A PLATFORM FOR SOLAR ENERGY AN ALTERNATIVE SOURCE FOR KABALE DISTRICT AT KABALE UNIVERSITY

BY

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A REPORT SUBMITTED TO THE FACULTY OF EDUC.I\ TION FOR THE STUDY

LEADING TO THE PROJECT IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE AW ARD OF THE BACHELOR'S

DEGREE OF SCIENCE WITH

EDUCATION AT KABALE

UNIVERSITY

JANUARY, 2021

DECLARATION

I declare that this report entitled "SOLAR ENERGY AN AL TERNA Tl VE SOURCE FOR KABALE MUNICIPALITY" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature: .....~.'.

Date: 19/01/21

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APPROVAL

This work has been submitted with my approval as the student supervisO

Mr. HABUMUGISHA ISAAC

Signature: --- --~---- - --------- - - - - - - ----------

Date: 29/01/21

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ACKNOWLEDGEMENT

I would like to express my gratitude to Mr. Habumugisha Isaac, who was my supervisors. for his constant guidance in the implementation of this project. I must particularly thank him for his commitment and unrelenting effort to see me do all the assignments appertaining to this project. He was always available for consultation and ensured there was no laxity in the implementation of the project. I particularly thank him for his insight, advice and help towards the overall success of this project. Without his encouragement, the project woulrl not have been implemented as successfully as is the case. Finally, I would also like to thank my parents for their endless support and not forgetting my friends and classmates with whom we spent sleepless nights at times when trying to get some concepts right and I was able to come up with a working project

ABSTRACT

The energy received on Earth from the Sun is plentiful and totally renewable. Basically. the sun enabled life on our planet, and our life cannot be imagined without it. The sun is directly or indirectly at the origin for nearly all the energy resources on Earth, as fossil fuels (coal. natural gas and oil), hydro (global water circulation is due to the sun), wind, waves, biomass, etc. The sunlight was used as an energy resource already by ancient civilizations. Since ılien a lot of innovative technologies and advancements were performed in this field. The paper presents the main milestones of the developments performed in this important field of energy conversion.

Even though the initial cost of setting up the solar panel system is considerably high because or the solar cells being fragile and can easily break, there are cheaper options that have been proposed over time. This project discusses the design and construction of a prototype for a solar panel framework. Solar cells are used for sunlight detection. The solar panel is positioned where it is able to receive maximum light. Silicon solar cells produced an efficiency 0ľ 20% for the first time in 1985. Whereas there has been a steady increase in the efficiencv of solar panels. the level is still not at its best. Most panels still operate at less than 40%. As a result, most people are forced to either purchase a number of panels to meet their energy demands or purchase single systems with large outputs. The solar panel framework was constructed by using solar cells from broken solar panels. In terms of cost it is cheaper, less complex and still achieves the required efficiency.

DEDICATION

I dedicate this project to my parents Mr. and Mrs. Karwemera Sarapio for always being available for me and their unwavering support.

CHAPTER ONE

INTRODUCTION

1.1. Background

Turning the suns light into electrical energy started in the 19" century In 1839. French physicist Alexandre Edmond Becquerel discovered the photovoltaic effect, which is the creation of electric charge as the result of exposure to light through the simulation of electrons in metals such as selenium or platinum as conductors. In 1950, Aleksandra developed the first solar cell based on photovoltaic effect and the development of solar panels begun based on collection or solar cells. Through the 1950s, the efficiency of solar cells kept on increasing l'rom 8% in 1957 to 14% in 1960.Up to date, modification of solar panels still goes on to increase their efficiency

Solar powered equipment works best when they are pointed at the sun. Therefore, a solar panel increases how efficient such equipments are over any fixed position at the cost or additional complexity to the system (Otieno, 2015). A solar panel should be fixed in such a way that as position of the sun in the sky is varied both with seasons and time of day as the sun moves across the sky, it is able to convert maximum solar energy

The conversion principle of solar light into Electricity, called Photo Voltaic PV) conversion. is not new, but the efficiency improvement of the PV conversion equipment is still one or top priorities for many academic and/or industrial research groups all over the world. Among the proposed solutions for improving the efficiency of PV conversion is a solar tracking (Id et al., 2016).

