College of Science, Engineering and Technology

CSET Learner Research Summit

Learner Research Summit Publications

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Dean's Message

Executive Dean CSET,
Prof Alderton

Promoting interest in science through research is one of the ways that the College of Science, Engineering and Technology (CSET) has been engaging with school learners. For the college, this initiative is important to not only encourage a sense of interest in science, but to also expose students to proper ways of "doing" science. The learners work under the mentorship of a member of the academic staff on a predetermined topic and present their results at an annual summit. Thus far, the college has hosted three summits. The summit is hosted in collaboration with the College of Law as an attempt to infuse multidisciplinarity into this initiative. This edition contains the result of presentations from the 2015 summit. The learners focused on several topics, but mainly on light as the core theme. The college sees the publications as steps towards a periodical that will promote a science discourse amongst learners; a publication that will showcase the fact that it can never be too early to engage in research.

Prof I. Alderton

Executive Dean, College of Science, Engineering and Technology

LRS Chairperson Message

LRS chairperson, Prof Coleman

CSET at the University of South Africa (Unisa), engages with many communities as part of its community engagement initiatives aimed at promoting Science, Engineering, and Technology (SET) as a possible career choice to learners. The college does this in a variety of ways ranging from outreach initiatives to activities promoting engaged scholarship. The Learner Research Summit (LRS) is one such endeavour. The summit is not only aimed at promoting SET as a possible career choice to learners but focuses largely on fostering their research skills. The learners are given topics (from the summit themes) to research and the college's academics in collaboration with the College of Law's academics guide them through their research. This is done in partnership with the educators. This initiative is aimed at learners in grades 8 up to 11. CSET academics facilitate learners in the development of research skills investigating topics/projects relevant to the theme(s). Learners in collaboration showcase their innovative research projects/findings during a scheduled Learner Research Summit. During the Learner Research Summit, the learners showcase their findings through either an oral presentation or a poster presentation. The Learner Research Summit is now in its third year running, having started in 2013. The Learner Research Summits have been held at Unisa, Pretoria, Florida campuses and at EPP Mhinga High School in Malamulele, Limpopo Province. The main goal is that eventually the Learner Research Summit will transform into a national Learner Research Conference.

Prof A Coleman
LRS Chairperson

CSET Community Engagement Chairperson Message

CSET Community Engagement chairperson, Prof Dube

The Learner Research Summit is a Community Engagement initiative from the College of Science Engineering and Technology (CSET) together with the College of Law that in a way affirms the vision of UNISA, which is "The African University Shaping Futures in the Service of Humanity". This initiative was designed with the purpose of enabling young minds to think creatively and critically and also to have a desire to solve problems within their communities. LRS is a platform where young learners, both from high school and primary school, are drawn into the excitement of the world of research and discovery. In 2015 LRS celebrated its third year with yet another successful event where we saw a great improvement in the type of research work delivered as well as in the presentations that the learners delivered confidently to peers and academics from UNISA. Learners researched, under the mentorship of CSET academics and educators, within very critical and challenging topics of 'World Class Learning Unleashed", "Crystallography" and "Sustainable Energy". Despite the complexity of the themes, the learners gave very interesting views on the topics and delivered some excellent presentations. Such a platform is encouraged as it creates an exciting space of learning where the students are exposed to knowledge in an exciting way and they own the learning process as they view themselves as problem solvers. We believe that such an initiative will assist learners with their research work in their curriculum since they would have covered research methodology. This LRS publication serves as a confirmation of UNISA's commitment to engage with communities in studying natural sciences, and discovering and explaining fascinating phenomena.

Prof S Dube

CSET Community Engagement Chairperson

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Table of Contents

Solar Energy: Energy of the Future

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Abstract -*A regular car drives on fossil fuels that have been harvested from earth, causing much damage. All the greenhouse gases are emitted into our atmosphere causing holes in the ozone. How long will it take for scientists to take action? Globally, there are about 3.8 billion vehicles and altogether they produce about 75% of carbon emissions. An electric car wouldn't be much of a solution because you would have to recharge the battery with electricity and the manufacturing of electricity uses a lot of coal and still emits lots of carbon dioxide.*

Keywords: Solar energy, solar car, renewable energy

1 Introduction

1.1 Air pollution

Wherever we go, inside, outside, on top of a mountain, deep in a coal mine, you are always surrounded by a sea of gases called the air or the atmosphere. Without the atmosphere, people, animals and plants could not live. Air is said to be polluted when it contains enough harmful impurities to affect the health, safety or comfort of living things [6].

1.2 Renewable energy

Renewable energy is energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy could replace conventional fuels through the transformation of renewable energy into everyday usable energy. [1] Renewable energy is reliable and plentiful and will potentially be very cheap once technology and infrastructure improve. Research demonstrates that renewable energy produces only minute levels of carbon emissions and therefore helps combat climate change caused by fossil fuel usage [2].

1.3 Different types of renewable energy

- Solar: This form of energy relies on the nuclear fusion power from the rays of the Sun. This energy can be collected through solar collectors or attic cooling with solar attic fans for domestic use to the complex technologies of direct conversion of sunlight to electrical energy using mirrors and boilers or photovoltaic cells [3]
- Biomass: The type of energy harnessed from plants is hydrogen and fuel cells: These are not strictly renewable energy sources but are very abundant in availability and are very low in pollution when utilised [3].
- Wind Power: Wind energy can be used to pump water or generate electricity, but requires extensive areal coverage to produce significant amount of energy [3].
- Hydroelectric Energy: Hydroelectric energy is the type of energy that uses the gravitational potential of elevated water [3].
- Geothermal Power: Geothermal power is the type of energy left over from the original accretion of the planet and augmented by heat from radioactive decay seeps out slowly everywhere, every day [3].

2 What are solar cars and what makes them different from normal cars?

Solar energy cars are similar to other everyday cars in that they have the characteristics of a normal car. They have a body, wheels, a motor, brakes, seats and most important, some kind of fuel to make them run.

Solar cars are different only in the fuels that make them run. They are called solar cars for the reason that they use sunlight for fuel. [4].

2.1 Parts of the solar car include

- A motor
- Switch
- Wheels
- Gears
- Dash board
- Shafts
- Pinion
- Crocodile Clips

2.2 Different systems of a solar car [5]

- *Aerodynamics:* Solar powered cars are far more aerodynamic than your average street vehicle. A good aerodynamic shell is efficient, convenient and lightweight.
- *Mechanical Systems:* Mechanical systems in solar cars must be more lightweight and efficient than those made for ordinary vehicles.
- *Electronic Systems:* Electronic systems control the storage and use of all the energy in the vehicle. They must use very little power for anything other than powering the motor.

- *Composites:* Nowadays, a steel chassis is no longer in use. Steel is still used for the roll bar, but everything else is composites.
- *Solar Power:* A solar array is soldered and encapsulated. Just sourcing the materials to be able to pull of such a big job is no small feat in itself.
- *Strategy: As* the car is designed, model and simulate race performance as well as the performance of individual components such as the solar array.

3 Objectives

3.1 Importance of renewable energy nowadays and the problem with coal and oil

- *Environmental Benefits:* Renewable energy technologies are clean and sources of energy that have a much lower environmental impact than conventional energy technologies [7].
- *Energy for our children's children:* Renewable Energy will not run out ever. Other sources of energy are finite and will someday deplete [7].
- *Jobs and Economy:* Most renewable energy investments are spent on material and workmanship to build and maintain the facilities, rather than on costly energy imports [7].

The problem with oil and coal is that the air pollution from oil and coal is the cause of hundreds and thousands of deaths worldwide [8].
A conventional electric vehicle is a type of electric vehicle an internal combustion engine with an electric propulsion system [9].
A solar electric vehicle is an electric vehicle that is powered completely or significantly by direct solar energy [10].

