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Compact Solar Elevator

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Abstract: The elevator facilitates disable person to move and it easy to carry heavy things between the floors. However, the environment is getting serious considering activities that help to sustain fossil energy. Energy from the solar truly an alternative to counting on. That is how this project presents the elevator with some aspects concerning the solar cells as an alternative to producing energy by direct conversion of the solar light into electricity. This designed elevator using a set of pulley powered by the hybrid battery bank and supporting by the solar cell array as the recharging power supply. Experimental studies of this model measure the voltage collected from the solar panel during daylight and the pulley response with loads is carried out to compare the energy consumption. Finally, as a conclusion the project of a solar elevator successfully function with an alternative energy supply.

Keywords: Elevator, Vertical Transport, Solar Energy

1. Introduction

Schindler, a global elevator and escalator provider, have produced an elevator that uses a hybrid system designed to supply up to 100 per cent of the elevator's power needs, using energy from rooftop solar panels and stores solar energy in batteries until needed. Schindler proves that the system can save up to 60 per cent more energy-efficient than hydraulic elevators [1]. While Otis, a company that claimed as a leader in elevators installed this new generation elevator in the cities such in Spain, Portugal and France in 2015 that's capable of running entirely on solar energy by 500-watt power to operate [2]. This technology can be apply to this compact solar elevator system includes many features that are designed to save energy and reduce costs. In comparison, our project model using dc motor and rope as pulley that equips with counterweight as the lifting system.

1.1 A brief history of elevator generation

The technology of the elevator development has evolved from the necessity for movement of raw materials, including coal and lumber from hillsides until the introduction of steel beam construction to provide the passenger and freight elevators in use today [3].

In the 1850s, the elevator was in transition from carrying goods to carrying people. The safe of the passenger of the elevator got the attention from the Elisha Otis, who then introduced the secured cab

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from falling if the cable rope broke [4]. The first passenger successful installed in 1857 in a five-storey building in New York, powered by the steam engine [4]. Next, the first electric elevator was built by Werner von Siemens in 1880 in Germany [3]. In 1874, J.W. Meaker patented a method which permitted elevator doors to open and close safely. In 1887, American Inventor Alexander Miles of Duluth, Minnesota patented an elevator with automatic doors that would close off the elevator shaft [4]. Last but not least, the first vacuum elevator was offered commercially in Argentina in 2000 [3].

1.2 Solar for alternative powered elevator

Solar energy is a free renewable source, and it is readily and causes no pollution hence, it can be used to generate electricity. Solar cell or photovoltaic cell is the medium of converting the solar energy into electrical energy, can be used in the solar powered elevator. The solar panels are placed on the rooftop of building and the energy captured by the solar panels can stored in batteries or it can be used immediately for working of the elevator [5]. Renewable energy is going to be very important in the near future and the solar powered elevators should help reduce energy consumption and make the world more in sustainable condition. The new residential elevator is easy to install, more sustainable, and safer during power failures or outages.

2. Materials and Methods

2.1 Materials

There are five main set of components block that need to consider (refer Figure 1).

- Solar panel. Solar panel used to absorb sunlight and generates electricity. The electricity is then supply to charge battery.
- Solar panel LED driver circuit. This circuit is being used to charge battery with the electricity which gets from solar panel. It also acts as voltage divider and connection circuit between battery and Arduino.
- Battery. The battery that used in the project is a rechargeable battery which functions as electric storage. It is charges by solar and supply electricity to Arduino.

