# Faculty of Electrical and Electronic Engineering Technology

# DEVELOPMENT OF HYBRID POWER GENERATION SYSTEM USING SOLAR ENERGY AND PIEZO ELECTRICITY WITH ARDUINO BASED

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**Bachelor of Electrical Engineering Technology (Industrial Power) with Honours**

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# DEVELOPMENT OF HYBRID POWER GENERATION SYSTEM USING SOLAR ENERGY AND PIEZO ELECTRICITY WITH ARDUINO BASED

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**A project report submitted**
**in partial fulfillment of the requirements for the degree of**
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## DEDICATION

I am grateful to Allah SWT for this precious opportunity. I want to dedicate this project to my beloved parents Honeyzah Binti Zaini and Abd Rahim Bin Karim for raising me until I am able to continue my studies in Universiti Teknikal Malaysia Melaka (UTeM). To all my family members, your support are the main reasons why I am surviving mentally and physically during my journey to complete my studies.

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## ABSTRACT

Electricity serves as a lifeline for people in this era. Various operations of modern world technology necessitate a large amount of electric power. The demand for electricity is growing every day, and the human population is also increasing. As technology advances, new ways of harvesting energy for a different power generation method emerge. This project is focusing on generate electrical power from sunlight and human footsteps. This two-power source is environmentally friendly to our ecosystem. The concept behind this project is to harvest and convert the wasted energy from human locomotion in the environment, as well as solar energy, into electrical energy. Piezoelectric sensor is design with other components in a series parallel combination which convert the kinetic charge into electrical charge using the piezoelectric effect. The data collected revealed that the piezoelectric sensor's voltage is directly proportional to the number of step forces applied, and that the solar panel produced more power between 11 am and 2 pm. As a result, this prototype can charge and store electrical energy in a battery to be used later. In this project, a non-traditional method was using to generate electrical power by simply walking or running as an input source, as well as harvesting solar energy from the sun. When used in congested areas such as train station and shopping malls, this method proves to be extremely beneficial.


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## *ABSTRAK*

Tenaga elektrik berfungsi sebagai sumber kehidupan bagi orang di era ini. Pelbagai operasi teknologi dunia moden memerlukan sejumlah besar tenaga elektrik. Permintaan elektrik meningkat setiap hari, dan populasi manusia juga meningkat. Seiring kemajuan teknologi, kaedah baru untuk mendapatkan tenaga untuk kaedah penjanaan tenaga yang berbeza muncul. Projek ini memfokuskan untuk menghasilkan tenaga elektrik dari tenaga suria dan manusia. Dua sumber kuasa ini mesra alam kepada ekosistem kita. Konsep di sebalik projek ini adalah untuk menuai dan menukar tenaga yang terbuang dari pergerakan manusia di persekitaran, serta tenaga suria, menjadi tenaga elektrik. Sensor piezoelektrik direka dengan komponen lain dalam kombinasi selari siri yang menukar cas kinetik menjadi cas elektrik menggunakan kesan piezoelektrik. Data yang dikumpulkan menunjukkan bahawa voltan piezoelektrik berkadar langsung dengan jumlah daya langkah yang diterapkan, dan bahawa panel suria menghasilkan lebih banyak tenaga antara jam 11 pagi dan 2 petang. Hasilnya, prototaip ini dapat mengecas dan menyimpan tenaga elektrik dalam bateri yang akan digunakan kemudian. Dalam projek ini, kaedah non-tradisional digunakan untuk menghasilkan tenaga elektrik dengan hanya berjalan atau berlari sebagai sumber input, serta menuai tenaga suria dari matahari. Solar apabila digunakan di kawasan yang sesak seperti stesen kereta api dan pusat membeli-belah, kaedah ini terbukti sangat bermanfaat.


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**LIST OF SYMBOLS**

UTeM
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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| $Mon - SI$ | - | Monocrystalline Solar Panels |
| P-SI | - | Polycrystalline Solar Panels |
| A-SI | - | Amorphous Silicon Solar Panels |
| CVP | - | Concentrated PV Cell |
| TFSC | - | Thin-Film Solar Panels |
| PbTi03 | - | Lead (II) Titanate |
| PbZr03 | - | Lead (II) Zirconate |
| PVDF | - | Polyvinylidene Difluorideor Polyvinylidene Fluoride |
| PZT | - | Lead Zicornate Titirate |
| SLA | - | Sealed Lead Acid |
| AGM | - | Absorbed Glass Mat |
| VRLA | - | Valve Regulated Lead Acid |
| AC | - | Alternating Current |
| DC | - | Direct Current |
| IDE | - | Integrated Development Environment |

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

One of the most important aspects of economic infrastructure is energy. The availability of energy system is important to humanity's survival. The capacity or ability to work vigorously is referred to as energy. It plays an important role in our daily lives. In fact, it is primarily required in every field, including the home, industry, communication, transportation, defence, and agriculture. Conventional and non-conventional energy sources are the two broad categories of energy resources. Traditional energy sources are scarce in the environment, but their applications are limitless. Non-conventional energy sources, on the other hand, are sources that are abundant in the environment but are only used for specific purposes.

