



**Faculty of Electrical and Electronic Engineering Technology**



**A DEVELOPMENT OF A SMART BUS STOP LAMP POST BY  
SOLAR LIGHTING SYSTEM**

**MUHAMMAD AMIERUL AFIQ B ABU SAMAH**

**Bachelor of Electrical Engineering Technology with Honours**

**2022**

**A DEVELOPMENT OF A SMART BUS STOP LAMP POST BY SOLAR  
LIGHTING SYSTEM**

**MUHAMMAD AMIERUL AFIQ B ABU SAMAH**

**A project report submitted  
in partial fulfillment of the requirements for the degree of  
Bachelor of Electronics Engineering Technology with Honours**



اونيورسيتي تیکنیکل ماليسيا ملاک  
**Faculty of Electrical and Electronic Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2022**

**BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II**

Tajuk Projek : A DEVELOPMENT OF SMART BUS STOP LAMP POST BY SOLAR LIGHTING SYSTEM

Sesi Pengajian : 2022/2023

Saya MUHAMMAD AMIERUL AFIQ B ABU SAMAH mengaku membenarkan laporan Projek Sarjana

Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan

**SULIT\***

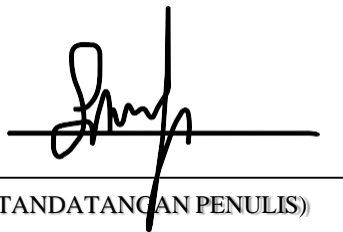
(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

**TERHAD**

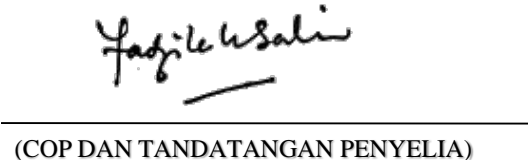
(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

**TIDAK TERHAD**

Disahkan oleh:



(TANDATANGAN PENULIS)



(COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: 693-1 Km5 Semabok Dalam  
75050, Melaka

**DATIN DR. FADZILAH BINTI SALIM**  
Pensyarah Kanan  
Jabatan Teknologi Kejuruteraan Elektrik  
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik  
Universiti Teknikal Malaysia Melaka

Tarikh:

Tarikh: 31/12/2022

Tarikh:

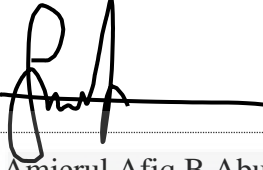
Tarikh: 20/02/2023

\*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

\*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

## DECLARATION

I declare that this project report entitled “A Development Of A Smart Bus Stop Lamp Post By Solar Lighting System” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :   
Student Name : Muhammad Amierul Afiq B Abu Samah  
Date : 31/12/2022

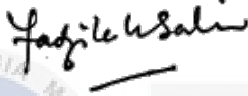
اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## APPROVAL

I hereby declare that I have checked this project report and, in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honors.

Signature

: 

Supervisor Name

: DATIN DR. FADZILAH BINTI SALIM

Date

: 20/02/2023

Signature

:  اونيورسيتي تيكنيكل ماليزيا ملاك

Co-Supervisor

Name (if any)

: AMALIA AIDA BINTI ABD HALIM

Date

: 20/2/2023

## *DEDICATION*

My dissertation is dedicated to my family and many friends. I am very grateful to my loving parents, En. Abu Samah and Pn. Shariffa, whose words of support and push for persistence continue to ring in my ears. My precious brothers and sisters who have never left my side. I also dedicate this dissertation to my numerous friends and family members who have been there for me throughout the process. I will be eternally grateful for everything they have done for me, especially my fellow friends who have assisted me in developing my technological abilities, as well as the many hours of proofreading and technical competence.