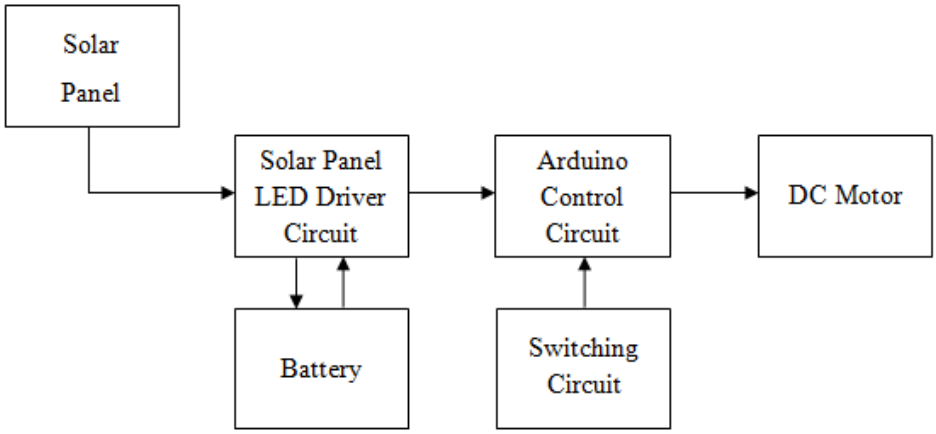


Figure 1: Specific of block diagram of project

- Switching circuit. It is a device circuit that let user to control the motor direction which depends on case of push buttons by special algorithm programming which writing using Arduino programme code.
- Arduino Control Circuit. Arduino UNO board functions as a microcontroller which controls the input and output. This circuit decides the motor direction.

2.2 Modelling Process

Based on the requirement, the design is divided into two major developments (as shown in Figure 2); software development and hardware development. In order to confirm the system is working, the programs need to be done correctly. With the intention of the project is working, the whole circuitry need to be constructed correctly and the functionality are checked.

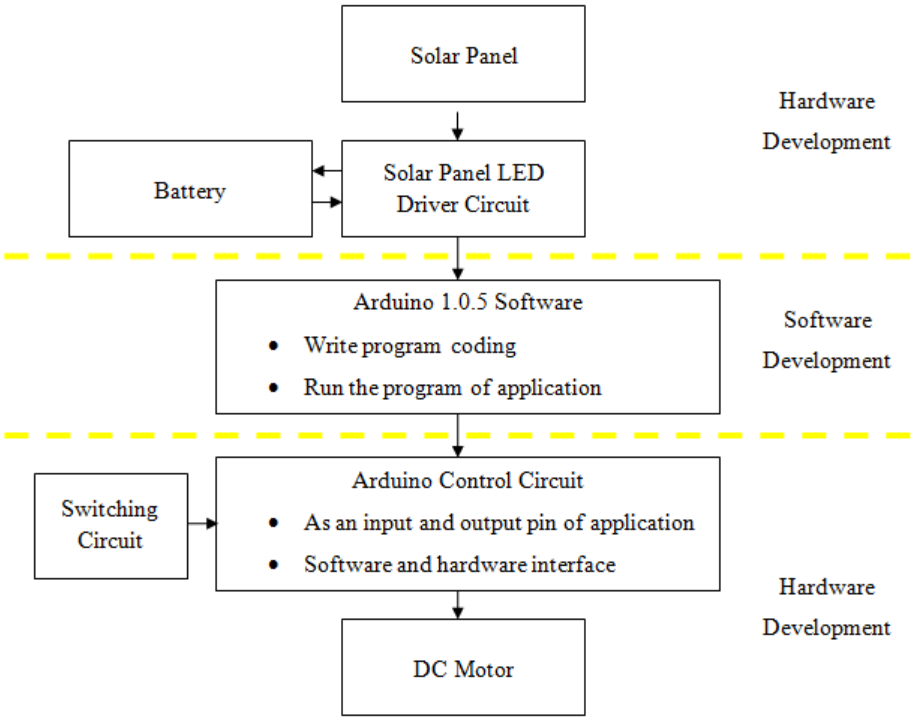


Figure 2: Modeling process

2.3 Configuration of project

First, solar panel and battery used as input voltage supply in this project. Therefore, solar panel and battery connected to solar panel LED driver circuit to regulate the voltage of solar panel and control the current charge for battery. Then, the output voltage of solar panel LED driver circuit interfaced to Arduino control circuit using DC jack male connector of Arduino. Thus, Arduino control circuit consist analog integrated circuit L293D which using to control the directional of the dc motor depend on case of push buttons by special algorithm programming which writing using Arduino programme code.