Maximum power point tracking (MPPT) is the process of maximizing the power output from the solar panel by keeping its operation on the knee point of P-V characteristics. MPPT technology will only offer maximum power which can be received from stationary arrays ol solar panels at any given time. The technology cannot however increase generation of power when the sun is not aligned with the system

1.2. Statement of the Problem

The energy requirement of the mankind is continuously growing. lt is forecasted that b IU middle of our century the global energy demand will at least double. This huge energy necessity and the actual environmental challenges will be possible to be covered bv the increasing electrical energy conversion from renewables, among them solar energy according to (P.Roberts and Gleg Pascal) 2003.One of the greatest problems our world is facing today is climate change **With** the current industry, power generation depends on the world's natural resources. According to ecologist Joe Bidden. if continue using these resources for the next decarles. it will greailv affect the ecosystem, which might trigger a great transition on our climate, hence, the climate change. Solar energy being from a renewable resource, it provides electricity and causes nO la"" to the environment.

1.3. Aim and objectives:

1.3.1. Aim

To design solar energy as an alternative source of energy for Kabale district

1.3.2. Objectives

To review solar energy as a cheap and reliable source of energy for the people living in Kabale municipality.

1.4. Significance of the study

The thermal behavior of the switching devices or components seems to be quire interesting with many applications on the performance of the Solar PV system both from user point o! I"" """ application point of view. Hardly very few researches are being attempted in evaluation ol the performance of the solar PV panels as regards to the switching component> of the i"" Therefore an earnest attempt is made to analyze and evaluate the performance of the solar !' panel in this regard by having an experimental setup and investigations. *By* improving in the performance, will result with an optimum power utilization by the power system with greater returns.

1.5. Definition of terms

Solar cell: This is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect which is a physical and chemical phenomenon.

Solar energy: This refers to capturing the energy from the sun and subsequently converting it into electricity.

Renewable resource: This is a natural resource which will replenish to replace the portion depleted by usage and consumption either through natural reproduction or other recurring processes in a finite amount of time in a finite amount of time in a human time scale

1.6. Scope

The proposal covers an introduction to solar energy, how it can be an alternative source of electricity, and how it will benefit our municipality. It encompasses the installation process ol solar panels, where should they be located, how much electricity they can produce, how much will be the needed budget for the project, how long would they last, and how the project should be managed by the municipality heads.

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction.

This chapter analyses the previous literatures in the field of efficient of solar cells, study of the semi-conductor material used in PV cells, principle of solar collector, etc. The review and comparison of the past literature will assist in centralizing on the research topic and provide groundwork for selecting the solutions for the proposed problem statements. To carry out research on various techniques involved in solar design, journals, scholarly articles. books. Conference Proceedings, manufacturer's data sheets, standards and handbooks were surveyed comprehensively. The outcome of the literature review gives a detailed path for present and future research works.

2.2. Study of semi-conductor material.

Britt et al., (2009) have presented an experimental investigation to study a semiconductor material used in a PV cell and its importance in determining the efficiency of the solar cell at various parameters such as regards to behavior with respect to temperature. weight and as well as other parameters with which it is used and all those contribute to the deciding factor of efficiency of the PV cell The inventor has conducted many experimental' researchrrs to devise improvised methods and apparatus for forming thin film layers of semiconductor materials. The field or photovoltaic generally relates to multi-layer materials, converts sun light directly inro DC Electrical Power.

The basic mechanism for this conversion is "The Photovoltaic Effect". Solar cells are typically configured as a co-operating sandwich of P Type and N Type semiconductors. in which the N Type semiconductor material (on one side of the sandwich) exhibits an excess of electrons and the P-Type semiconductor material (on the other side of the sandwich) exhibits an excess of holes each of which signifies the absence of an electron. They have worked on thin film solar cells

2.3. Study of solar concentration.

Bareis et al., (2004) have investigated on the concentrating solar energy receivers. In their study they have commented that the solar collectors can be classified into focusing type (concentrating type) and Non focusing type (non-concentrating type).

The inventor has designed the concentrating type solar energy receiver comprising a primary parabolic reflector having a center and a high reflective surface on a concave side of the reflector and having a fixed axis extending from the concave side of the reflector and passing through a fixed point of the primary parabolic reflector and a conversion module having a reception surface. Non concentrating type solar collecting devices intercept parallel un concentrated rays of the sun with an array of photovoltaic cells. The output is the direct function of array.

Zhao et al., (2011) have conducted a study on solar collecting and utilizing device and have concluded that the efficacy of a solar energy conversion system depends on the various parameter such as the quantum of radiation, intensity, direction. the tilt angle of the collector. temperature etc. In case of solar collector and utilizing device the sun tracking and beam focused radiation are of paramount importance. This device consist of paraboloidal mirror. a sun light collector, a solar storage and conversion device and a solar tracking equipment wherein said sunlight collector compresses a light guide which convert factual into substantially parallel light **beam** and deflect them in a desired direction and a curved surface condenser mirror which

receive the substantially parallel light beams reflected from the light guider and converting them into a solar storage and conversion.