## ABSTRACT

Our project is about developed a smart lighting system at bus stop by solar system. The objective of this project is to create a project that can save the usage of electricity and to ensure the safety of users especially at night. In addition, there are several studies covered in this project, namely, using PIR “Passive Infra-Red” sensors to detect the presence of people at the bus stop. All these objectives are intended to address the problems that arise as we undertake research to produce this project. Among the problems we identified during our testing process were the authorities the irresponsible people do not turn off switch went not in use. With that, we used a PIR sensor to detect the motion of people and LDR sensor to detect the presence of light. In this project we connected from solar to the solar charger control and supply to the battery to store a voltage. Therefore, at night the load can get a supplied from the battery to run the smart lighting system at the bus stop. For my data and analysis, we collected 7 days of charging battery using solar system with different weather and try to run out the output for 4 hours straight without stop. We collected every 20 minutes and take a reading for how many Ampere/hours Ah are used every 1 hours each. So that we can analyse the charging solar at daytime can accommodate the usage of battery at night. Based on the results of the analysis and debate, it can be determined that the creation of a smart bus stop lamp post with solar lighting has achieved its stated purpose. In addition, this tool has also been proven to save time and energy usage in performing tasks.

## ***ABSTRAK***

Projek kami adalah tentang membangunkan sistem pencahayaan pintar di perhentian bas oleh sistem solar. Objektif projek ini adalah untuk mewujudkan projek yang dapat menjimatkan penggunaan tenaga elektrik dan memastikan keselamatan pengguna terutamanya pada waktu malam. Selain itu, terdapat beberapa kajian yang diliputi dalam projek ini, iaitu, menggunakan sensor PIR “Passive Infra-Red” untuk mengesan kehadiran orang ramai di perhentian bas. Kesemua objektif ini adalah bertujuan untuk menangani masalah yang timbul semasa kami menjalankan penyelidikan untuk menghasilkan projek ini. Antara masalah yang kami kenal pasti semasa proses ujian kami adalah orang yang tidak bertanggungjawab tidak mematikan suis tidak digunakan. Dengan itu, kami menggunakan sensor PIR untuk mengesan pergerakan orang dan sensor LDR untuk mengesan kehadiran cahaya. Dalam projek ini kami menyambung dari solar ke kawalan pengecas solar dan membekalkan kepada bateri untuk menyimpan voltan. Oleh itu, pada waktu malam beban boleh mendapat bekalan daripada bateri untuk menjalankan sistem lampu pintar di perhentian bas. Untuk data dan analisis saya, kami mengumpul 7 hari pengecasan bateri menggunakan sistem suria dengan cuaca berbeza dan cuba menghabiskan output selama 4 jam terus tanpa henti. Kami mengumpul setiap 20 minit dan mengambil bacaan untuk berapa banyak Ampere/jam Ah digunakan setiap 1 jam setiap satu. Supaya kita dapat menganalisis pengecasan solar pada waktu siang dapat menampung penggunaan bateri pada waktu malam. Berdasarkan hasil analisis dan perbincangan, dapat ditentukan bahawa penciptaan tiang lampu perhentian bas pintar dengan lampu solar telah mencapai tujuan yang dinyatakan. Selain itu, alat ini juga telah terbukti dapat menjimatkan masa dan penggunaan tenaga dalam melaksanakan tugas.



## ***ACKNOWLEDGEMENT***

First and foremost, I'd want to offer my heartfelt thanks to the many people and organizations that helped me throughout my graduate studies. First and foremost, I would like to express my heartfelt gratitude to my supervisor, Datin Dr Fadzilah bt Salim, for his enthusiasm, patience, insightful comments, helpful information, practical advice, and never-ending ideas, which have greatly aided me throughout my research and writing of this thesis. His vast knowledge, extensive experience, and professional skills in Electrical Engineering helped me to effectively accomplish my research. This would not have been feasible without his help and supervision. I could not have asked for a better supervisor during my studies. My heartfelt gratitude goes to my parents and family members for their love and prayers during my studies.

I'd also want to thank you to Universiti Teknikal Malaysia Melaka (UTeM) for allowing me to complete my bachelor's degree program. I am also grateful to the following FTKEE university personnel, co-workers, and classmates, as well as those persons who are not included, for their assistance.

Finally, but not least, thank you to everyone in my course for a wonderful four years of sharing premises with you.

## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	
<b>APPROVAL</b>	
<b>DEDICATION</b>	
<b>ABSTRACT</b>	<b>i</b>
<b>ABSTRAK</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iii</b>
<b>TABLE OF CONTENTS</b>	<b>iv</b>
<b>LIST OF TABLES</b>	<b>v</b>
<b>LIST OF FIGURES</b>	<b>vi</b>
<b>LIST OF SYMBOLS</b>	<b>viii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>ix</b>
<b>LIST OF APPENDICES</b>	<b>x</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>11</b>
1.1 Background	11
1.2 Problem Statement	11
1.3 Project Objective	12
1.4 Scope of Project	12
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>13</b>
2.1 Introduction	13
2.2 Smart Lighting system	13
2.3 Using PIR for smart concept.	15
2.4 World electricity use	15
2.5 Solar Energy	16
2.5.1 Photovoltaic system.	17
2.5.1.1 Monocrystalline Silicon Cell	18
2.5.1.2 Polycrystalline Silicon Cell	18
2.5.1.3 Thin Film Cells	19
2.6 Concept of light sources using Photovoltaic system.	19
2.6.1 The process to determine the appropriate size of PV panels for a particular application.	20
2.7 Summary	22
<b>CHAPTER 3 METHODOLOGY</b>	<b>23</b>
3.1 Introduction	23

3.2	Methodology	23
	3.2.1 Development of PV system.	25
	3.2.2 Circuit Project Diagram	25
3.3	Hardware Project Development	26
	3.3.1 Monocrystalline Solar.	26
	3.3.2 Arduino Uno.	27
	3.3.3 PIR Sensor.	28
	3.3.4 5V Relay Module	29
	3.3.5 LDR sensor	29
	3.3.6 PWM Solar Controller Charger	30
	3.3.7 Battery storage	31
3.4	Summary	32
<b>CHAPTER 4 RESULT AND ANALYSIS</b>		<b>33</b>
4.1	Introduction	33
4.2	Project Prototype	33
	4.2.1 Hardware Installation	34
4.3	Coding for Arduino UNO.	35
4.4	Experiment Test	36
4.5	Calculation	37
4.6	Experiment Result	37
	4.6.1 Reading for Day 1	37
	4.6.2 Reading for Day 2	38
	4.6.3 Reading for Day 3	40
	4.6.4 Reading for Day 4	41
	4.6.5 Reading for Day 5	42
	4.6.6 Reading for Day 6	44
	4.6.7 Reading for Day 7	45
4.7	Reading for Discharge Load	46
4.8	Analysis Of the Result	48
4.9	Sensor	48
	4.9.1 PIR Sensor	48
	4.9.2 LDR Sensor	49
4.10	Summary	49
<b>CHAPTER 5 CONCLUSION AND FUTURE IMPROVEMENTS</b>		<b>51</b>
5.1	Conclusion	51
5.2	Project Objectives	51
	5.2.1 To analyze the bus stop lamp post from the previous work	51
	5.2.2 To design a smart bus lamp post using Arduino UNO	52
	5.2.3 To evaluate the performance of a smart bus stop lamp post using PIR sensor system with solar	52
5.3	Project Limitation	52
5.4	Recommendation	53
5.5	Project Potential	53
<b>REFERENCES</b>		<b>54</b>
<b>APPENDICES</b>		<b>55</b>

## LIST OF TABLES

TABLE	TITLE	PAGE
Table 4.1	Result For Day 1	37
Table 4.2	Reading for Day 2	38
Table 4.3	Reading of Day 3	40
Table 4.4	Reading for Day 4	41
Table 4.5	Reading for Day 5	42
Table 4.6	Reading for Day 6	44
Table 4.7	Reading for Day 7	45
Table 4.8	Reading Of Discharge Load	47
Table 4.9	Condition Of PIR motion Sensor	49
Table 4.10	Condition Of LDR sensor	49

*(List of Tables is optional. Please remove this page if it is not used)*

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1	Using PIR sensor on Street light	14
Figure 2.2	The graph depicting world electricity generation	16
Figure 2.3	Configurations of PV lighting systems with different light sources	20
Figure 3.1	Flowchart of the project development.	24
Figure 3.2	PV system circuit diagram.	25
Figure 3.3:	Circuit Diagram of this project.	26
Figure 3.4	Monocrystalline Solar	27
Figure 3.5	Type of Arduino Uno	28
Figure 3.6	The PIR sensor	28
Figure 3.7	5V Relay Module	29
Figure 3.8	LDR sensor	30
Figure 3.9	PWM solar charge controller	31
Figure 3.10	Battery Solar	32
Figure 4.1	Front view of project prototype	34
Figure 4.2	Hardware Project Prototype up view	34
Figure 4.3	Coding declaration for Arduino UNO	36
Figure 4.4	Reading for Day 1	38
Figure 4.5	Reading For Day 2	39
Figure 4.6	Reading for Day 3	41
Figure 4.7	Reading for Day 4	42
Figure 4.8	Reading for Day 5	43
Figure 4.9	Reading for Day 6	45
Figure 4.10	Reading for Day 7	46

