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The Impact of Smart Homes On Energy Consumptions-A Survey

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***Abstract*— As more smart devices are integrated into homes; the demand of electricity has steadily increased which has led to a higher electric bill throughout the last few years reported by many consumers. Many people realized that smart appliances require more electricity, which in turn brings higher electricity bills. This paper aims to survey the research done on the impact of smart homes on energy consumptions.**

Keywords—Smart home, energy consumption, eco-house, oman eco-house

I. INTRODUCTION

Particularly in residences and offices, home automation systems have been rapidly getting prominence [1]. The systems are set up with the goal of giving the user better accessibility to and more management over the home's electronic equipment. If the user has a device with a compatible web browser, they will be able to monitor and control equipment at home both locally and remotely through the internet [1]. In general, home automation systems can be installed in any structural system as long as the technology's constraints are addressed before deployment.

This research will benefit the government, policymakers, Energy companies, the Technology industry, consumers, and citizens. Many people are realizing that smart appliances require more electricity, what is missing in previous research papers is how Oman will be affected by the new technologies embedded in houses. As more smart devices are integrated into homes, the demand for electricity has steadily increased which has led to a higher electric bill throughout the last few years reported by many consumers.

One proposed solution was for manufacturers to improve their power efficiency. Many estate owners will greatly benefit from additionally many businesses rely on high electricity consumption. Research in this area will help Oman electricity providers plan for future energy demands since electricity consumption has been increasing. Smart homes could help Omani citizens decrease their utilities spending exponentially.

II. BACKGROUND

The rapid growth of the word energy has sparked concerns about the increasing consumption of energy which could lead to unforeseen consequences such as exhaustion of energy resources and climate change. The purpose of this paper is to examine the effect of smart technologies on energy consumption. We hypothesize that there will be an increase in energy consumption because of: (a) devices having a more complicated architecture where they will have to serve their respective functions and connect to the internet to report their status. (b) An increase of devices such as sensors was not present for homes. (c) An increase in devices using electricity due to innovation. (d) increase in energy demands. The research indicates that there has been increasingly more amount of energy being consumed globally although smart homes could help offset that amount greatly.

An article written by the folks at Bluepseed [2] called “The Seven Advantages of Smart Home Automation” discuss some of the compelling advantages a smart home has which include flexibility of your devices, controlling home functions remotely, improved functionality of home appliance, increase energy efficiency and home management insights. These could prove to be a main motivator for consumers to switch over to smart homes systems.

An editorial written by Canada’s Oil and Natural Gas Producers (CAPP) [3] examines closely on the “The Worlds Energy Needs”. It explains how our energy consumption as a globe continues to increase and will increase exponentially due to China and India’s emerging middle-class lifestyles. It presents some interesting facts and figures on the way the current globe is consuming energy and predicts future trends. This article attempts to spread awareness on just how huge our current energy consumption is and where it generated from.

III. METHOD

The research papers published in journal and conference proceedings were used to prepare this survey. Google Scholar was used to do the search procedure. Keywords such as ‘smart homes’, energy consumption’, ‘home automation’ etc. was used to conduct the search.

IV. DISCUSSION

The researchers in question have brought forward an interesting review on available information regarding energy consumption in buildings titled “A review on buildings energy consumption information” [4]. Although it has been acknowledged by the researchers that there needs to be more information about this topic it still presents some alarming facts about the consumption of electricity. It exposes a steady increase between 20% and 40% in more developed countries. An excessive amount of electricity is being consumed by HVAC systems (around 20% of total consumption in the USA). furthermore, the data shown reflects 49% primary energy growth and a 43% CO2 emission growth between 1984 and 2004. This clearly confirms that there has been an

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extravagant trend in energy consumption worldwide which could bring back unforeseen consequences such as exhaustion of resources and severe environmental impact.

In this paper [5] titled "Trends in worldwide ICT electricity consumption from 2007 to 2012. Computer Communications" the researchers talked about how ICT devices consume electricity from 2007 to 2012 based on 3 aspects: communication networks, data centers, and personal computers. They calculated the electricity use of each category and analyzed the findings. They found that the yearly growth of electricity consumption in communication networks is 10% yearly, and in personal computers 5% yearly, and in data centers 4% yearly. This shows conclusive evidence that there has been an extensive surge in energy consumption.

The Tejani Al-Kuwari and Potdar [1] brought forward an investigation titled "Energy conservation in a smart home" measured the energy conservation across 4 homes using a Z-Wave home automation system. They found that houses without smart home technologies installed consume significantly more power (2765 kWh). This relationship remained after considering the different seasons throughout the year. It experiments with the smart gateway disabled also included human inattentiveness. This paper shows just how significant energy consumption could be reduced with the help of smart technologies. They found that using smart home technologies in four different houses has shown a decrease in energy consumption from 14789.813 (kWh) to 12023.935 (kWh).

Kaur and Sood [6] brought forward an energy-efficient architecture that divides their system into three different layers. The sensing and control layer, the information processing layer, and finally the presentation layer. The experiment conducted by the researchers shows that a remarkable amount of energy has been conserved using their proposed architecture. Although this paper focuses a lot on the architecture of "Internet of things" it shows how the information provided by sensors can be used to put the appliance into sleep mode to preserve energy and how the architecture could be improved to increase energy efficiency.

The paper [7] titled "Electric energy management in residential areas through coordination of multiple smart homes" tries to investigate electrical energy management using Smart Grid, a new methodology that controls user assets such as home appliances. However, Smart Grid requires shifting to decentralized control strategies that can cause undesired outcomes, like contingencies, rebound peaks, and instabilities in the network. The result of the research shows that controlling of energy management in several households (Smart Grid) is an advantage for both utility service provider and consumers.

In the paper [8] titled "Energy conservation through smart homes in a smart city: A lesson for Singapore households" by Bhati, Hansen, and Chan were aiming to analyze the insight of houses in Singapore that use smart technology. They had three case studies that were developed for the research and were reviewed, all were related to smart houses. They found that even with smart technology present in the house to monitor energy consumption, users take electricity for granted so they don't change their behavioral patterns.

The researcher states that more homeowners are using IoT in their houses such as thermostats and sensors-enabled lightings to improve convenience and comfort. However, Smart technologies are not limited to those benefits. As the researcher claims that Smart technologies can also optimize energy consumption, reducing utility bills and waste by controlling home heating, lighting, cooling, and plug loads all leads to better energy management.

The paper [9] titled "ThinkHome Energy Efficiency in Future Smart Homes" explains the use of building automation systems (BAS) is closely linked to achieving an energy-efficient building service, which is considered an almost necessary requirement for a sustainable (low-energy, low-emission) home or building. Smart homes are becoming a hot topic in academic research as well as the residential construction industry. With increasingly the energy prices, reducing energy usage benefits the economy, but it also pays on a macro level, where national and international environmental goals and laws must be met.

Energy consumption has been increasing substantially [10] and smart homes could be an indirect solution to the increase of energy consumption through the last few years. Although the literature suggests that energy consumption has been increasing steadily smart homes in particular show a great decrease in energy consumption [11]. A concerning report shows how energy consumption could double every 20 years primarily because of HVAC systems [12]. Researching and reviewing these sources gave the conductors a better grasp on the consumption of energy globally.

V. CONCLUSION

To conclude, smart houses have lower electricity consumption than conventional houses due to the automation of technology in them. Future works are needed to further analyze electricity consumption and cost saving in smart houses in Oman and in different regions in Oman as many variables play a role in the research such as lifestyle and weather.

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