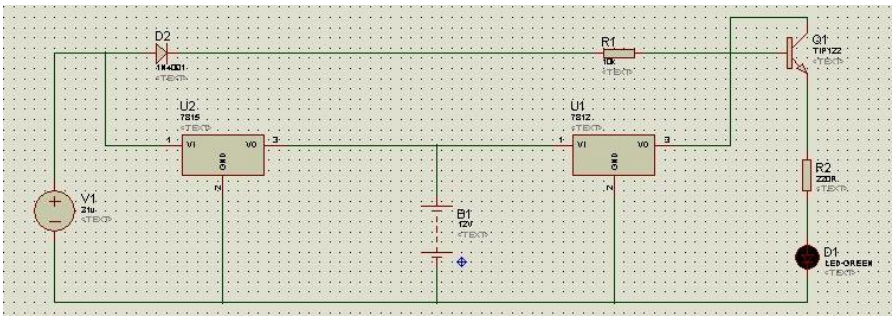
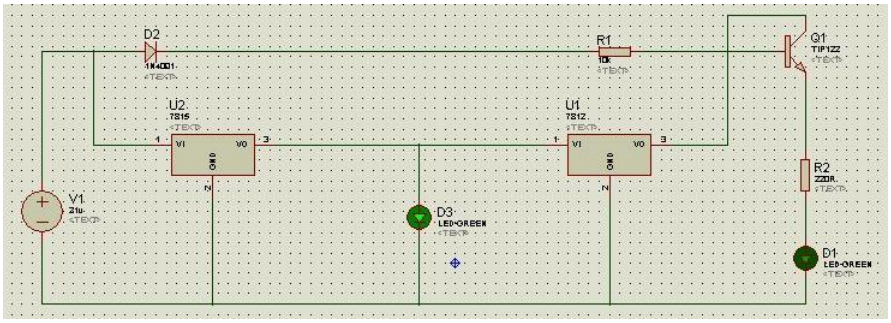
3. Results and Discussion

The result was divided into two categories which were included the software analysis result and hardware analysis result.

3.1 Results from simulation

Table 1 shows the characteristic of the simulation circuits under certain conditions.

Table 1: Solar Panel LED Driver Circuit

Condition	Simulation Circuit
When the solar panel is not charging the battery, the LED will not be lighted up	
When the solar panel is charging the battery, the LED will be lighted up	

3.2 Hardware result analysis

i. Solar panel

An experiment was done on solar panel to collect of voltage that able to be absorbed by solar panel. This experiment was done for 5 days with 2 hours duration (12.30pm-2.30pm). Solar panel was put under the hot sun to absorb sunlight and its open-circuit voltage was tested and recovered in every 5 minutes. The average open circuit voltage of solar panel is around 18V to 19V. The lowest voltage is 17.02V while the highest voltage is 21.00V. Whether it was raining, the voltage does not decrease also. Figure 3 shows the graph of average open circuit voltage with time.

ii. Solar panel LED driver circuit

For the solar panel LED driver circuit, it is tested by placing the project under sunlight (outdoor) and placed it under shelter (indoor). Figure 4 shows the result of this testing.

iii. Load

An experiment was done with load of this project. The time taken for different number of load which moves in up and down direction was tested and recorded as in Figure 5.

