

**A STUDY OF SMART MOSQUE BASED ON INTERNET  
OF THINGS**

**BY**

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**A dissertation submitted in fulfillment of the requirements for  
the Degree of Master of Information Technology**

**Kulliyyah of Information and Communication Technology  
International Islamic University Malaysia**

**FEBRUARY 2020**

## ABSTRACT

As of late, increasing enthusiasm for pervasive technology, for example, smart street lighting, service observing, smart city and the smart building has prompted expanded dependence on remotely sent IoT sensor devices for detecting and checking function. As of now, numerous devices have been conveyed worldwide, and a few more are being sent day by day. Smart buildings are expected that the advancement of Smart Mosque technology will redefine the manner in which we live later on in the future. The energy utilized in buildings cover a significant part of worldwide energy utilization. Indeed, even now, utilizing assured and economically accessible technology, it is potential to accomplish a significant decrease in building maintenance costs and energy utilization giving a progressively comfortable living environment simultaneously. Same like a lot of buildings, mosques handle numerous administration difficulties, for example, how to administer security, how to get the message out – for this situation, the word of Islam, and how to give the most satisfying experiences to mosque visitors. The main purpose of this study was to gather information on the Smart Mosque based on IoT. The primary objective of this thesis is to deal with the challenges within the current Mosques, and therefore the first objective that to identify the criteria of a Smart Mosque based on IoT and second research objective to identify the benefits of the Smart Mosque for Muslim ummah and Mankind. Moreover, the third objective to investigate the relationship between Smart Mosque and sustainable environment. Data were collected using online questionnaire and 141 responses were received. The finding of the first research objective showed that more than half of participants with 62.4% say that one of the main criteria of the Smart Mosque based on IoT can be automated building and another high rated participants with 36.2% that Smart Mosque should be environmentally friendless and another important criteria is Interact Smart Mosque with the energy system with 34%. The finding of the second research question shown that the majority of participants with 73% had answered that the Implementation of the Smart Mosque based on IoT would be benefits for Muslim ummah and Mankind because it is really need to adopt traditional mosque with modern technology nowadays. The finding of the third research questions shown that more than half of participants with 73.8% believe that Smart Mosque will be very effective and as mosque is one of the most important and widespread buildings in world and it will be very beneficial and play essential role in sustainable environment, and it is clear that sustainability, moderation, and cleanliness area unit entrenched in Muslim teachings and are integral to the faith of the believers.

