of the formation of e-wastes due to manufacture of devices with short lifespans.

Also, by focusing on the harm brought about by the technology, finding solutions will help in improving the performance of the IoT especially to the environment. Since it is majorly used for reduction of wastes, the technology in itself should have ways of reducing its e-wastes or means of alleviating their effects on the environment. Therefore, one of the best solutions would be improving on the lifespan of the gadgets and devices that are used for the Internet of Things. Companies have the responsibility of conducting research for future increment of the lifespan of electronic devices.

For the environment, IoT is a double sword bringing both benefits and challenges. People should be aware of the both sides so they can weigh the pros and cons thoroughly to benefit the most and sacrifice the least. For instance, the best approach to address the environmental impact is a design-for-the-environment approach. Taking the environmental impact from the beginning to integrate it with IoT development as a system will be the best we can do for future generations. Furthermore, as consumers, we are fully aware of the environmental impact of products we buy and sell on a daily basis; we should make sure that we manage the product in a proper way to minimize the environmental impact. Through this step, the Internet of Things will have accomplished its goals.

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