



# FINAL REPORT

RANA SOLAR GENERATOR

## ABSTRACT

“When one starts beating the edge of a drum, he/she will play it sooner”

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INTRODUCTION TO ENGINEERING

## INTRODUCTION

*Ne ame aḍe le vu tome fom la, egbo na vu la ṣuto foge*

(If someone starts beating the edge of a drum, he/she will play it sooner).

The drum edge is sounding in Ashesi's Engineering school and Rana solutions seeks to take up the mantle to play the music of Africa's development. As analyzed from the aforementioned Ewe proverb, the edge of the drum refers to the beginning of a task. One has to start at a point and move gradually just as the cliché goes, a thousand miles begins with a step. The proverb encourages people to be determined and zealous in every aspect of life's situation. Challenges in life should be seen as opportunities and not as permanent obstacles which cannot be overcome. This report details out the problem-solution fit for the power outage problems in Ghana in a class simulation project to design a solar powered generator.

## EXECUTIVE SUMMARY

In recent times, Ghana has been faced with energy problems due to the inability of the existing hydroelectric power source to serve the entire nation. This led to the issue of load-shedding popularly known as "Dumsor" in Ghana. In light of this problem, there is the encouragement of the use of other sources of power especially solar energy. Solar energy is considered as a reliable source of energy which is convenient and reduces the occurrence of environmental pollution. However, in order to harness solar energy and convert it into useful electricity, resources such as solar panels, batteries and inverters are required. In a developing country like Ghana, the standard of living is low and the cost of living is high. The use of solar panels can be afforded by the affluent and this does not auger well for the nation. In the long run the problem of power outage persists and it remains a burden on the government. Also, people who have the means to afford power backup sources resort to purchasing fuel generators which create many other problems such as noise pollution, smoke and the cost of refueling.

Likewise, a category of middle class and upper lower class Ghanaians were identified as the majority of the population who faced the consequences of frequent power outages. Some of the reasons include the cost of solar system installations and the constraint of fixing solar panels on roofs since majority live in rented apartments.

Team B3 identified this a problem and went through the design-thinking process to design a solar powered generator with the user specified as tenants.

## THE SOLAR POWERED GENERATOR

Rana (literally means sun in Hausa) is a solar powered generator which consists of electrical components required to provide additional low cost but quality power supply for electrical appliances. With Rana one can easily harness the energy from the sun and enjoy efficient power supply with a movable solar package, which can be kept in the room after the battery is fully charged in the sun. Unlike other large solar panels where there is the need for complex roof installations with an expensive cost, Rana bridges the gap between affordability and owning a reliable back up source of power.

## KEY FEATURES OF THE PRODUCT.

- Easy to use: movability and smooth functionalities
- Efficient power supply to electrical appliances
- Made with Aluminum for durable comfort, no rust
- Quality ventilation to cool the system
- When not in use, solar panel can be kept in its compartment and this protect the panel's surface
- An alarm system serving the purpose of burglar protection
- LCD to display the power

## CIRCUIT DIAGRAM OF THE SOLAR GENERATOR

Rana consist of a solar panel, battery, inverter, charge controller, and an alarm system, which are controlled by an Arduino board. The diagrams below represent the general electrical circuit connections for the solar powered generator.

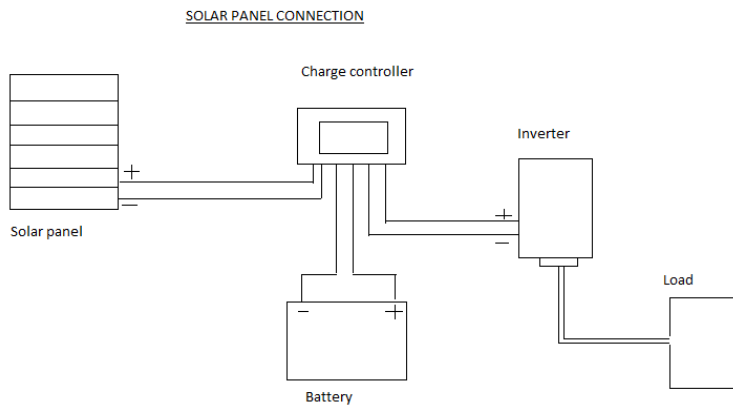


Figure 1. shows the circuit connection of the solar panel and its devices.