## خلاصة البحث

في الآونة الأخيرة، ابتداءً ازدياد الانفعال مع التكنولوجيا الحديثة، على سبيل المثال، انتشار استخدام إضاءة الشوارع الذكية و المدن الذكية و المباني الذكية لقد سبب في الاعتماد المتكاثرة على أجهزة استشعار عن بعد التي تمتلك قدرة التحكم على شبكة انترنت الأشياء للتحقق من و كشف الأجهزة المتصلة في نفس الشبكة. لقد انتشرت هذه الأجهزة حول العالم في عدد كبير وبطريقة مستمرة. من التطورات الحديثة المتوقعة من بعد تكنولوجيا المباني الذكية هي المساجد الذكية التي لها قابلية تغيير الطريقة التي سنعيش فيها في المستقبل القادم. الطاقة التي تستخدم في المباني تحتوي على نسبة كبيرة من الاستهلاك العالمي للطاقة. في الواقع، في الزمن الحاضر، لكي نحقق هدف التكنولوجيا التي يمكن الوصول إليها بطريقة اقتصادية، من المهم أن نحقق انخفاض في تكاليف الصيانة و استهلاك الطاقة في المباني، و في نفس الوقت يجب أن يحصل تحسن في راحة البيئات المعيشية بطريقة تدريجية. مثل الكثير من المباني، المساجد أيضا تواجه عددا من الصعوبات الإدارية، مثلا الأمن و التحقق من مقصد البناء وهذا في حالة المساجد هو التحقق من رسالة الإسلام وتجربة مرضيه لزوار المسجد. المقصد الأساسي لهذا البحث كان تجميع المعلومات التي تتعلق بالمساجد الذكية التي تعتمد على شبكة انترنت الأشياء و المقصد الأساسي لهذه الأطروحة هو كيفية مواجهه الصعوبات التي تحدث في المساجد الحالية. ولهذا لقد طرح البحث على ثلاثة الأهداف بحثية كالتالي. أولا، المعايير و الشروط للمساجد الذكية التي تعتمد على شبكة انترنت الأشياء. ثانيا، فوائد المساجد الذكية للأمة الإسلامية و البشرية. وثالثا، البحث في علاقة المساجد الذكية مع البيئة المستدامة. للإجابة لهذه الأسئلة، تم جمع البيانات باستخدام الاستبيان عبر الانترنت و لقد تم الحصول على ١٤١ رد. أظهرت النتيجة التي توصل إليها السؤال البحثي الأول هو أن أكثر من نصف المجيبين مع ٦٢,٤٪ يقولون إن أحد المعايير الرئيسية للمسجد الذكي المبني على إنترنت الأشياء يمكن أن يكون بناءً آلياً، والمشاركين الآخرين مع ٣٦,٢٪ يقولون أن المسجد الذكي يجب أن يكون صديقاً للبيئة وأن هناك معياراً مهماً آخر هو التفاعل المسجد الذكي مع نظام الطاقة مع ٣٤٪. أظهرت نتيجة السؤال البحثي الثاني أن غالبية المشاركين مع ٧٣٪ قد أجابوا بأن تنفيذ المسجد الذكي على أساس إنترنت الأشياء سيكون مفيداً للأمة الإسلامية والبشرية لأنه من الضروري حقاً تكيف المسجد التقليدي مع التكنولوجيا الحديثة في الوقت الحاضر. أظهرت نتائج السؤال البحثي الثالث أن أكثر من نصف المجيبين مع ٧٣,٨٪ يعتقدون أن المسجد الذكي سيكون فعالاً للغاية لأن المسجد هو أحد أهم المباني وأكثرها انتشاراً في العالم ولذلك المسجد الذكي سيكون مفيداً للغاية وسيلعب دوراً أساسياً في البيئة المستدامة. ومن الواضح أن مبادئ الاستدامة والاعتدال والنظافة متأصلة في تعاليم المسلمين وهي جزء لا يتجزأ من إيمان المؤمنين.

## APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Information Technology.

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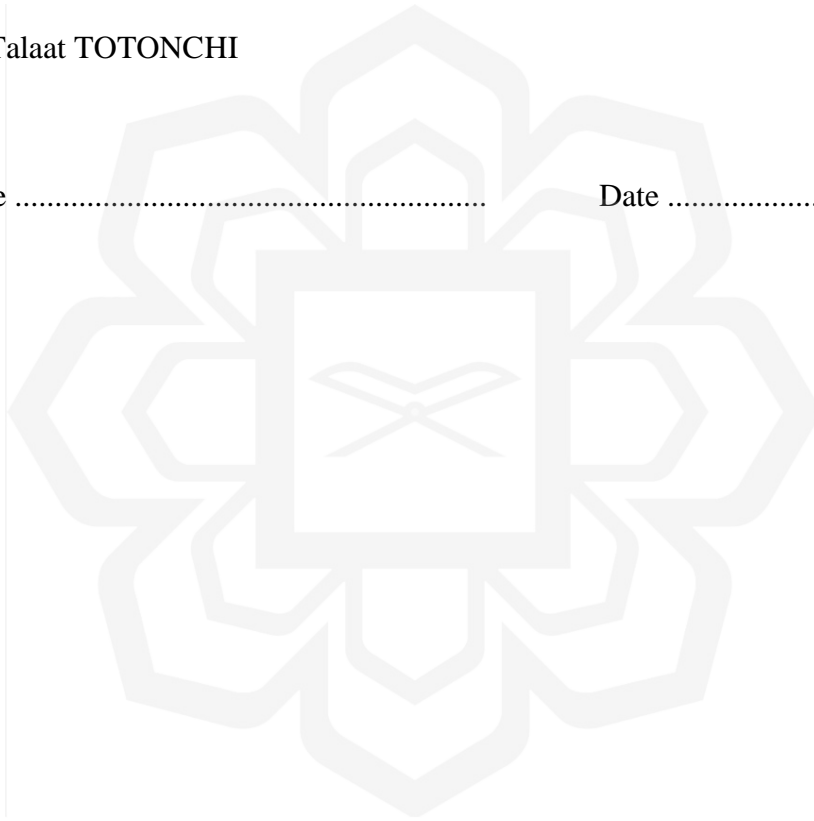
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I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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*This dissertation is dedicated to my beloved parents*

## ACKNOWLEDGMENTS

I am thankful to Almighty Allah (S.W.T), the Most Beneficent and Most Merciful, for His guidance and blessings me the knowledge, health, patience, and perseverance necessary to accomplish this research.