4 Problem scope and specification

4.1 How Different Forms of Renewable Energy is used?

Wind Energy [11]

- Energy-generating-wind-turbines
- Wind-powered vehicles
- Wind/kite-powered cargo ships
- Wind-powered sports
- Wind-powered water pumps

Hydroelectric Energy [12]

- Storage of drinking water
- Fight climate changes
- Improves the air that we breathe

Geothermal Energy [13]

- Bring warmer temperatures into your home without using fossil fuels
- Drying fruits, vegetables, wood, wool
- Extracting gold and silver from ore

Biomass Energy [14]

- Direct combustion of biomass
- Charcoal production
- Production of liquid fuels (ethanol production in biodiesel)
- Production of gaseous fuel

Solar energy [15]

- Heat for making hot water, heat buildings and cooking
- Generate electricity with solar cells or heat engines
- Extracting salt from sea water

4.2 Relative benefits of the different types of Renewable Energy

Wind Power Energy [16]

- A clean fuel source
- Domestic source of energy
- Wind turbines can be built on existing farms or ranches
- Its sustainable
- Cost effective

Biomass (fuels) Energy [17]

- Cost benefits
- Easy to source
- Reduce greenhouse gases
- Economic security
- Reduce dependence on foreign oil
- Lower levels of pollution

Solar Energy [18]

- Financial savings
- Keeps our climate liveable
- Super water efficient
- Security
- Jobs and economy
- Peak power
- Energy independence

4.3 Limitations of a Solar Car

- *Speed and Power:* Solar power cars are designed to accelerate slower and reach lower maximum speeds [19].
- *Expensive:* Photovoltaic solar cells and the equipment required to convert sunlight to electricity is expensive, so the cost of a solar car will be much higher [19].
- *Power Storage and Consumption: When* a solar car is operated in low light conditions or after dark, it begins to consume power faster than it can be replenished. This means more power is necessary to operate these heavy vehicles thereby reducing their overall efficiency.

5 Literature review

5.1 How Solar Panels work

A solar panel is made up of many small solar cells [20]. Each of these cells uses light to make the electrons move. The cells are made up of two different layers stuck together. The first layer is loaded with electrons, so that the electrons are ready to jump from this layer to the second layer. That second layer has had some electrons taken away, so it is ready to take in more electrons[20].

When the light is absorbed by an electron in the first layer, the electron jumps to the second layer. That electron makes another electron move, which makes another electron move, and so on. The sunlight started the flow of electrons.

5.2 How the solar car works

The solar car is made very stable with strong wheels and rubber rings that hold the wheels stable to be able to ride over the rough ground. The panel absorb the energy, sends and charge to the motor, and moves against the pistons, which allows the car to move forward and if the wires are plugged in the opposite charge, the car will reverse.

5.3 How the car was made

- Assemble the car's apparatus and start planning the car.
- Fit the rubber rings on the outline of the wheels.
- Join a wheel to the side of a shaft and assemble the running gear up to the wheel of the shaft.
- The wheel and the shaft in the second hole will head of the car and the wheel with the running gear in the fifth hole from the back will be the rear of the car. Fix the other side of the wheels with another's wheels. Hammer it tightly onto the other end of the shaft.
- Test whether the car moves smoothly.
- Join the pinion gear to the motor with the projecting side to the motor.
- Insert the motor into the motor holder and fix it tightly on the bottom of the panel using the double sided tape.
- Position the small gear and the big gear to interlock. (it helps with the forward and reverse movement of the car).
- Check the solar panel with wires. The black wire is negative and the red wire is positive.
- Distribute the wires from the solar panel to the terminals of the motor. Insert the black wire to the negative charge and insert the red wire to the positive charge.
- Place the solar panel in a see-saw-like position (place it on the motor with the sticky square).
- Place the car on the ground of the angle, with the panel facing the sunlight. The car will move forward.

5.4 How solar cells work

Sunlight is composed of miniscule particles called photons, which radiates energy from the sun as the radiation of the sun heats the silicon atoms situation in the solar cells of the panel; they transfer their energy to loose (free) electrons, knocking them clean of the atoms.

5.5 How solar energy is converted to mechanical energy

Solar energy can be converted into mechanical energy through the use of various energy-efficient solar equipment like solar panels, solar heaters, solar cookers, solar cars and many such inventions. In all these devices, the sun's energy is harnessed in the form of sunlight, reflected using a reflector and converted into usable energy. Solar panels consist of a large number of solar cells arranged in a systemic manner.

The energy produced from solar radiations are widely used today for carrying out many mechanical works [26].

5.6 Solar panel efficiency

The energy conversion efficiency of a solar cell is the percentage of the solar energy to which the cell is exposed that is converted to electrical energy [27]. By conversion, solar cell efficiencies are measured under standard test conditions unless stated otherwise. STR specifies a temperature of 25°C and an irradiance (G) of 1000 w/m² with an air mass 1.5 spectrum. These conditions correspond to a clear day with sunlight incident upon a sun facing 37° tilted surface with the sun at an angle of 41.81° above the horizon. This represents solar noon near spring and autumn equinoxes in the continental United States with surface of the cell aimed directly at the sun. Under these test conditions a solar cell of 20 V efficiency with a 100cm² ((10cm) ²) surface area would produce 20 W.

According to research, the efficiency of the solar cells used in a PV system in combination with latitude and climate, determines the annual energy output of the system. For example, a solar panel with 20% efficiency and an area of 1m² will produce 200 W at STC, but it can produce more when the sun is high in the sky and will produce less in cloudy conditions and when the sun is low in the sky.

5.7 Different types of crystals used in Solar Panels

There are three basic types. *Monocrystalline* cells are cut from a silicon ingot grown from a single large crystal of silicon whilst *polycrystalline* cells are cut from an ingot made up of many smaller crystals [21]. The third type is the *amorphous* or *thin-film* solar cell [21].

5.8 Benefits of the different Solar Panels

Monocrystalline [22]

- Longevity
- Efficiency
- Lower installation costs
- Embodied energy
- Great heat resistance
- More electricity
- Bankability

Polycrystalline [23]

- Lower per panel costs
- Durability and longevity
- Environmental enhancements
- Lower electric bills

Thin-film [24]

- Versatility
- Flexibility
- Good performance in indirect light
- Good performance in high heat

5.9 How much energy the Solar Panels provide [25]

The amount of electricity a solar panel produces depends on three main things: the amount of sunlight hitting the panel, the size of the panel, and the efficiency of the solar cells inside.

A typical solar panel produces around 200 watts of power. There's a little bit of variation on this, bases on the size and efficiency of the solar panel you choose; you'll see panels that produce 205, 210, even 230 watts.

The amount of power needed to drive a solar car on the road depends on the weight of the vehicle. The lighter the vehicle the less power is used and the farther the vehicle will travel.

6 Problem solution options

The invention is created to advance our world with the intention of not causing any damage that would delay and diminish our natural resources. A solar car travels the same speed as a regular car with its main source of energy from our natural sunlight and input force on the power of the gears and pistons.

6.1 Testing and reliability

We can test the solar car by putting it outside in direct sunlight which causes the car to move. Or, it can be testing indoor if you replace the sunlight with a strong portable light. For best results the portable lamp must have at least a 120 Watt bulb and a reflector.

Solar car components include solar array and power trackers, batteries, motor and controller, instrumentation, steering and suspension, brakes and the tires and hubs.

The solar panel works because the silicon cells absorb radiation from the sun. The motor heats because it gets energy from panel through the crocodile clips. The wheels need a pinion and gear interlocking in order to move. The car also needs a switch in order to go and stop.

7 Conclusions

In order to improve our research, we need an axel to allow the car to turn and a sensor, in order to prevent hazards and accidents amongst solar cars.

8 Recommendations for further study

The popularity of solar cars is gaining significant ground. Lately, through gasoline fuelled cars still prevent in automotive market. Solar cars are cars that are powered by solar energy. The cars feature solar panels on the upper surface. The role is to convert sunlight into electrical energy.

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Solar Energy Car: A better Option for the Future

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Abstract-*This paper presents the results of the model solar car performance results. In the analysis, the learners compared performance of solar car at different tilt angle. To eliminate experimental errors, both these tests were done at the same time.*

Keywords: solar energy, electric cars, sunlight

1 Introduction

Worldwide, more than 90% of the transport sector is powered by fuels derived from oil. However, the consumption of diesel and petrol is considered problematic due to costs of oil, doubts about of security of oil supplies [1], greenhouse gas (GHG) emissions, and the emissions of air pollutants such as NOx, PM10 and volatile organic compounds.