Sadati et al., (2010) worked on evaluation of supplying ruler and residential area using photovoltaic systems in IR. Iran. They have commented on use of sun's energy has the biggesl energy supplies and is clean and annexable source which can be utilize by using appropriate technologies. The total solar radiation received by different regions throughout the year the energy consumption required effect of temperature voltage current curve characteristics have been conceder for evolving a photo voltaic system to meet the domestics required, economi analysis has been made for justification of the use age of photovoltaic system.

Zhao et al., (2007) had worked Solar Collectors. The solar device is categorized as a multi laver heat storage structure and the said heat storage structure corresponds to plurality of curved

surface mirrors and as a light receiving hole for receiving the condensed light from the curved surface mirror. The heat structure contains a working fluid to transfer of storing the energy such as groups of melted salts, water steam, smelting raw material and photo electric cell.

As compared thermal power generation the solar electric power generation reduces the civil works in the building, avoids pollution, waste handling and air preheat-pollution treatment with comparative calculation for building a solar thermal power station, it is inferred that it's costs intensive compared to conventional power station. However consiciering the environmental impact on the space occupation and land usage, his method is more appropriate

CocOko et al., (2012) have worked on Optimum Collector Tilt Angle for low latitudes. There are many factors that affect the solar radiations falling on the earth Some of the factors that affect the intensity of the extra-terrestrial solar radiation on the earth's horizontal and tilted surfaces are clouds, dusts and shades. In designing the solar equipment the designer has to pay more attention towards harnessing the insulation to the optimum level for effective performance of the equipment. Determination of the tilt angle at lower latitudes is one such effort for a country like

Nigeria.

2.4. Study of solar efficiency.

Nataraj et al., (2012) have worked on application of circuit model for energy conversion system

The solar energy is directly converted to electrical energy without any electrical parts by the use of photovoltaic system. PY system is widely utilized to cater power demands of the society in many countries. The efficacy of the PY system depends on the operation of the system components and its performance. The efficiency of the solar system conversion technolOg stands at about 15 to25% mainly because of the conversation of DC power to r\C power through battery bands. The best way to utilize the PY System energy is to deliver it 10 the AC mains directly, without battery banks. Studies on the PY system in operation reveal that inverters contribute to 63% failure rate, modules 15% and other components 3 with d failure occurring on an average of every 4 to 5years. To reduce the failure rate of the PY systems it is necessary to reduce failure rates of inverters and components of effective performance.

Njoku et al., (2011) have worked on thermal performance, modeling of the reverse absorbers hallow solar pond. There are many application of solar energy catering to the varied demands of the society which are cost effective and culminate in efficient effective use of solar thermal power which are usually required for low temperature applications.

e f the popular applications are air heaters, crop dyers. solar cooker'>. solar st i l ls solar is etc However lot of research is still going on about in-cooperating these applications with - r::oG.ifications.

(distinct from the non-convictive salt gradient solar ponds which are of

Shallow solar pond/pe of "Collection-Cum-Storage" water heater. The conventional type ponds attain temperatures ranging less than 100 C.

_ - d:L~tical thermal analysis and simulation of the performance of two configurations of _ ~2ilSOrbershallow solar pond (RASS), one with top insulated another with top exposed are presented ensuing model equations are solved to determine the desired performance parameters Se.rlaion studies are carried out and graphical descriptions are made in the proposed research

.'~ =· **a!. {!995) worked** on in improving the efficiency of Solar Cells. They have found that e **efficiency of the solar** cell varies from 15% to 22% and innovations are being carried out b *changing* the **combination** of semiconductor material in the PV cell and find out improved ffcency.**The inYemor** has analyzed the properties of semiconductor material thoroughly and come **out with a** combination of cells- cascaded cell, permits achieving more than overall ency of 23°oJ . .:p to the present time it has been proposed to use either Germanium or ---------- ~--senide as the substrate for solar cell in which the principal active junction is formed **N-Type** and PT rype Gallium Arsenide. Attempts are continuing at developing solar cells that efficientlyuse as much of solar spectrum as possible. In order to catch as much as possible rotons. the semiconductor used in the solar cell must be designed for a small band gap. since the semiconductor material is otherwise transparent to radiation wirh proton energy less than the

pan gap

ill

CHAPTER THREE

RESEARCH METHOD

Lroduction

methodologies that will be used in collecting data and development of this system is covered ts chapter. This chapter provides training in choosing methods, materials, scientific tools and rhriques relevant for the solution of the problem.