I am very grateful to Allah that Has given me a supportive family. My gratitude and appreciation to my dear father, Mr.Talaat TONCHI, and my dear mother, Mrs. Salwa Nasih, for their tireless endurance, patience, and understanding during my absence throughout the period of my studies.

This journey has taken a lot of my patience and perseverance. However, the main anchor of my achievement is my supervisors Prof. Dr. Mohamad Fauzan Bin Noordin and Asst. Prof. Dr. Hazwani Bt Mohd Mohadis, without their guidance and help, this journey will never reach its destination.

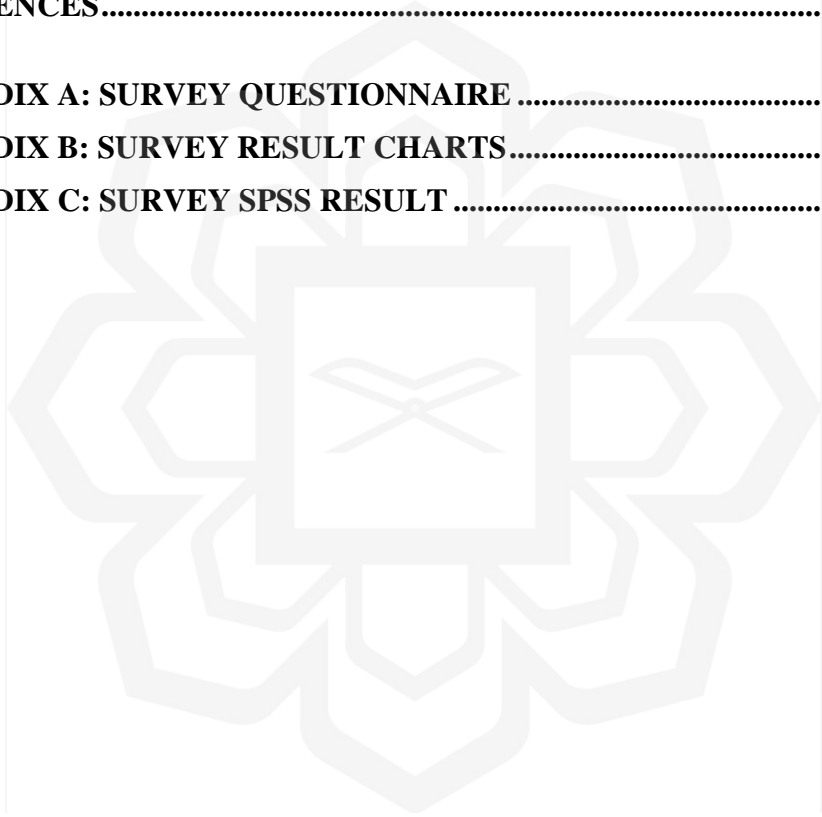
I wish to express my appreciation and thanks to those who provided their time, effort, and support for this project. To the members of my dissertation committee, thank you for sticking with me. And a special thanks to IIIT organization and Dr. Ahmed TONJI for their help and support throughout the period of my studies.

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# **CHAPTER ONE**

## **INTRODUCTION**

### **1.1 BACKGROUND OF THE STUDY**

Internet of Things (IoT) as characterized by the ICT (Information and Communication Technology) as an impressive international system infrastructure by self-designing capability reliant upon normal and interoperable connection protocol where real and practical objects have personalities, physical properties, and realistic characters utilize astute interface also consistently incorporated toward this information arrange. IoT is systems administration of real devices, structures, and different things inserted by hardware, software, sensor, actuator, and system interface that empower to gather and trade information .("Internet of Things (IoT) Research Initiative | Department Of Science & Technology," n.d.) The entirety of this is because of the full accessibility of the internet and the production of the device with wi-fi capacities. Technology expenses are running down, and smartphone can do nearly anything with their inbuilt features and applications.