As the demand of modern transport increases, the suppliers are forced to increase production of vehicles in order to meet the demand. In addition, high production of modern transport also increases pressure of fuel supply. Unfortunately, there is an increase in air pollution as a result of combustion of fuel gas that produces carbon monoxide, which is very harmful to the ozone layer.

The modern transport depends on non-renewable energy such as coal and petrol. Non-renewable energy within time will run out and therefore there is a need to look at other ways of fuelling the vehicle. Currently there is a research going on looking at alternative ways to fuel the car. Countries like USA have designed hybrid cars that run both using petrol and electricity. Universities are researching on biofuel as a way to go and others are researching on solar energy car.

This research work will look at using solar energy to fuel the car. The aim of this research is to check if the position and size of the solar energy panel affect the speed of the solar car. The following topics will be addressed, literature review on what other researchers have discovered regarding the research question, the methodology on how the research will be carried out, the results, and conclusion and recommendation.

2 Objectives

The objectives of this study are:

- To understand which energy is preferred by people to fuel a vehicle
- To see how the position of the solar panel affects the speed of the vehicle
- Explore clean energy by researching and discussing solar power as an energy source for vehicles
- Show that solar energy can be easily collected and converted to electrical energy

Does the tilting of solar panel have an effect on the production of electricity? It is true that the position of the panel have an effect on the production of electricity. The ideal position of the solar energy panel is “when the sun is hitting the panels at a perfectly perpendicular angle (90 degrees) [2]. This explains why the solar panel is place on the top car to ensure the sun will hit it at an angle of 90 degrees.

The following research questions were tested:

- Did the angle of the solar panel affect the performance of your solar kit car?
- Why the angle of the solar panel affect the performance of your solar kit car?
- How does the sun power your car?
- Can one create a histogram of the solar car results and discuss the distribution?
- What factors affect how fast each solar car kit travels?

3 Literature review

Sun powered auto rely on upon a sun oriented cluster that utilize photovoltaic cells (PV cells) to change over daylight into power [3]. When daylight (photons) strike PV cells, they energize electrons and permit them to stream, making an electric current. PV cells are made of semiconductor materials, for example, silicon and composites of indium, gallium and nitrogen. Crystalline silicon is the most well-known material utilized and has an effectiveness rate of 15-20%. The primary sunlight based family auto was implicit 2013. Researchers at Case Western Reserve University have additionally built up a superior sun based auto which can revive faster,

because of better materials utilized as a part of the sun oriented boards [4].

Sunlight based auto just keep running on sun based force from the sun. They are extremely steady and can come in various sizes. To keep the auto running easily, the driver must watch out for this gage to spot conceivable issues. Auto without gage quite often highlight remote telemetry, which permits the driver's group to screen the auto's vitality utilization, sun powered vitality catch and different parameters and in this manner liberating the driver to focus on driving. Solar autos join innovation commonly utilized as a part of the aviation, bike, elective vitality and car businesses. The configuration of a sunlight based vehicle is extremely constrained by the measure of vitality contribution to the auto. Most sunlight based autos have been worked with the end goal of sun based auto races.

Solar energy car is the electric car that uses the sun to charge the battery for it to move. Do the size, quality and the position of the solar panel has an effect on the speed of car?

According to [5], "efficiency quantifies a solar panel ability to convert sunlight into electricity". It means that the more efficient panel is, the more it will produce electricity compared to the one with less efficient panel. It can be concluded than the efficiency of the panel play the important role to fuel electricity for the solar energy car.

4 Methodology

Learners use engineering design principles to test a fully solar powered model car. Several options exist, but the Junior Solar Car Kits was purchased by Mechanical engineering department, UNISA. Learners were provided with a photovoltaic panel that produces ~3V at ~3W. The solar kit had the following accessories wheels, axles, drive gears and solar panel. A chassis was built additionally using wood that provides an excellent body light weight. The testing of the solar car culminates in a solar race between classmates.

Figure 4.1 shows two solar prototypes that were used to test whether the position of the solar panel has an effect on the speed or not The following components were used to build the solar car; four wheels, solar panel with crocodile clips, rubber rings, running gear, motto, and shaft and motto holder. The other apparatus used is stop watch and measuring type. One prototype car, the solar panel was standing at 45 degrees and the other car it was laid flat on the surface of the solar car as shown in figure 4.1. The two cars were place on a track and released at the same time. It was done several times to see the effect of the position of the panel.

Figure 1: Two solar cars

4.1 Materials List

Solar car and accessory kit): The kit and its accessories were brought from the supplier and the following materials:

- solar panel
- 2 axles
- 4 wheels (sized to fit axle)
- driving gear (sized to fit axle)
- electric, DC powered motor
- different gears for motor
- drill with bits is also needed to help size gears to fit axles

Chassis materials:

- balsa wood – flat 40x 80 mm boards
- wood glue

5 Results and discussion.

It was observed that both cars moved at the same speed. That is the car with the solar panel at 45 degrees and the one at 90 degrees they both cover the same distance at the same time as shown in figure 5.1.

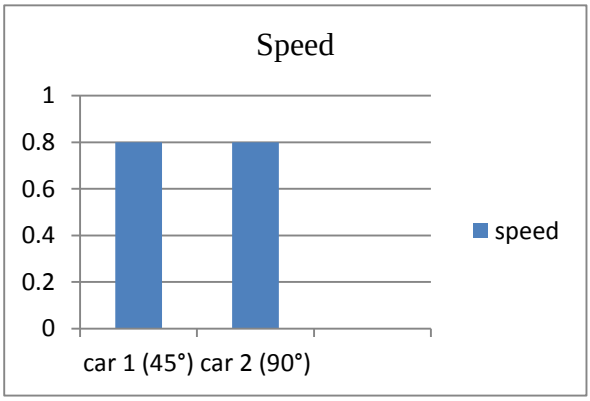

Figure 2: Graph of the results

6 Conclusion

During the experiment it was concluded that the position of the solar panel has no effect on the speed of the solar car. However, other researchers reveal that the position of the solar panel is crucial. Therefore it means that more experiments has to be done again to confirm if the position of the solar panel has no effect on the speed of the solar car.

7 Acknowledgements

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Optical Vision and Light: Measuring the Ability of Individual Eyes to Read

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Abstract - *Please consider these Instructions as guidelines for preparation of Final Camera-ready Papers. The Camera-Ready Papers would be acceptable as long as it is formatted reasonably close to the format being suggested here. Note that these instructions are reasonably comparable to the standard IEEE typesetting format. Type the abstract (100 words minimum and 150 words maximum) using Italic font with point size 10. The abstract is an essential part of the paper. Use short, direct, and complete sentences. It should be brief and as concise as possible.*

Keywords: Light, human eye

1 Introduction

Light is the natural agent that stimulates sight and makes things visible. In this case, light expression in someone's eye indicating a particular emotion or mood.

People see differently. Some need spectacles to view different things and some do not. That is due to the difference in visual acuity amongst individuals. It is the difference in visual acuity that prompted the present research. The idea was to know the effect of light on eye vision as perceived by the two eyes individually.

2 Visual perception

The human eye is an organ which reacts to light for several purposes. As a conscious sense organ, the eye allows vision. It allows light perception, vision, colour differentiation and the perception of depth.
Visual perception is the ability to interpret information and surroundings from visible light reaching the eye. The resulting perception is also known as eyesight, sight and vision. The various physiological components involved in vision are referred to collectively as visual system.

The visual system in humans allows individuals to assimilate information from the environment. The act of seeing starts when the lens of the eye focuses an image of its surroundings onto a light-sensitive membrane in the back of the eyes, called the retina. The retina converts patterns of light into neuronal signals.

3 Hypothesis

The two eyes of a human being are not balanced in terms of vision. It is assumed that the left eye perceived images differently compared to the right eye. In addition to this, it is believed that the two eyes of a human being do not have the same reading ability. The present work attempts to test whether this hypothesis is true or not and to what extent.