3.2. List of equipment.

Solar cells

Old phone charger

Battery

Solider

Voltmeter

33. System design.

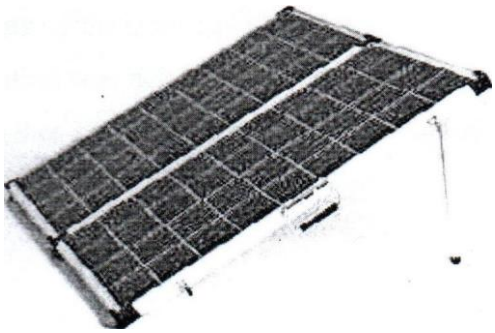

Figure 1.1

Solar cells from broken solar panels are arranged together in series using soldering wire to form a **solar** panel. This solar panel directly charges the battery (power bank) which in turn charges oilier electrical appliances such as phones and bulbs

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. RESULTS

A solar panel **frame work has** been completely designed and implemented.

4.1.1. Testing of the system

Under the - :- **:::G:lonaliry cest,** a fixed solar panel at 15 degrees to the horizontal was tested for its immensity **absorption** over a time interval of I hour and the. Intensity of the sun was easured **volts by the** voltmeter for two days. The device was able to detect light sourer. Thr ~--"--.;, **f3"** **m.e project were** obtained from the voltmeter for the solar panel that has a fixed 1-'-.a;_....-... ~ resulcs were recorded for two days and tabulated. The voltmeter readings were .:e:e:c.a~- on :ighc intensity falling on their surfaces .The voltmeter in that way was used to easure th. e intensity of light and therefore they are a valid indication of the power that gets to srface of the solar panel. As a result, by measuring the light intensity at a given time, it will possia~e IO gee the efficiency of the fixed solar panel. The light intensity is directly rporional to the power output of the solar panel. The results were obtained for different days. = _5 :-esulrs from different days was helpful in that it made it possible to compare the various z.==s ~ from different weather conditions. The values obtained were recorded and used to graphs**to** show the relation.

lmeter readings for a bright Sunny day 6th, March, 2020.

Time intervals	Voltmeter readings(V)
10:00-11:00	5
11:00-12:00	6
12:00-1:00	10
1:00-2:00	10
2:00-3:00	10
3:00-4:00	9
4:00-5:00	8
5:00-6:00	6

4.2.2. Voltmeter readings on a cloudy day on 13", March, 2020.

Time intervals	Voltmeter readings(V)
10:00-11:00	2
11:00-12:00	2
12:00-1:00	6
1 :00-2:00	7
2:00-3:00	5
3:00-4:00	2
4:00-5:00	8
5:00-6:00	6

4.3. DISCUSSIONS

Excel was used to generate graphs showing the intensity of light against time for the solar system.

From the curves, it can be seen that maximum sunlight occurs at around midday with maximum values obtained between 1200hrs and 1400hrs.In the morning and late evening. the intensity of sunlight diminishes and the values obtained are less than those obtained during the day.

The voltmeter readings are expected not to be close. This is because whenever the sun is in different positions there is a change in intensity of sun light.

The values vary because the panel is at a fixed position. Therefore, at most times the solar panel is not facing the sun at the same inclination. This is apart from mid-day when it is almost perpendicular to the sun. Days with the least cloud cover are the ones that have most light intensity and therefore the voltmeter readings will be highest. The solar panel svstem is most efficient when it is sunny. It will be able to harness most of the solar pawn which will be converted into energy.

The increase in efficiency can be calculated. However, it is important to note that there will be moments when the increase in power output for the fixed solar panel system is minimal, notably on cloudy days. This is expected because there will not be less intensity of sunlight for the systems. Similarly, on a very hot day at mid-day, the systems has high output because the sun is perpendicularly

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusions

The solar panel frame work was designed showing the different components of' system

The required materials were obtained locally from the old solar panels and new broken solar panels

The system was tested and then implemented with minimum resources and an affordable solar panel framework was implemented.

5.2. **Recommendation for further work**

For future projects one may consider the rotating solar panel which is able to collect sunlight effectively at any time of the day using a stepper motor

There is need to adopt the designed system because it is cheap and affordable compared to the already existing.

APPENDIX

Cost of analysis

Table 6 shows the cost of constructing a rotating solar panel framework that can light up three bulbs and charge electronic gadgets is as shown below.

Number	Component	Quantity Cost (Uganda shillings)
1	Solar cells	30,000
2	Solder	5,000
3	Wires	10,000
4	Plastic board	3000
5	Glue	2000
6	Battery	60,000
7	Solar frame	10,000
Total		**120,000**

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