As noted by Gartner(2014), "the world will be a more deeply and intimately connected place, with an estimated 7.3 billion tablets, PCs, and smartphones, by the end of this decade. By the year 2020, this massively connected system is likely to expand at an even more rapid rate to 26 billion connected devices around the globe".(Gartner, 2014)

Along these lines, can see developing the massive extent of the Internet of Thing (IoT). IoT is perched on an ideal tempest. In addition, the story rotates around some necessary territories sensor technology, network modeling, data science, predictive technology, machine learning and security, and IoT improvement depends on advancing technology like RFID, NFC, 3G, 4G communication technology, Wi-Fi sensor, and localization technology. (Khan, Aalsalem, Khan, & Arshad, 2016)

We do not generally consider religion being at the main edge with regards to technology and development; however, digital Islamic administrations are a quickly developing region. Simply a year ago, the Dubai Islamic Affairs and Charitable Activities Department (IACAD) propelled stage of those Smart Mosque tasks, and there are approximately 3.6 millions of Mosques in the globe, that means around 500 Muslims for each mosque. By 1.3 % for each annual development, this quantity of mosques around the globe is relied upon to arrive at 3.85 million by 2020. (Dubai launches smart mosques initiative | ConstructionWeekOnline.com, n.d.)

Further, as Islam is the quickest developing religion and by 2050, Muslims are anticipated to grow by 73 percent by high ripeness rate since the Muslim community on the earth is growing higher, Muslims can not stay detached from the IoT technology. Subsequently, the IoT merchants and makers consider the Islamic set of principles for saving their Muslims IoT client's safety and protection, the reception of those IoT technologies amongst the Muslims in order to significantly expanded. (The Future of World Religions: Population Growth Projections, 2010-2050 | Pew Research Center, n.d.)

## **1.2 STATEMENT OF THE PROBLEM**

Like a lot of buildings, mosques experienced numerous administration challenges, for example, how to administer security, how to get the message out – in this case, the message of Islam, and how to give the most satisfying experiences to mosque visitors. Sensors to recognize abused and underused zones within the Mosque, provide the opportunity to streamline area utilization. Besides, the major problems in mosques includes wastages of water and electric. Smart technologies can help to handle a considerable lot of these difficulties. Moreover, to identify the criteria of Smart Mosque using IoT technologies.

As of late, there is increasing enthusiasm for pervasive technology, for example, smart street lighting, service observing, smart city and the smart building has prompted expanded dependence on remotely sent IoT sensor devices for detecting and checking function. As of now, numerous devices have been conveyed worldwide, and a few more are being sent day by day. Many research works portraying plans have been offered for the universal and self-administration of these remote sensor devices. These plans serve humanity with limiting client intercession and subsequently unburdening the framework proprietor of the monotonous undertakings from standard-essential leadership in a gadget the executives. Subtle cameras and thermal sensors give information assurance safe info on how the building is being used. That enables smart systems to get alterations concerning where heat and lights are needed, for example, on the usage of organizations such as air conditioners.

### **1.3 RESEARCH QUESTIONS**

This research attempts to produce answers to the following questions:

1. What are the criteria of the Smart Mosque based on Internet of Things (IoT)?
2. What are the benefits of the Smart Mosque towards Muslim ummah and Mankind?
3. What is the relationship between a Smart Mosque and a sustainable environment?

### **1.4 RESEARCH OBJECTIVES**

The primary objectives of this thesis are to deal with the challenges within the current Mosque, and therefore the following specific objectives are defined:

1. To identify the criteria of a Smart Mosque based on IoT.
2. To identify the benefits of the Smart Mosque for Muslim ummah and Mankind.
3. To investigate the relationship between Smart Mosque and sustainable environment.