4 Experiment

We measured the visual acuity of the left and right eye separately. We used the Snellen chart for the purpose. The Snellen chart is an eye chart that can be used to measure visual acuity. Figure 1 illustrates the particular Snellen chart that was used for this research. The test page in Figure 1 was printed in A4 standard format. The candidate was placed 2.8 meters (or 9 feet) away from the chart. If you wish to the test facing the screen, you will have to calculate the distance at which you must stand facing it, using the following formula: measure the height of the first letter "E" (see Figure 1) in millimetres. Then divide the value of this measurement by 88. Finally, multiply it by 6. The results show the distance at which you must be placed, in meters.

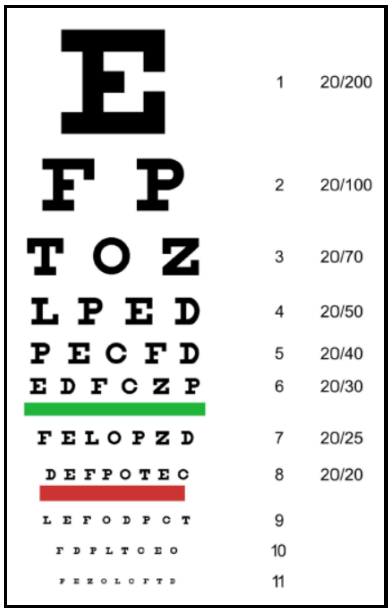

Figure 1: The Snellen chart used for the eye test

Now in order to test both eyes individually, i.e. one eye at a time, start with the right eye, covering the left eye without pressing on it. Then, examine the left eye by doing the opposite. If you are using correction glasses, you can cover the eye with a sheet of paper.

Read the letters from the largest to the smallest. If you can read the letters of the 8th line, your sight is optimal. Here, note that the optimal sight is 20/20 as shown in Figure 1. If this is the case, the eye is said to have a visual acuity of 20/20.

If your visual acuity is less than 20/20 or if you have doubts about your sights, visit your ophthalmologist.

5 Results

The bar chart in Figure 2 shows the level of visual acuity of both eyes as well as how far the right eye and left eye could see.

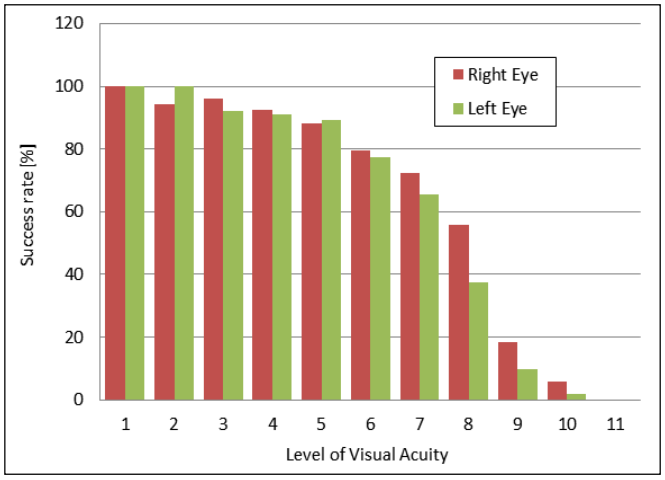

Figure 2: Ability of left and right eyes to read the Snellen chart as measured amongst the participants

From our observations, we realise that everyone that was part of the test was able to correctly read the largest font using the left or right eye.

With the second largest letter, the success rate was the highest with the left eye. In other words, the left eye rated far much better than the right eye.

On the lower extreme, very few people (less than 20% of the participants) could read the four smallest letters on the scale. At level 11 on the Snellen chart (see Figure 1), no participant could read the smallest letter on the scale.

We then compared the performance between the left eye and the right eye. In the majority of the tests carried out the right eye performed better than the left one. This can be seen on the line graph in Figure 3 where the performance of the left eye is plotted alongside that of the right eye.

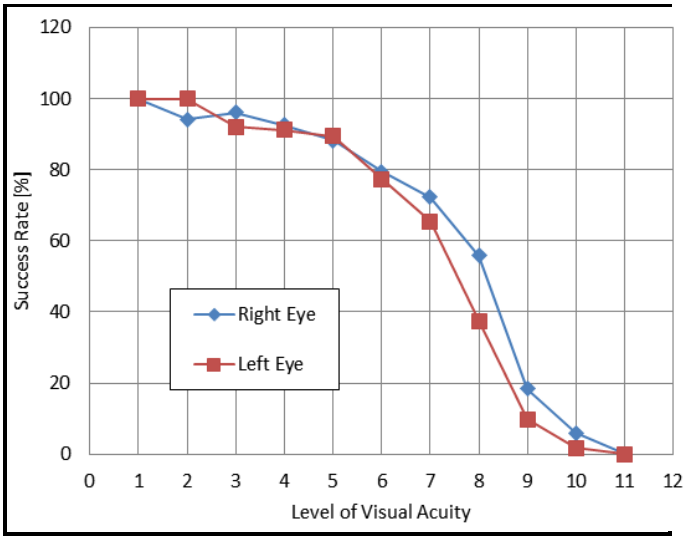

Figure 3: Comparison of the reading ability of the two eyes from the eye tests done on the participants

6 Conclusion

The right eye sees much better than the left eye when we start with the left eye. This means that our eyes are not balanced in terms of vision, this means that the right eye reflect light better than the left eye. Therefore the hypothesis has been proven to be valid.

7 Acknowledgement

As Edward Phatudi Learners, we would like to thank the College of Science, Engineering and Technology (UNISA) for inviting us to be part of the summit. We also acknowledge our mentor, Prof Francois Mulenga, who has been there for us.

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Light Support All Aspects of Life

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[1]Department Name, University Name, City, State, Country
[2]Department Name, Company / Institution Name, City, State, Country

Abstract -*We all know that without light life would be difficult to live, because we need light in our everyday life. Mark my word ''need'' not ''want'' light can do so much for us where as some we can't recognize. Did you know? With light we can see things, we can heat ourselves and homes, and plants can make their own food with the process called photosynthesis. The purpose of this research is to present and display to you how light support all aspect of life. A preliminary qualitative research highlight the notion that light from the sun is a source of life and therefore light supports all aspect of life. This research will use numerous examples to present support to the topic of this research and to bring to light the example of aspect of life that supported by light. This research will also present suggestion of technology that uses light to support life.*

Keywords: A Maximum of 6 Keywords

1 Introduction

Dieter Broers and Prof.Alexsandr stated that light affects our lives to a much large extend than what we have been aware of so for. Undoubtedly so our sun determines our life and without the light there would be no life on earth as the sun creates and sustains life. Sun light has an influence on human life that goes beyond the physical and biological aspect, For example, the sun influences our emotions and our consciousness whereby this influence extends to the point that one could ever ask whether it may be, possible that the sun determines our collective destiny?. If we include all available scientific data into an equation, this question can be answered with a clear and definite YES.

2 Background

Our approach to the research is the five (5) W's and H.

2.1 Who discovered light?

Light was never discovered, a multitude of scientists worked over many generations to develop the understanding of the light we have today. The Greek Euclid and hero in the first century realized that light travelled in a straight line

2.2 Where does light come from?

According to Dr Eric Christian light comes from the sun and other stars that produce huge amount of heat and light through fusion and that are the sources of most visible light in the universe.

2.3 What is light made of?

Gregory Smith said that light is generally produced via the same mechanism : electrons changing their orbits around nuclei.

2.4 What light are we talking about ?

We are talking about visible light, which is visible to the human eye and is responsible for the sense of sight and our research concentrated on the sunlight.

3 Methodology

We have two similar names which are method and methodology and they differ in meanings.

Method: is a particular procedure for accomplishing or approaching something especially in a system

Methodology: is a systematic theoretical of the method applied to a field of study in a research design we found that they are two types of method that are discovered quantitative and qualitative and our research has chosen qualitative method.

Qualitative method is a research about exploring issues understanding phenomena and answering questions by analysing and making sense of unstructured data.

In qualitative methodology there are many methods to be mention but we choose only a few which is phenomenology, grounded theory, ethnography and case study, we have decided to adopt the case study method.

The data collected tools in the case study of the qualitative method are as follows:

- Solar panels
- Meter readings
- Plants

Research tools like

- Observations
- Field note
- Social network(WhatsApp, Facebook and Twitter)

Qualitative methodology allows multiple tools to be used together and this is called triangulation, we are going to

triangulate data analysis, observations and field note in this research study.