*(List of Figures is optional. Please remove this page if it is not used)*



## LIST OF SYMBOLS

$\delta$	-	Voltage angle
%	-	percent
	-	
	-	
	-	
	-	
	-	
	-	

*(List of Symbols is optional. Please remove this page if it is not used)*



## LIST OF ABBREVIATIONS

V	-	Voltage
PIR	-	Passive Infra-red
LDR	-	Light-dependent resistor
PWM	-	Pulse width modulation
A/h	-	Ampere/hour
PV	-	photovoltaic
W/h	-	Watt/hour
-	-	-

*(List of Abbreviations is optional. Please remove this page if it is not used)*





## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
X	X	X

*(List of Appendices is optional. Please remove this page if it is not used)*



# CHAPTER 1

## INTRODUCTION

### 1.1 Background

This project is about bus stop lamp post in Malaysia. The bus stop is one of the important facilities in any district. It can be a place to wait for the bus and take shelter if it is a rainy day. Therefore, the bus stop must be in good condition and can be operated well in a very long term.

This project was taken up because mostly bus stop lamp post in Malaysia does not operate well at night and will cause unexpected things to happen. So, there is a need for a solution to prevent it. Besides, many bus stop lamp posts are not in good condition due to lack of maintenance. A lack of workers to do maintenance can also be a major problem.

Developing a lamp post at the bus stop that uses solar system can save electricity. A development of a smart bus stop lamp post using solar lighting system using a sensor to detect the presence of people. In this project we have implemented a motion sensor to detect the present of people. This project can make the city in eco-system. This solar system will charge the battery during sunrise and use the battery using sunset.

### 1.2 Problem Statement

The bus stop lamp post are mostly not well operated. This is because the bus stop lamp post uses a switch to light up the lamp. The careless attitude of people that some irresponsible people do not turn off the light when not in used can cause a waste of electricity.

In the nutshell, when the using of the bus stop lamp is frequently used it will shorten the life expectancy of the lamp and cost high usage of electricity.

In addition, the frequency of using bus stop lamp post will need a maintenance more often because of the usage. The shortage of workers also lead to this problem. In the event of a damaged bus stop post lamp, the authorities will have to repair it immediately the bus stop lamp post to prevent any discomfort area can cause any kind of crime. Thus, there is a need to develop a smart lamp post in order to save the electricity.

### **1.3 Project Objective**

The objective of this project is as follows:

- a) To analyze the solar lighting system at bus stop lamp post development from the previous studies.
- b) To design a smart bus stop lamp post using Arduino UNO.
- c) To evaluate the performance of a smart bus stop lamp post using PIR “Passive Infra-red” sensor system with solar.

### **1.4 Scope of Project**

This project scope’s is defined as follows to avoid any uncertainty about the project owing to various limits and constraints :

- a) This project is targeted for using at night.
- b) The using of PIR sensor is using to detect the presence of people.
- c) This project uses Photovoltaic solar panels.
- d) The type of microcontroller used in this project is Arduino Uno.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