### **1.5 THE SIGNIFICANCE OF THE STUDY**

Nowadays, where everything is mostly identified with technologies, it was just about time for a Smart Mosque to turn into a piece of another smart objective, and Mosque performs a cultural center building and needs the best structure, worth, and sustainability. This request, first and preeminent, The mosque is a position critical for Muslims to worship, in this manner feeling comfortable and quiet is pivotal to seek a sense of peace, quietness, and

peacefulness. Besides, it will be an excellent answer to whom that says, Islam is not a religion that could be adopted with new technology. An exact example of the attitude that Islam is not matched with modern science is a paper, that the French orientalist Ernest Renan gave at the Sorbonne University in Paris on twenty-nine March 1883 where he said: “In fact what essentially distinguishes the Muslim is the hatred of science, the conviction that research is useless, frivolous, almost impious: the science of nature, because it is in competition with God; the science of history, because when applied to times prior to Islam, it would revive ancient mistakes”. (Renan, 2011)

Last but not least is the fact that while reviewing literature, it founded that there is a lack of research work related to the Smart Mosque. So, this research will try to fill up the gap in the literature regarding the Smart Mosque and will be a useful contribution like an opportunity for researchers to evaluate and use this research.

## **1.6 DEFINITIONS OF TERMS**

### **ICT**

Information and communications technology (ICT) insinuates all the development used to manage broadcast communications, impart media, intelligent structure the board frameworks, shifting media handling and transmission frameworks, and system-based control and adopting capacities. (Techopedia.com, 2016)

### **IoT**

Internet of Things (IoT) is an international system framework, connected physical and virtual things within the abuse of data grab and communication ability. That will give a

specific item description, sensors, and association ability as the reason for the advancement of autonomous steady administrations and applications. (Jia, Feng, Fan, & Lei, 2012)

### **RFID**

Radiofrequency identification system (RFID) is a programmed technology and helps devices or PCs to recognize things, record metadata, or handle specific objective by radio wave. (Jia et al., 2012)

### **WSN**

Wireless Sensor Network (WSN), particularly network consisting of minor, reasonable autonomous devices implemented with sensors, can take measures, local store, handle detected information, and can communicate with one another. (Bellavista, Cardone, Corradi, & Foschini, 2013)

### **HVAC**

Heating, Ventilating, and Air Conditioning (HVAC) gear perform heating and cooling for the public, private, business, or mechanical buildings. (Hess-Kosa, 2011)

### **SMART BUILDING**

A smart building is a structure that utilizes robotized systems to manage the responsibilities of the building, including warming, ventilation, cooling, lighting, security, and various frameworks. (Tracy, 2016)

### **SMART MOSQUE**

Smart Mosque is an actionable and automated mosque that deploys digital technologies to offer enhanced experiences to worshippers. Besides this, the Smart Mosque is equipped

with IoT sensors that interact with the visitors, improve internal and external safety, save energy, and track events and prayer timings.

## **1.7 SUMMARY**

This chapter has provided the background of the research and the problem statement. Then the research objectives and questions were stated, and at the end of chapter definition of a term and also the significance of the research were explained.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

The references for the research contain some primary books, articles, and conferences paper. The secondary references could be categorized into sections: the ones were written in English, and those who write in a different language (Arabic and Turkish). There are specific articles and research that should be checked cautiously concerning their significant decisions.

#### **2.1 MOSQUE**

The mosque is an essential building in Islam. At the beginning of Islam, the announcement was directly in each part of the Islamic religion, and nowadays, it is important just as in the mosque is an architectural design for the religious services of the Muslim ummah. (Mohamad Tajuddin, 1998) The mosque and the Grand Mosque are mentioned in the Holy Quran twenty-eight times, and reference was made to the Masjid-Al-Haram wording of House 17 Once, it was referred to as the Maqam Ibrahim and Musalla Once, the mosques were referred to by word Houses once. One of the numerous mercy that Allah (SWT) given to the Muslims Ummah is that He(SWT)made the entire world pure with the goal that it serves as a mosque and a grand mihrab. Like this, the whole world is a mosque, and this is appeared by the hadith told by Bukhari and Muslim on the ruling of Jabir ibn Abdullah that the Messenger of Allah(SAW)said,

جُعِلَتْ لِي الْأَرْضُ مَسْجِدًا وَطَهُورًا أَيْنَمَا أُدْرِكُ رَجُلٌ مِنْ أُمَّتِي الصَّلَاةَ صَلَّى

"The earth has been made for me a place of prostration and a means of purification, so wherever a man of my Ummah is when the time for prayer comes, let him pray."