3.1 Experiment (1)

Photosynthesis: Light energy comes from the sun to the plants the leaves of the plants absorbs the energy that comes from the sun. The leaves also absorb the CO2 which is also known as carbon dioxide. The glucose that is released into the air as a by-product which means oxygen is produced into air and obviously when we water the plants the roots absorb water.

How does photosynthesis affect life today?

- Photosynthesis provide food directly to plans and as a by-product it creates oxygen which is needed to get most energy from that food/plants turning it back into water, carbon dioxide and energy almost all on earth depends either directly or indirectly on photosynthesis most of energy used by humans to power our modern society comes from fossil fuels whose energy was harnessed from the sun by photosynthesis
- We eat fruits and vegetables which grows from photosynthesis
- Without fruits or vegetable we wouldn't be alive
- Some of the animals do eat plants and we eat some of those animals

3.2 Experiment (2)

Solar panels: Light is truly the messenger to the universe…
Solar power is the conversion of sunlight into electricity either directly using photovoltaic (PV) or indirectly using concentrated solar powers (CPS)
The question is:

How does solar panel convert sunlight into electrical current or power?

- It is well known that the sun that we use as the main power for light outside our house is the same main power that solar panels receive power from.
- Therefore the solar panels transfers direct current to the inventor, from the inventor transfers alternative current to fuse box and as you can see the fuse box is connected to household applications and the meter box which transfers it to the grid that is most know as electric [poles for our street to have light and glow when it is dark.
- Back to the sun we can see that the sun gives of light so that we can see when we are outside and also helps to provide power to the solar panels which gives us electricity.

Note that If we had solar in our houses the wouldn't have been the so called ''LOAD SHEDDING'' therefore light is the key to our smooth life

4 Findings

Throughout our research we have found that:

- Light energy can be used and harnessed as solar energy
- By using it as solar energy we can be able to eradicate the use of coal and decrease air pollution
- Light energy led to efficient solar panel systems that create electricity without producing global warming crisis
- Light energy in means of solar energy can save tons of Rands.

5 Recommendations

Light does support all aspects of life. Since we have load shedding problems we recommend that people start using light from the sun as a source of electricity

- The national government offers incentives that help offset the cost of installation so that a consume can realize energy savings more quickly according to Christine Tusher, solar panels can be used to generate a portion of your homes power in order to reduce your dependency on traditional power source for instance you can install panels to provide electricity and to reduce or lower your bill
- According to Christine Tusher installing solar panels can decrease your house hold carbon footprint by an average of 34,180 pounds for an example in Germany one gets an extra allowance for a solar energy that one consumes directly in the house instead of saving it in the public power grid how clever is that
- Despite the competitive disadvantage that solar energy technologies have right now, availability of ''free sunlight'' will remain a driving force behind the development of new ideas that can make solar power more affordable in the future

6 Conclusion

- In conclusion according to Elizabeth Anne VIau (Platinum.1999)
- Without the sunlight there would be no life on earth
- The suns energy warms the planet the weather and the water cycle, and makes it possible for plants to grow
- The sun provide external energy source which is stored in the plants through the photosynthesis like my colleague have said through photosynthesis food is found for all the animals in water and on land the remains of quantic land animals form the base of minerals and these minerals are the foundation of precious metal such as diamond, gold and coal therefore the wouldn't be life without the sun
- Elizabeth Anne Vlau (Platinum.1999) further explain that the solar energy that energizer the plants goes on

to become the fuel that allows animals to live grow and industrial societies to flourish

- The trees absorb sunlight and convert it into new energy sources and oxygen
- Fossil feedstock's are created
- In the conversion of those fossil feedstock's, fuel ,electricity and chemical products are formed and used for transportation , industrial, economy e.c.t which sustains our lives

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Light Pollution

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Abstract - *Research is focused on finding what light pollution is, types of light pollution, and effects of light pollution on our wildlife, climate and even humans. An investigation was conducted to see the effects of artificial light on the observation of stars. Ways to prevent light pollution are also included*.

Keywords: Light Pollution, Glare, Light Trespass, Skyglow, Light clutter, Artificial Light.

1 Introduction

Ever wondered why we never see a sky lit with stars? Or why we only see so many stars when we are in the rural areas? These are some of the questions we asked ourselves while doing this research task and what we found was quite amazing. To answer the previous questions, the only thing to blame is Light Pollution. Light Pollution, according to Wikipedia [1], is excessive, misdirected or obtrusive use of artificial lighting. The Oxford dictionary [2] says it is the brightening of the night sky caused by street lights and other man - made sources, which has a disruptive effect on our natural cycle and inhibits the observation of stars and other planets. To sum up these two definitions light pollution is the use of too many artificial lights which are unshielded. As mentioned previously in one of the definitions light pollution affects the observation of stars, but it also has some serious consequences for wildlife, climate and humans.

2 Literature review

2.1 A brief history of light

In 1802, Sir Humphry Davy invented the platinum filament light, but it produced light for a short period of time and was much too bright for practical use. On 24 July 1874, a Canadian patent was filed by Henry Woodward and Matthew Evans for a lamp consisting of carbon rods mounted in a nitrogen-filled glass cylinder. They were unsuccessful at commercializing their lamp and sold rights to their patent to Thomas Edison in 1879.

With the help of this patent Thomas Edison began serious research into developing a practical incandescent lamp in 1878. The first successful test was on the 22 October 1879 and it lasted 13.5 hours. Edison and his team later found out that a carbonized bamboo filament could last more than 1200 hours. Later on Edison and Swan (another scientist that created the light bulb) companies merged into the Ediswan Electric Company and incandescent lamp was sold all over America. It was from the likes of Edison and Swan that the evolution of light bulbs occurred. In the 20th century every household has at least 5 light bulbs, making it the most successful form of business in the consumer/producer industry.

The very same light that lights up our homes at night is now another contributing factor to the depletion of this earth of ours. This is light pollution.

2.2 Types of light pollution

The various types of light pollution are discussed below [3]:

1. *Glare*- excessive brightness that causes visual discomfort. According to Bob Mizon, coordinator of the British Astronomical Association Campaign for Dark Site, glare can be categorized into two main types.

- Disability glare- This describes effects such as being blinded by oncoming car lights.
- -Discomfort glare- The effects of not being able to see properly due to excessive bright light, if this form of glare is experienced over an extended period of time it could cause potential fatigue.

2. *Light Trespass*- Light falling where it is not intended or needed. It occurs when unwanted light enters one's property, for instance, by shining over a neighbour's fence. A common light trespass problem occurs when a strong light enters the window of one's home from the outside, causing problems such as sleep deprivation or the blocking of an evening view.

3. *Skyglow*- This refers to the glow effect that can been seen over populated areas. It is a combination of all the lights reflected from what it has illuminated escaping up into the sky.

4. *Light Clutter*- This type of light pollution is commonly mistaken with sky glow. Light clutter refers to the excessive groupings of lights. This type of grouping of lights may generate confusion, distract from obstacles and potentially causes accidents.

Figure 1: Shows light cluttering in Las Vegas, Nevada strip.

2.3 Effects of light pollution

This section discusses the effects of light pollution.

1. Light pollution poses a serious threat to nocturnal wildlife, having negative impacts on plant and animal physiology. It can confuse the migratory pattern of animals; alter competitive interactions of animals, change predator-prey relations, and cause physiological harm. The rhythm of life is orchestrated by the natural diurnal patterns of light and dark; so disruption of these patterns impacts the ecological dynamics.

2. With respect to the adverse health effects, many species, especially humans, are dependent on natural body cycles called circadian rhythms and the production of melatonin, which are regulated by light and dark (e.g., day and night). If humans are exposed to light while sleeping, melatonin production can be suppressed. This can lead to sleep disorders and other health problems such as increased headaches, worker fatigue, medically defined stress, some forms of obesity due to the lack of sleep and increased anxiety. Links to different types of cancer have also been reported. There are also effects of glare on aging eyes.

3. With respect to energy, in 2010, the UN stated that "For the first time in history, more people live now in urban than in rural areas." This means that lighting is responsible for at least one-fourth of all electricity consumption worldwide. Over illumination can constitute energy wastage, especially upward directed lighting at night. Energy wastage is also a waste in cost and carbon footprint which contributes to climate change caused by global warming.