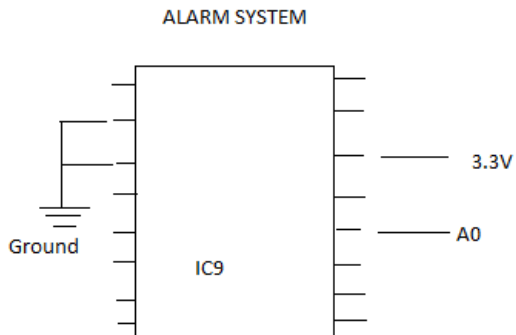


Figure 2. shows the circuit connection of the alarm system.

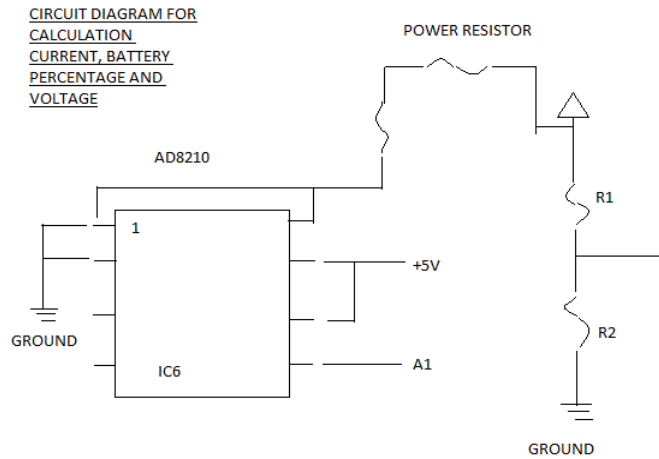
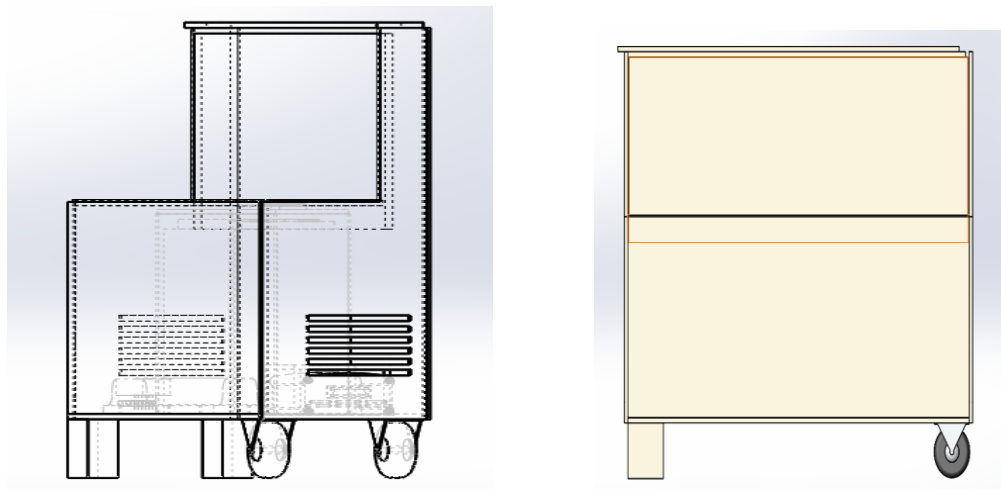


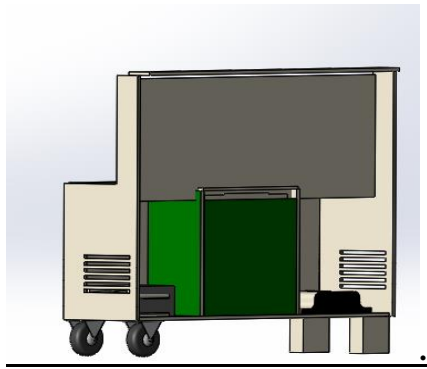
Figure 3. Shows the circuit diagram for the calculating the current, voltage and power.