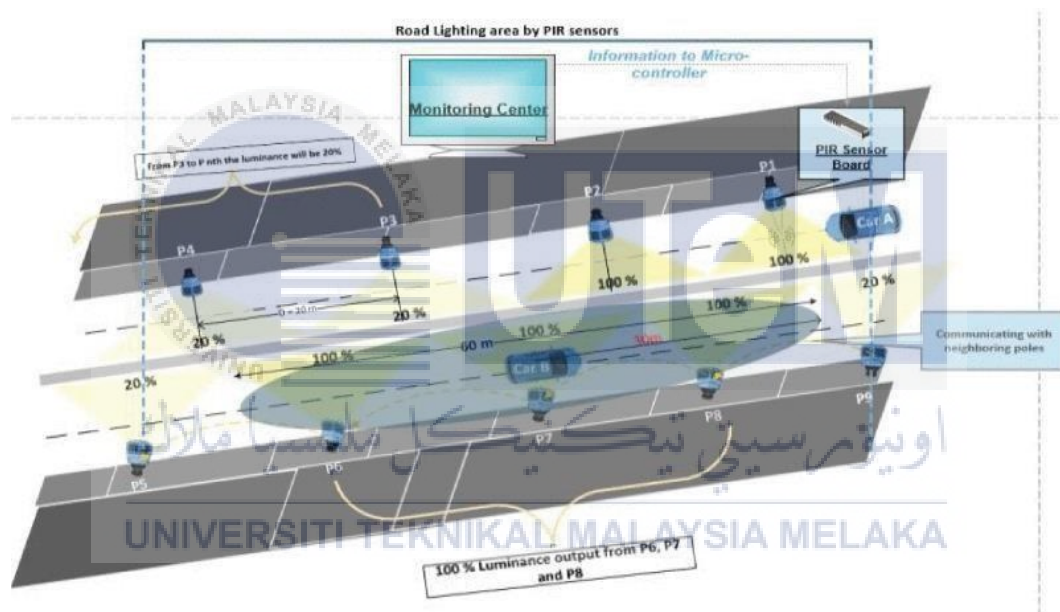
General topics, issues or areas of focus need to be identified and then provide the appropriate context for the literature review. The overall trend of the topic, suggestions in theory, methodology, evidence and conclusions or new issues should be stated.

In this chapter, further discussion of past research and related information will make important contributions to the field of study, light detection systems or closely related systems. In today's modern civilization, energy efficiency is regarded as one of the most important methods for reducing electricity use and preserving the environment. There are many sources of information about related areas published on the web about bus stop lamp post. The information collected provides suggestions on current methods and examples of opinions. The idea is therefore supported and justified by important past research.

#### 2.2 Smart Lighting system

Street lighting system's smart technologies are essential for creating a safe environment for residents and businesses. Street lighting in several nations have begun to use smart technologies. The first stage in installing a smart system is to lower energy usage and operating costs. To reduce power usage, advanced smart operating approaches are needed for maintaining, regulating, and communicating street illumination. Smart PIR sensors combined with LED streetlights could be used in urban areas to reduce power usage. Energy conservation and operating costs will be impacted by this integration of streetlights [1].

In this study, a PIR sensor lighting system as shown in Figure 2.1 is suggested for Aligarh University's campus area with the main objective of lowering energy consumption and operating expenses. With integrated smart PIR sensors and an adaptable part-night lighting system using standard LEDs, the proposed smart technique was applied to 36 streetlights. The suggested approach, a traffic-aware smart PIR street lighting system in Aligarh, results in 96-97% less power consumption over the course of six months than the standard lighting system. Therefore, these intelligent lighting systems can control power and cost usage [2].



**Figure 2.1 Using PIR sensor on Street light**

The passive infrared (PIR) sensor is a tiny gadget used to track the movement of objects and track the heat that live things emit. These PIR sensors exchange information with the central management system, which autonomously manages and regulates the smart lighting activities. Additionally, the PIR sensor operates continuously throughout the night when motion is detected, turning on the roadway and executing the system's inbuilt algorithm. A

thorough overview of the campus's smart PIR sensor lighting system is shown in Figure 2.1 [2].

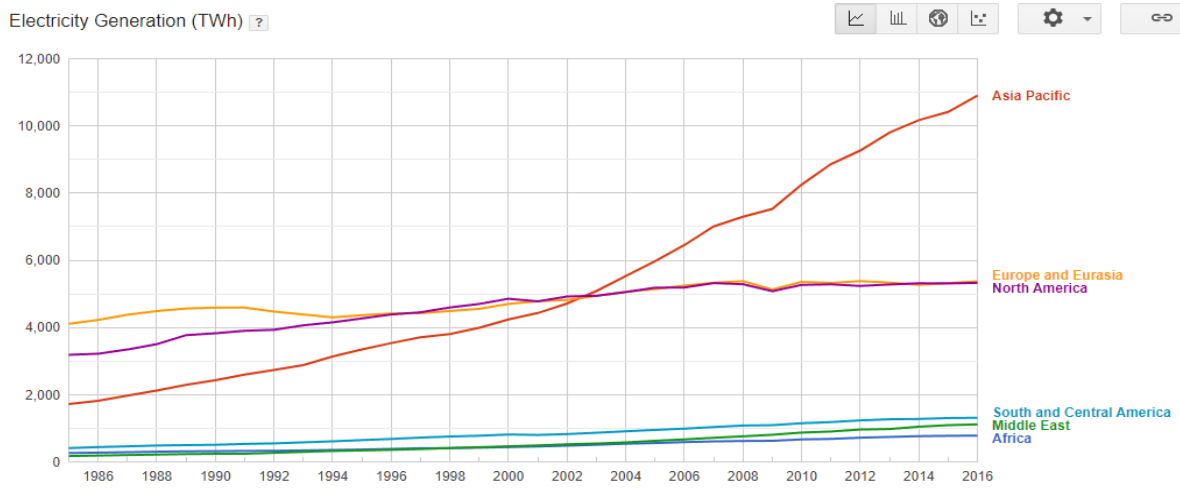
### **2.3 Using PIR for smart concept.**