3 Investigation done by NASA

An Investigation was conducted by NASA and Google Maps to see the effects of artificial lighting on the observation of stars. Investigation question- Does artificial lighting have an impact on the visibility of stars and other planets?

Hypothesis- Artificial light has an impact on the visibility of stars.

Method- A picture of a residential home with their outside lights on was taken. The picture also showed the sky and the visibility of stars. Another picture was taken during the 2003 Northeast blackout, a massive power outage that affected 55 million people. The picture again showed the sky and the visibility of stars.

Observation- It was observed that in the first picture the stars were not visible and that the sky seemed as if it was glowing. In next picture it was observed that the stars were in abundance and the sky did not glow.

Figure 2: Images taken of the same home with and without the lights on. (Pictures taken by Todd Carlson [Source 5]).

To conclude the investigation it was agreed that artificial light affects the observation of stars. It also showed us that, unlike many other forms of pollution, light pollution is reversible and each one of us can make a difference.

4 Ways to prevent light pollution

As mentioned previously, light pollution is reversible. Just being aware that light pollution is a problem is not enough; the need is for action. You can start by minimizing the light from your own home at night. You can do this by:

- Only using lighting that is needed
- Using energy efficient bulbs
- Installing motion detector lights and timers
- Properly shielding outdoor lights
- Keeping your blinds drawn to keep light glow inside
- Driving with dim headlights to make it easy for other drivers
- Becoming a citizen scientist and helping to measure light pollution
- Spreading the word about light pollution, many people don't know about light pollution or don't understand a lot about it.

5 Conclusions

This paper has discussed everything there is to know about light pollution. From what light pollution is, types of light pollution, effects of light pollution, investigation, and ways to minimize light pollution. In conclusion we would love to say; we must serve our fellow humans and the idea of life itself, as best as we can- we must strive to create a world in which people live healthy and productive lives without destroying the biodiversity on our precious Earth. We do this by preserving our beautiful night sky to inspire future generations to write poetry like Shakespeare, songs and paint beautiful portraits like Van Gogh.

6 Acknowledgement

The authors would like to thank UNISA's College of Science, Engineering and Technology, for inviting them to be part of the research summit. Special thanks to the mentors for the great time and learning experience.

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Light beyond the Bulb

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Abstract - *The International Year of Light and Light-Based Technologies (IYL 2015) is a global initiative adopted by the United Nations to raise awareness of how optical technologies promote sustainable development and provide solutions to worldwide challenges in energy, education, agriculture, communications and health. The goal of IYL 2015 is to highlight to the citizens of the world the importance of light and optical technologies in their lives, for their futures and for the development of society [5]. Due to the situation in South Africa regarding load-shedding of electricity, we embarked on addressing this serious issue affecting the lives of South Africans. In this research study we investigate solar light-based technology. Using a model of a solar light bulb, we investigate how the solar bulb charges and stores energy in a plastic bottle filled with water. We will evaluate the effectiveness of solar light using the model and determine the advantages and disadvantages of this solar light bulb. Furthermore, we will pursue the impact that this solar light bulb will have on our communities.*

Keywords: Light, solar, load-shedding, community, consumption, green buildings.

1 Introduction

As South Africa is being faced with a shortage of electricity, and "load-shedding" has become a day-to-day reality, we wish to investigate an alternative source of light which will be both cost effective and efficient in providing light in our homes. Load-shedding occurs when people put a high demand on electricity consumption which cannot meet the present capacity.

As can be seen from Figures 1 and 2, solar energy seems to be a natural alternative source in South Africa due to the vast amount of sunlight which we credit to the position of South Africa in the southern hemisphere. We are therefore proposing a way to bring it into our homes.

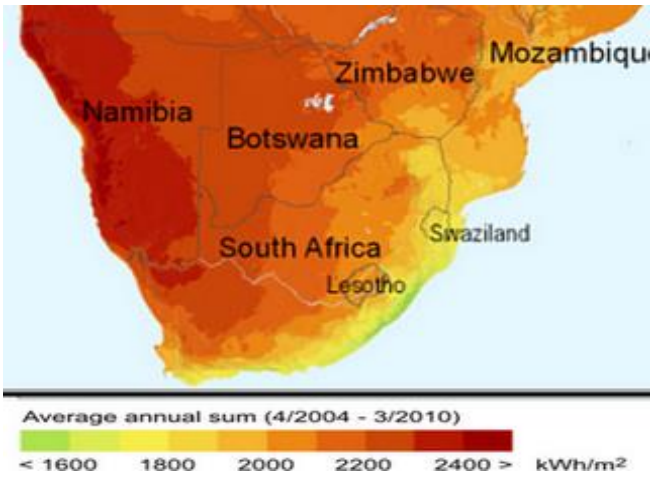

Figure 1: Sunshine intensity in South Africa

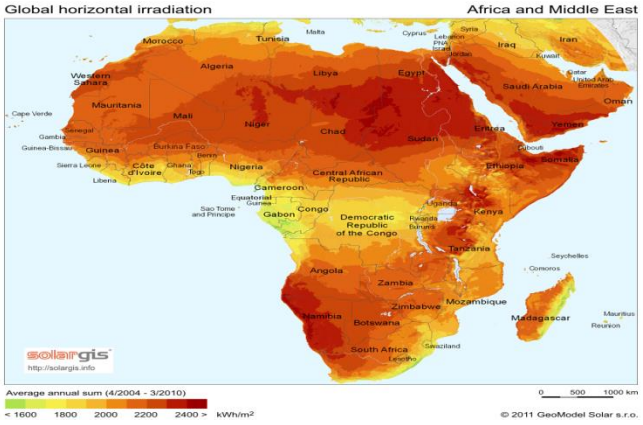

Figure 2: Sunshine intensity in Africa

2 Literature review

In 2002, Alfredo Moser, a Brazilian mechanic, came up with a way of illuminating his house during the day without relying on electricity [4]. Based on his idea of a plastic bottle filled with water being used to radiate solar light, we designed a "solar light bulb" [1]. The solar light bulb is a bulb that uses water and sun as its source of energy.

The solar light bulb relies on the Refraction Principle or Snell's Law, stating that the ratio of the sines of the angles of incidence and refraction of a wave are constant when it passes between two given media [3]:

$$v_1/\sin \theta_1 = v_2/\sin \theta_2$$

where v_1 = velocity of incident light;

v_2 = velocity of refracted light;

Θ_1 = angle of incidence;

Θ_2 = angle of refraction

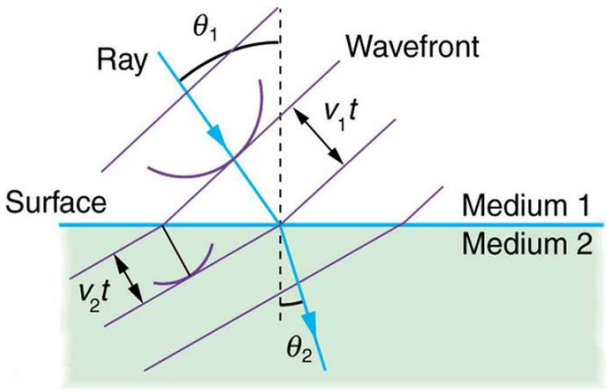

Figure 3 [Source 3]

3 Aims and objectives

- To determine the effectiveness of the solar light bulb.
- To determine the environment where the solar light bulb can be used.
- To determine the economic value of the solar light bulb.
- To determine how the solar light bulb charges.
- To determine how the solar light bulb helps in developing green buildings.

The following was the main research question:

Is the solar light bulb a solution to load-shedding?

4 Hypothesis

The solar light bulb can be used by communities as an alternative for electricity consumption, and will also be a source of light during the periods of load-shedding.

5 Methodology

Figure 4 shows the apparatus that were used in this experiment and Figure 5 shows the experiment in progress.