### MECHANICAL DIAGRAM OF THE ENCLOSURE.

The following represents the objectives of our manufacturing process;

- To optimize material usage in the lab and achieve a quality aesthetic product.
- To achieve accuracy in measurement of the various parts.
- To ensure safety in cutting and assembling parts.





*Figure 4. Shows the mechanical diagram of the solar powered model.*

### BUSINESS ANALYSIS

In terms of the business aspect of Rana, the product is entering a re-segmented market niche for tenants who need a backup power source during periods of power outage. Since this is a re-segmented market, there is the need to ensure market feasibility of manufacturing the product such that the customer identified is willing to pay for it even as the identified need is satisfied. The total cost was estimated per unit as GHC520. Yet to meet the affordability aspect, a plan was developed to ensure a smooth purchase of the product with an initial installment of GHC100 and then weekly installments of GHC 40 for 12 weeks. An NGO partnership will subsidize an amount of GHC 100. Revenue will thus be generated from the payment plan because the user will pay a total amount of GHC 580, where the profit earned is GHC 180. Considering viability of business, we believe this solar generator was designed to fit the needs of tenants to first of all provide them with gain access to electricity when it is required and also bridge the gap between affluence and ownership of a solar system. In addition, since the product employs a simple mechanism to use, it will require less skill to manage the system, hence this generator is easy to use, convenient and reliable. In addition, it poses as a feasible business idea due to the added value on the product to reduce status quo bias and also offset market competition. Some of these features include a security alarm, a study lamp and the general portability of the case.

Furthermore, in order to market the product and promote selling, we intend to utilize online social media platforms for intensive advertisement. This is a very effective marketing tool which will facilitate the ensuring the brand is sold out properly to meet the needs of the identified user. The print media will also be a marketing strategy which will utilize by partnering with New Journal Magazine, to ensure frequent featuring of the product in their monthly published magazines. The product will then be made available in local electrical distribution shops in various towns as well as online selling platforms such as Tonaton. With regard to this, we hope to ensure easy customer accessibility to the product. A general feedback system will be created for the early adopters of the product through simple text messaging of the user experience after the first month of purchase.

### COST BREAKDOWN

The cost influx from this table is due to the cost of materials (aluminum and Plexiglas). The dimensions below can be used for 2 case parts.

Tools/ Materials	Quantity/ Dimensions	Cost/ GHC
Solar Panel	1	170.00
Battery	1	110.00
Invertor	1	50.00
Charge controller	1	50.00
Aluminum	140*120	50.00
Plexiglas	40*30	20.00
Arduino	1	40.00
Wood	1	10.00
Labor	Varied	20.00
		Total = GHC 520.00

### ENVIRONMENTAL AND SOCIAL IMPACT

The Rana solar powered generator is a remarkable resource for generating electricity since it solely depends on solar energy and eliminates the emission of toxic substances into the atmosphere which will lead to environmental pollution. It serves as a source of sustainable energy generation because it uses renewable solar energy. On the other hand, it has a negative environmental impact in that the aluminum material, which forms the bulk of its parts formed a lot of waste during the manufacturing process. This metal waste in the form of metal pieces and metal fillings was not recycled hence this could be an environmental pollution factor, especially in relation to land pollution, since aluminum does not rust easily and will take a longer period to decompose.

Socially, in an attempt to curb the energy crisis in Ghana, this solar powered was designed to provide electricity to individuals who will be in earnest need of electricity during power outage instances. The main user is a tenant who is unable to afford a solar system installation in his rented room. Even though the tenant benefits from this innovation, this product may serve the needs of other individuals who fall outside the circle of our main user. In addition, another social impact of great importance is the reduction of the developmental burden on the government. Moving from the manufacturing process to the selling and marketing processes of the solar powered generator requires labor. Therefore, this product will create employment opportunities for individuals with interest and skill in local manufacturing. Emphasis is laid on local manufacturing because the manufacturing process of the generator is simple and does not require much expertise.