The infrared energy that every living thing emits in the region makes the PIR easily responsive. As an illustration, the sensor will detect infrared energy from the body when a human enters the sensor area field. The purpose of the light, which is housed inside the PIR sensor, is to illuminate when it detects the movement of a live object but not to react to a person who is standing still. A moving living item causes an abrupt change in infrared energy, whereas a static body causes infrared energy to change more slowly [3].

The temperature change in the environment will result in slower alterations. The PIR sensor is the most sensitive and an excellent alternative, but no motion sensor system is perfect. Each form of light sensor developed and invented, such as the photodiode, photovoltaic cells, photomultiplier, phototransistors, charge coupling device, and photo resistor, has a distinct function [4].

### **2.4 World electricity use**

Figure 2.2 shows the growth of global electricity generation during the last few decades. Take note of how electricity use is overtaking energy consumption, both of which are outpacing the global population [5]. The many drop-down menus affect which countries or regions are displayed, as well as the graph type and variables examined. Take note of the proportionate amount of electricity produced. Around 1 billion people live in Europe, 500 million in North America, and nearly 4 billion in Asia [5].



**Figure 2.2 The graph depicting world electricity generation**

## 2.5 Solar Energy

Solar energy is defined as the energy that the earth gets from the sun and turns into thermal or electrical energy. It is an important renewable energy source, and its technology is categorised as solar energy or active solar depending on how it gathers, distributes, or transforms solar energy into solar power. Although solar energy has an impact on the earth's climate and weather, it only accounts for 0.5% of the world's electricity. However, scientists predict that sunlight has the capacity to generate 5000 times the amount of energy that the world consumes. Solar energy is a broad phrase that refers to a variety of methods for extracting energy from the sun [6].

Electricity must be transmitted across long distances from massive power facilities to end consumers. Power is lost during long-distance transmission. Have you ever wondered why solar panels are used? They've installed solar panels on your roof to harness the energy of the sun. Rooftop solar power can help boost electricity efficiency due to the short distance. As a result, the amount of energy used and the amount of money spent on power can be managed.

To summarise, solar energy benefits households and makes life easier for some people, whether they are in businesses, residences, or industries. Communities benefit from solar energy and save more money because their electricity usage is minimized [6].

### **2.5.1 Photovoltaic system.**

A photovoltaic (PV) system is a combination of one or more solar panels, an inverter, and other electrical and mechanical components that generate electricity from the Sun's radiation. PV systems come in a range of sizes, from small rooftop or portable systems to enormous utility-scale power plants. Solar photovoltaic (PV) systems are semiconductor devices that convert sunlight into direct current (DC) electricity via electron transfer. They are a tested technology with a lifespan of 20–30 years.

The energy conversion process is separated with two types: light absorption produces an electron-hole pair in a semiconductor material, followed by the device's structure separating the electron to the negative terminal and the hole to the positive terminal to supply electricity [5]. To create additional electrical energy, solar cells may be connected in series, and many modules can be combined to make an array. Solar-PV systems provide a number of advantages, such as a simple design, a long operating life, high reliability, and the fact that they do not pollute the environment while producing power.

Monocrystalline silicon, polycrystalline silicon, and thin film PV cell technologies now dominate the worldwide market. High-efficiency PV technologies, such as gallium arsenide and multi-junction cells, are less widely employed due to their high cost, despite their suitability for concentrated solar systems and space applications. Only a few of the innovative PV cell technologies are perovskite cells, organic solar cells, dye-sensitized solar cells, and quantum dots [7].