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Conventional sources of energy are natural energy resources that have been used for many years and are accepted to fill human needs. Firewood, fossil fuels, and cow dung cake are among the energy sources. The most common of these sources is fossil fuel, this fossil fuel is from the plants and animal that lived million years ago and being buried deep in the ground. Coal, oil (petroleum), and natural gas are examples of fossil fuels. Conventional energy is non-renewable energy, this is because to produce conventional energy it takes time to be formed. This conventional energy is declining because the world is using its resources to the maximum and it is very difficult to be find.

Non-conventional energy sources have gained popularity in recent years as a result of the 1973 oil crisis, and they have been widely used since then. There are a lot of sources such as solar, wind, hydro, and human wasted energy to generate power. All this energy will not run out because it uses nature as a source of energy. All of this energy also a renewable energy and can avoid pollution in our world.

Solar energy sources are getting attention because they are a clean and renewable energy source. To convert light reflected from the sun into electrical energy, photovoltaic cells are required. This resulting energy can be used in various fields such as street lighting at night.

The deployment of various clean energy systems is an important strategy for environmental sustainability [1]. Most people spend their time walking even when they are at home. This nature is a fundamental nature in human life. By walking, kinetic energy can be generated when the force generated from the human footprint with the ground surface. By walking, kinetic energy can be generated when the force generated from the human footprint is with the ground surface. This energy is also known as renewable energy. By using a footstep power generator, the resulting kinetic energy can be converted to electrical energy. [2].

There are various ways to lead the world to a sustainable future. One of the most effective ways is to use energy sources from the sun and the power generated from human footsteps while walking to be converted into electrical energy.

## 1.2 Problem Statement

The demand for electricity is increasing due to the growing population in the country. At the same time, energy wastage also increases in various ways such as the energy form from human locomotion. The major solution is to reform this energy into a usable form. As technology advances and the use of gadgets grows, so does the number of electronic devices, and power generation using traditional methods becomes insufficient.

As a result, the energy waste can be converted to usable form using a solar panel and a piezoelectric sensor. The pressure generated from the human footstep will be converted into voltage energy by a piezoelectric sensor while the solar panel will capture light from the sun. Power generation systems through solar and piezoelectric energy are energy saving methods. The proposed system functions as a medium for generating electricity through the use of force and sunlight. This project is particularly useful in public places such as bus stops, movie theatres, train stations, shopping malls, airports, and colleges. As a result, these systems are installed in public areas where people walk and must travel through this system to enter or exit.

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## 1.3 Project Objective

The overall objective is to create a prototype of an Arduino-based solar and piezoelectric power generator that uses a piezoelectric sensor and a solar panel. The following objective have been considered to complete this project.

- To develop a hybrid power generation system using solar panel and piezo electric sensor.
- To monitor the voltage and current of the hybrid power generation system using Arduino Uno.
- To analyse voltage and current of the hybrid generation system using the obtained measurement data.

## 1.4 Scope of Project

The scope of this project are as follows:

- Design prototype of hybrid piezoelectric and solar energy harvesting.
- Make a prototype that can harvest electrical energy from footsteps and sunlight.
- The output energy from harvesting will be store in charging system.
- This project can be easily installed in any location and requires minimal renovation.
- This project will assist in generating power and lighting a DC LED bulb along a pathway, as well as storing the power in a rechargeable battery that can then be used to reduce the amount of electricity used for a variety of applications.
- Using an Arduino programme to track the data of voltage produced over time. This development has the potential to improve the project's monitoring system in terms of maintenance and control.

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# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

The topics will be related with other past research such as journals, books and web page. From the research made by other researchers, the result of the study is being use as the reference for this project fundamental. The topics that being studied in this chapter in example such as energy, solar energy, piezoelectricity, and Arduino.

## 2.2 Energy

Due to the high demand for energy in daily life in the world nowadays, the world is fast becoming a global village despite the fact that the shape of the earth cannot change [3]. Therefore, the demand for energy is also increasing to support social, economic, and human health development. Energy is very important in daily life because it is a basic thing in human life. Examples are such as lighting in homes and for communication systems. The main challenge for the energy sector for a good future is to source energy supply without damaging nature. There are 1.4 billion people in the world without electricity and 85 percent of them come from rural areas. Hence, the level of dependence of rural communities on biomass energy is expected to increase from 2.7 billion to 2.8 billion by 2030 [4].