Table 1: Data collection

DATES	COLLECTING DATA
02 August 2015	Brain storming concerning our research and went to the library and used the internet
04 August 2015	We met as a group to interpreting our data
05 August 2015	met our mentors and discussed our findings with them
21 August 2015	We analysed and concluded with the research
27 August 2015	We typed our research on a power point

Figure 4: Apparatus

Figure 5: Experiment in progress

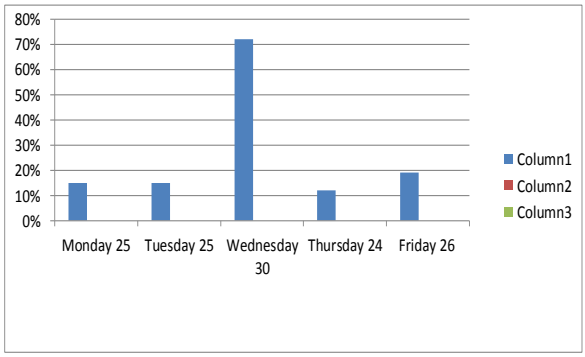

Figure 6: Results

6 Advantages and disadvantages

Advantages

- Sustainability
- Safety
- Cost-Effective

Disadvantages

- Water is a natural medium for algae and microbes
- Climatic conditions

7 Recommendations

We can overcome our disadvantages by charging both the bulb and the converter. The converter stores energy and releases it when experiencing rainy and cloudy weathers for the charging of the solar light bulb. The design of the solar light bulb can be modified on a larger scale to suit industrial, agricultural and other bigger buildings.

8 Interpreting Data

This innovation provides free energy without carbon emissions and is environmentally friendly. The carbon footprint of manufacturing one incandescent bulb is 0.45kg CO2. A 50 watt light bulb running for 14 hours during the daytime has a yearly carbon footprint of 200kg CO2. Moreover, approximately 90 percent of the power consumed by an incandescent bulb is emitted as heat rather than visible light. As per calculations, 15000 water bulbs at 200kgs will reduce pollution at 3 million kgs for a year of use [2].

10 Conclusion

The solar light bulb can be used by communities to reduce electricity consumption and be useful during periods of load-shedding. Taking our recommendations into consideration, the solar light bulb is a reliable and alternative source of light which will be both cost effective and efficient in providing light in our homes. It also reduces our dependency on electricity and helps develop greenhouse buildings.

11 Acknowledgements

The authors would like to thank the following for their support during the research:

- Dr Belinda Huntley
- Dr Tega Ighedo
- Department of Mathematical Sciences, Science Campus, Unisa

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Electromagnetic Radiation

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Abstract - *Electromagnetic radiation (EMR) is a form of energy that is produced by oscillating electric and magnetic disturbance, or by the movement of electrically charged particles traveling through a vacuum or matter. EMR consists of electromagnetic waves, which are synchronized oscillations of electric and magnetic fields that propagate at the speed of light. The oscillations of the two fields are perpendicular to each other and perpendicular to the direction of energy and wave propagation, forming a transverse wave. This paper is an investigation on electromagnetic radiation and waves. It is consistent of the formation of the radiation, description and uses of each EM wave, the negative implication along with solutions on how to combat the implications and the benefits of EMR.*

Keywords: EMR, electromagnetic spectrum, UV, EM waves, wavelength, frequency.

1 Introduction

Electromagnetic Field (EMF) and waves are an important and main media to carry signals from a certain source to the desired destination; this signal can be voice, data or image. The EMF is propagating at the speed of light in free space (300,000km/s) so it can be modulated, transmitted and received while conveying the necessary information. EMR is a form of energy emitted and absorbed by charged particles, which exhibits wave-like behaviour as it travels through space. The electric and magnetic fields come at right angles to each other and combined wave moves perpendicular to both magnetic and electric oscillating fields thus the disturbance.

Electron radiation is released as photons, which are bundles of light energy that travel at the speed of light as quantized harmonic waves. This energy is then grouped into categories based on its wavelength into the electromagnetic spectrum. These electric and magnetic waves travel perpendicular to each other and have certain characteristics, including amplitude, wavelength, and frequency. (UC Davis ChemWiki, 2015).

The general properties of all electromagnetic radiation are as follows:

- Electromagnetic radiation can travel through empty space. Most other types of waves must travel through some sort of substance. For example, sound waves need either a gas, solid, or liquid to pass through in order to be heard.
- The speed of light is always a constant. (Speed of light: 2.99792458 x 108 m s-1)
- Wavelengths are measured between the distances of either crests or troughs.

2 Formation of electromagnetic waves

Electromagnetic fields occur when electric and magnetic fields couple together. These fields align perpendicular to each other as the electromagnetic radiation travels at a point. Electromagnetic fields have their own alignment called polarization, which scientists can measure. Light is another concept that further exemplifies electromagnetic radiation. Light, which is made up of photons, shows how electromagnetic waves can have both wave-like and particle-like properties. Light can be reflected into a spectrum to analyse its wave-like properties, which scientists can also use digital cameras to capture the particle movements of photons liberations electrons. Light has its polarization as well, another feature of electromagnetic waves. This is why sunglasses can reflect light while still having visibility. Sunglasses are able to eliminate the harmful glare of sunlight by absorbing the polarized portion of light. For a mathematical standpoint, electromagnetic energy is made up of three parts; namely frequency, wavelength and energy.

3 Electromagnetic spectrum

EM radiation spans an enormous range of wavelengths and frequencies. This range is known as the electromagnetic spectrum. The EM spectrum is generally divided into seven regions, in order of decreasing wavelength and increasing energy and frequency. The common designations are: radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays. Typically, lower-energy radiation, such as radio waves, is expressed as frequency; microwaves, infrared, visible and UV light are usually expressed as wavelength; and higher-energy radiation, such as X-rays and gamma rays, is expressed in terms of energy per photon. (Lucas, 2015)

4 Description of EM waves and uses

Table 1 outlines EM waves & uses (Lucas, 2015) (BBC, 2014).

Table 1: Types of waves and use

Waves	Description	Use
Radio waves	Radio waves are at the lowest range of the EM spectrum, with frequencies of up to about 30 GHz, and wavelengths	• Broadcasting • Communications • Satellite transmissions

	greater than about 10 mm.	
Microwaves	Microwaves fall in the range of the EM spectrum between radio and Infrared. They have frequencies from about 3 GHz up to about 30 THz, and wavelengths of about 10 mm to 100 micrometres.	• Cooking • Communications • Satellite transmissions
Infrared	Infrared is in the range of the EM spectrum between microwaves and visible light. It has frequencies from about 30 THz up to about 400 THz and wavelengths of about 100 micrometres to 740 nm.	• Cooking • Thermal imaging • Short range communications • Optical fibres • Television remote controls • Security systems
Visible light	Visible light is found in the middle of the EM spectrum, between Infrared and UV. It has frequencies of about 400 THz to 800 THz and wavelengths of about 740 nm to 380 nm.	• Vision • Photography • Illumination
Ultraviolet	Ultraviolet light is in the range of the EM spectrum between visible light and X-rays. It has frequencies of about 8×10^{14} to 3×10^{16} Hz and wavelengths of about 380 nm to about 10 nm.	• security marking • fluorescent lamps • detecting forged bank notes • disinfecting water
x-rays	X-rays are roughly classified into two types: soft X-rays and hard X-rays. Soft X-rays comprise the range of the EM spectrum between UV and gamma rays. Soft X-rays have frequencies of about 3×10^{16} to about 10^{18} Hz and wavelengths of about 10 nm to about 100 pm.	• Observing the internal structure of objects • Airport security scanners • Medical X-rays
Gama rays	Gamma-rays are in the range of the spectrum above soft X-rays. Gamma-rays have frequencies greater than about 10^{18} Hz and wavelengths of less than 100 pm	• Sterilising food and medical equipment • Detection of cancer and its treatment

5 Negative impacts of EM radiation and waves

Over-exposure to certain types of electromagnetic radiation can be harmful. The higher the frequency of the radiation, the more damage it is likely to cause to the body (BBC, 2014):

- Microwaves cause internal heating of body tissues
- Infrared radiation is felt as heat and causes skin burns
- X-rays and gamma rays damage cells, causing mutations (which may lead to cancer) and cell death
- Strong UV sunlight can cause sunburn within hours of exposure
- UV rays can cause skin cancer, wrinkles, moles and freckles.