(Mohammad, 1996)

### **2.1.1 The Importance Of Building Mosques And Their Architecture In Islam**

The building of a mosque is a prophetic, Islamic tradition, the constructing of the mosque was the beginning stage of the development of Islamic success, which overwhelmed the more significant part of the world, as it has an essential impact on the life of the Muslim Ummah. This can be found in the case of the Messenger of Allah(saw), that first thing started to construct a mosque when he(saw) built up the Islamic State in Madinah. To accentuate the extraordinary significance of the mosque in the molding of the Islamic society. (Mohammad, 1996)

Since Islam's perspective of life all in all and exhaustive, the mosque must be at the core of the entirety of life's positive and productive actions to shape a decent generation. Along these lines, it is the obligation of the Islamic State and attractive for all Muslims to build a mosque everywhere throughout the world. Allah (SWT) said,

قَالَ تَعَالَى: ﴿إِنَّمَا يَعْمُرُ مَسَاجِدَ اللَّهِ مِنْ ءَامَنَ بِاللَّهِ وَالْيَوْمِ الْآخِرِ وَأَقَامَ الصَّلَاةَ وَءَاتَى

الزَّكَاةَ وَلَمْ يَخْشَ إِلَّا اللَّهَ فَعَسَىٰ أُولَٰئِكَ أَنْ يَكُونُوا مِنَ الْمُهْتَدِينَ ﴿١٨﴾ التوبة: ١٨

“The mosques of Allah are only to be maintained by those who believe in Allah and the Last Day and establish prayer and give zakat and do not fear except Allah, for it is expected that those will be of the [rightly] guided.” [Taubah:18].

The Messenger of Allah (saw) energized the construction of a mosque and made it engage with, focusing on that it is a rewardable action. It has been reported for on the ruling of 'Uthman ibn 'Affan that the Messenger of Allah (saw) said,

مَنْ بَنَى لِلَّهِ مَسْجِدًا بَنَى اللَّهُ لَهُ مِثْلَهُ فِي الْجَنَّةِ

"Whoever builds a mosque for the sake of Allah, Allah will build something similar for him in Paradise." {Sunan Ibn Majah 1:4:736}

### 2.1.2 The Role Of The Mosque In Islam

The very idea of the mosque directs that it is fundamental to the activities of the Muslims. Besides, the Islamic Shari'ah has confirmed that the mosque is expected to assume numerous imperative roles within the Muslim population. (Mohammad, 1996) The mosque has consistently assumed a functioning role in the direction of the Muslim society, showing

both the young and more seasoned ages just as delivering a scene for Muslims to gathering with each other on Islamic events. In any case, the mosque has considerably more possible than this, and we need to use it thoroughly, such a significant number of more zones of the lives of Muslims may serve from it. (Ad-Darsh, 2018) To the Prophet and his Companions, the masjid was not only a place where they prayed, yet it was likewise a spot where they learned, presented the Qur'an, made dhikr and du'a', met with one another, socialized, got the designations, arranged the campaigns and raised assets for different high aims. It was once in a while even a spot for tending to the sick, and a haven for the homeless. In the physical world, it was at the focal point of their lives. Simultaneously, it was the support of their learning and profound growth. (Dr. Hatem AlHaj, 2014)

The purpose of the mosque is not simply to accumulate peoples. It is intended to motivate people to connect through adoration, cooperation, and looking for Allah's pleasure. Every Muslim should attempt to arrive at such a point of amicability with others, and get rid of selfishness that isolates him from others. ("Mosque in Islam: An Integrated Role," 2013) In any case, these days everything seems to be the opposite of the role of the mosque that has gotten limited to establishing up the five prescribed prayers, and then it closes its entryways. Therefore, the mosque has gotten disengaged from regular day to day existence. (Mohammad, 1996)

## **2.2 ENERGY EFFICIENCY**

One of the significant difficulties related to the IoT empowered smart building is to increase the vitality effectiveness of the smart building. Energy is rare and is costly, to develop buildings that are more energy efficient is a crucial test concerning big data investigation.