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In the year 1,750, near Richmond, Virginia, the first commercial coal mining was recorded. Due to its higher energy carrying capacity than corresponding quantities of biomass-based fuels, coal temporarily became the most preferred fuel for steam engines [5]. It is worth noting that coal used to be a much cheaper and cleaner fuel in previous centuries. In the past

few decades, fossil fuel -based energy generation has dominated and has resulted in global resistance as it releases large amounts of carbon dioxide [3]. In the 21st century, climate problems are on the rise due to uncontrolled greenhouse gas emissions. This can be prevented if there is an effort to practice the use of renewable energy sources. Indirectly it can significantly reduce the risk of climate change.

When the world is feeling the effects of rising oil prices. Then began research on alternative energy sources in the late 1990s**.** By substituting energy sources from fossil fuels to renewable energy such as solar energy and wind energy will be able to help the world achieve sustainability in the future [3]. All individuals in the world are looking forward to a sustainable future following in recent decades there have been various efforts to replace petroleum -derived materials from fossil fuel -based energy sources to renewable energy sources. Recently, SDGs launched a campaign to help prevent climate change in the 21st century and inform its consequences. This is to ensure a sustainable future for all the inhabitants of the earth.

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## 2.3 Solar Panels

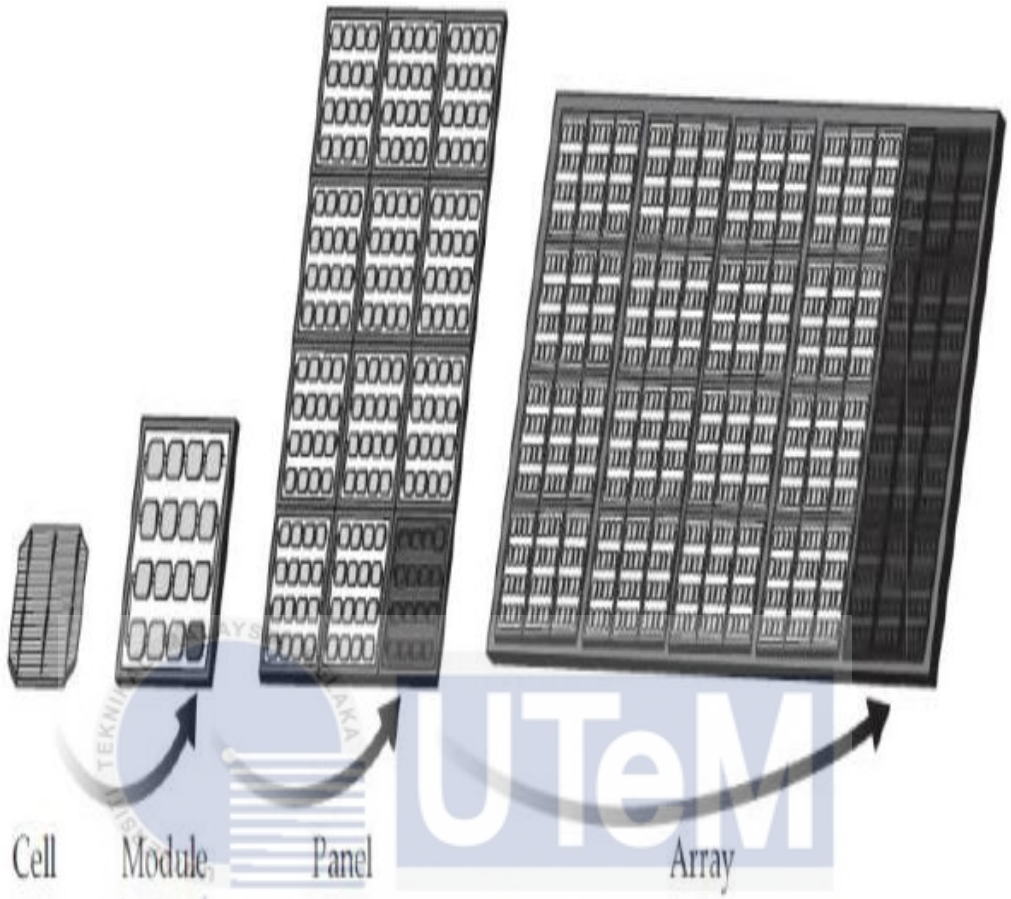


Figure 2.1: Components of a PV Array

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The sun emits solar radiation to the earth, that solar radiation is used to produce alternative energy sources. Figure 2.1 shows the components of a PV array. The solar cell converts the solar radiation into electrical energy which will then be stored in the battery before being channeled to any load. The function of solar panels is as a material to harvest sunlight and convert it into a usable source of energy. Solar power is a non-renewable energy source that only works when the sun is shining. Solar energy sources can only be used when there is sunlight, so they are classified as non -renewable energy. Solar panels are also known as photovoltaic cells, during the day or during hot weather, these solar panels will collect sunlight and convert it into electrical energy. [6].