Other impacts include:

1. Electrical hazards: Very strong radiation can induce current capable of delivering an electric shock to persons or animals. It can also overload and destroy electrical equipment. The induction of currents by oscillating magnetic fields is also the way in which solar storms disrupt the operation of electrical and electronic systems, causing damage to and even the explosion of power distribution transformers, blackouts, and interference with electromagnetic signals (e.g. radio, TV, and telephone signals).
2. Fire hazards: Extremely high power electromagnetic radiation can cause electric currents strong enough to create sparks when an induced voltage exceeds the breakdown voltage of the surrounding medium. These sparks can then ignite flammable materials or gases, possibly leading to an explosion.
3. Lighting: Compact energy efficient fluorescent light bulbs may emit dangerous levels of Ultraviolet radiation when the protective coating around the phosphor, which creates light inside the bulb, is cracked by mishandling or faulty manufacturing. This cracking of bulb's shielding allows UV

rays to escape at levels that could cause burns or even skin cancer (Wikipedia, 2015)

6 Solutions to negative implications

The health implications are many, but there are a variety of ways you can protect yourself and family from EMF waves.

1. Ground on Earth: Until the last couple hundreds of years, humans primarily walked barefoot and were outdoors most of the day. Science shows that an actual energetic grounding occurs when one has contact on natural surfaces, even to a point where harmful EMF can travel over the body. It's shown that through earth connection, one becomes more alkaline, less stressed, and has improved immune system, among other benefits. If you work in an office space in the concrete jungle of the city, make an effort to have natural plants indoors, spend a portion of your free time at home outside or on the grass during breaks, and make an effort to walk barefoot when possible.
2. Wear an EMF blocking pendant: New technologies – some sketchy, some very reliable – have emerged as alternative means to protect from damaging EMF's. Quantum Balance necklaces are one example, alternative and attractive pendants which are shown to shield one from the majority of frequencies.
3. Protect your Home: You can find a bio-electric shield for your home or apartment, somewhat of a necessity especially if you are in range of neighbours' Wi-Fi or own many electrical appliances. Brands vary, but search for a reliable, well tested, and scientifically backed energy neutralizer.
4. Unplug appliances: Besides wasting energy, electronics when plugged in emit higher EMF's. Coffee pot, curling iron, microwave, printer, computer, etc…, if it's not in use, save energy and curb the damage you may be doing to yourself.
5. Safeguard your Bedroom: Keep your bedroom clear from as many electrical conveniences as possible. Never leave your laptop around your sleeping area; within 3 feet of your head, EMF emitting technologies can interfere with your sleep and inhibit your regenerative patterns through the night.
6. Laptop Risks: Cosying up on the couch with your laptop may seem convenient, but it is not recommended. Laptops emit the strongest frequency when plugged in and charging (when the battery is closest to your hands), so work away from its charger and avoid using the computer on your lap. Whenever possible, strive to avoid working directly on a laptop computer by plugging in a secondary keyboard and mouse to help lessen your exposure (this is especially helpful if you are working on your laptop for extended periods of time).
7. Avoid installing Wi-Fi in your home: In October of 2007, the German government advised its public to avoid using Wi-Fi because of the possible health risk they pose. Strong waves from Wi-Fi, which emit electromagnetic radiation even when they aren't in use, can be curbed by avoiding the installation of cord-free internet. Use the free internet at the cafe down the street instead and save some money while you're at it.
8. Ban Blue-tooth Headsets: When using a cell phone, use the speaker or headphones. Do not use a Blue-tooth wireless headset: combined with the phone, it can exceed even the current inadequate safety limits.
9. Lighting: The lights you install at home can also make a difference. Avoid installing low-voltage (12 volt) halogen, fluorescent tube and energy-efficient compact fluorescent lighting (CFL). Virtually all of these energy efficient technologies can throw a nasty EMF from their ballast or transformer. They also create 'dirty electricity' (high frequency radiation that emanates from your home's wiring). The good news is that cleaner LCD lighting technology is just around the corner, so wait for it to develop and lower in price before doing major lighting upgrades.
10. Don't Wear Your Phone like a Beeper: A better place for your phone is in your backpack, purse, or briefcase; electromagnetic radiation diminishes rapidly beyond 3 feet, making it a safer option. A cell phone is relatively neutral to carry on your person if in 'flight' mode or 'off line; however, if that is not an option, favour keeping the keypad positioned towards your body and the battery facing outward. Another tip is to exchange the side of your head you normally talk on with the phone. You may not be able to escape from technological tools which, let's face it, have transformed modern day living substantially, but you can alter the degree of electromagnetic radiation which targets your body. Utilizing the above tips, you can safeguard your health and future in a subtle, but surely important, way (Froelich, 2013).

7 Benefits of EM radiation

- One form of electromagnetic radiation from the sun is visible light. This obviously gives us light for many animals (including humans) to see. Light is also very important for plants to carry out the process of photosynthesis, which is required to give out oxygen.
- There is no medium required for the wave to travel, they also travel at the speed of light and this makes it good for communication for examples cell phones make use of the advantages of electromagnetic waves.
- X-rays are used to treat malign tumours before its spreads throughout the human body. They help radiologists identify cracks, infections, injury, and abnormal bones and they also help in identifying bone cancer. X-rays help in locating alien objects inside the bones or around them.
- Gamma rays detect cancer and are used for its treatment.
- Usage of UV rays in butcheries sterilizes and disinfects fresh meat.
- Electromagnetic radiation is used for communications and transmission of information. The waves that are used in this way are radio waves, microwaves, infrared radiation and light.

8 Methodology

A survey was done on electromagnetic radiation, as a task to find out how many Atteridgeville community members and Holy Trinity Secondary Catholic School learners know about electromagnetic radiation and how it has an impact on our daily lives. Two different surveys were conduction for the community and school learners, and the results are presented in a table, pie chart and graph.

Survey questions and results

The following questions were asked to the community members:

- Have you ever heard about electromagnetic radiation?
- Do you think humans are exposed to it?
- Were you aware that most appliances/devices we use daily emit EM radiation?
- Do you know of anyone whose health has been affected by the emission and exposure to EM radiation?

And the interpretation of results:-

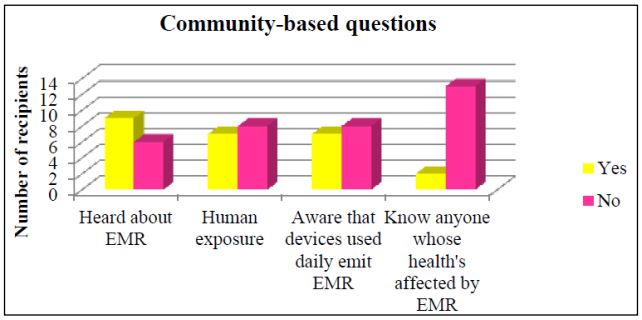

Figure 1: Survey results-community

Table 2 shows the results obtained from the school-based survey and questions which were asked:-

Table 2: Survey results-school (n=127)

Question	Yes	No
Do you know about Tshwane Wi-Fi installed around our school?	94	34
Were you aware the objective of installing the Wi-Fi was to assist with school work?	22	106
Has any of you connected to the Wi-Fi for whatever usage you needed for it?	47	80
Do you think the Wi-Fi will assist with school work and assignments?	84	44
Did you know Wi-Fi emits and makes use of radio waves for communication?	2	125

9 Conclusion

Can we survive without EMR? Even though the negative implications outweigh the benefits, we still need EMR for daily usage in our lives, and the benefits outline why we say this. X-rays and gamma rays lay a huge role in the medical industry, and microwaves and radio waves enable faster communication with development in the technological world, making life easier and more efficient.

Although electronic devices and the development in communications make the life easier, it also has negative effects.

The negative effects are particularly important in the electromagnetic fields in Radiofrequency (RF) zone which are used in communications, radio and television broadcasting, cellular networks and indoor wireless systems. Along with the widespread use of technological products in daily life, the biological effects of electromagnetic waves have begun to be more widely discussed.

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Event Photographs

Learners team and mentors

Learners team and mentors

Learners team and mentors

Learners team and mentors

Learners team

Learners and staff in the audience

Speaker

Speaker

Cross section of the learners attending LRS workshop

Cross section of the learners attending the LRS