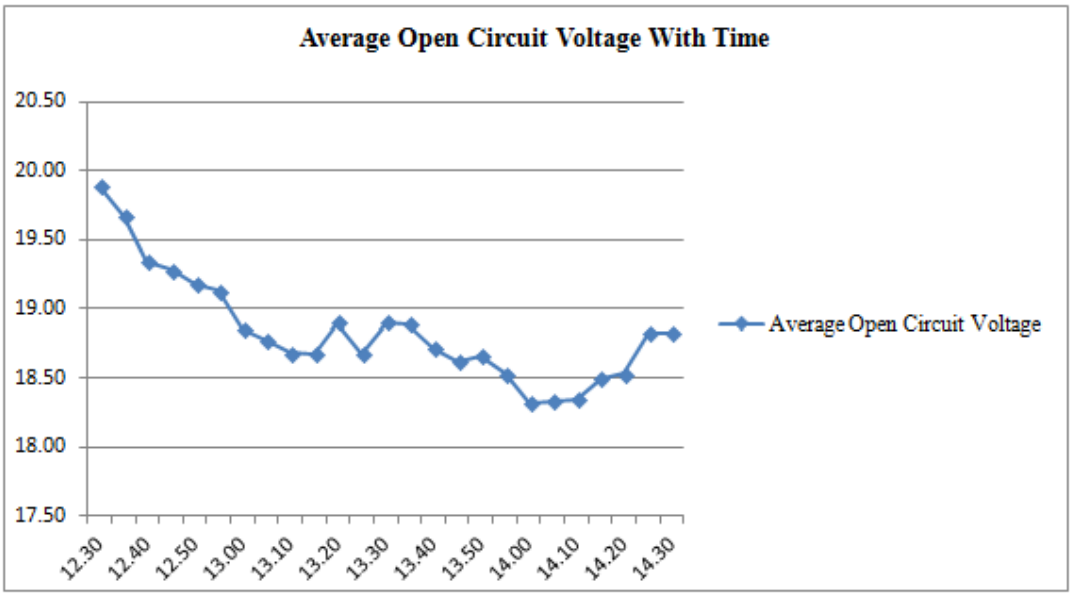


Figure 3: Graph of average open circuit voltage with time

Outdoor	Condition	Indoor
Lighted up	LED	Not lighted up
	Actual Diagram	

Figure 4: Result of solar panel LED driver circuit testing

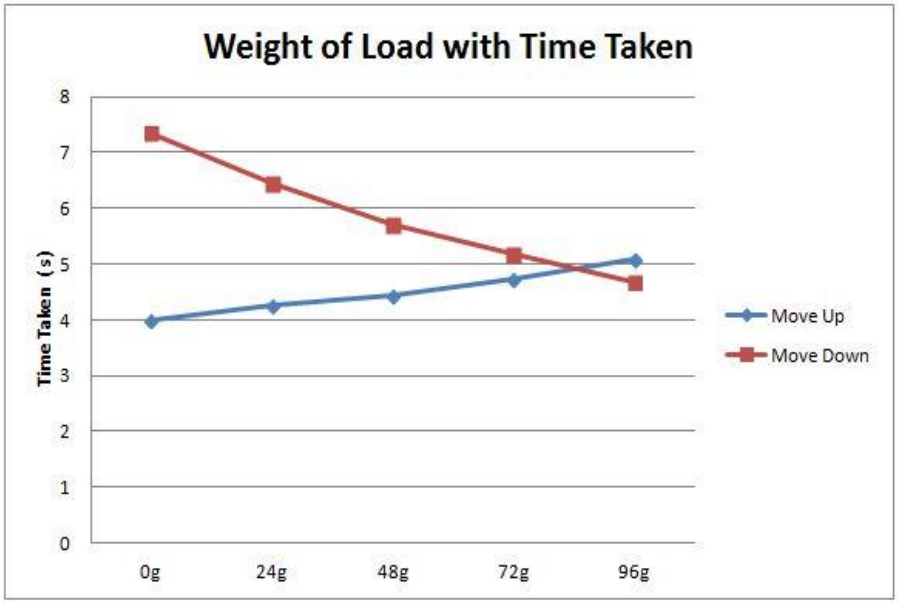


Figure 5: Result for the testing load verses time

3.3 Discussion

Since one of the purposes of this project is to understand the concept of the solar system of a simple pulley elevator, we have gained the knowledge very well. Throughout the project, we faced some problem with our coding, circuit design and components. But with the help of supervisor and seniors, we are able to run it after failed so many times. Dc motor was chosen for this project due to its advantages of easy to control its rotation angle compares with others motor such as the servo motor, which only can rotate in 180 each time its rotate. With the lift application, a flexible rotation angle is much needed thus the dc motor is the best candidates for this project.

There are some advantages of this project. The elevator is compact yet functioning well. It is also using sustainable energy. The rechargeable battery as the power hybrid in the event of a power failure or outage. By this era, many people are installing residential elevators to help make everyday tasks more convenient or to increase mobility for those with a physical limitation. At the same time, people are looking for ways to be more energy efficient and keep their energy bills down. So, this compact solar elevator does both by allowing anyone to confidently and independently reach every floor of their home while using far less energy than other residential elevators.

4. Conclusion

Finally, we have done with our project successfully. Even though there were some problems we have to face, but at last we could achieved for what we all put effort for. More importantly, we are very happy because could achieve our aim of this project which is to understand the concept of a simple pulley system elevator using solar energy. After so much of effort and hardworking, we also could achieve all the objectives of this project. We are so proud could built an elevator that really helpful for people and also which is very environmental-friendly. Thus, an energy consumption elevator surely will be needed in mean of time. This kind of elevator is more energy- efficient technology and the existence of this elevator will contribute to raise some awareness of environment. Using this elevator, people could save their energy and time moving their heavy things from a floor to another floor. Lastly, we are so grateful being involved in this project and we gained more knowledge than we expected.

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References

[1] S. Doug, "Schindler Launches Solar-Powered Elevator, Helps Solar Impulse Project", The Vert, April 17, 2013. [Online]. Available: http://greenbuildingnews.com/2013/04/17/schindler-launches-solar-powered-elevator-helps-solar-impulse-project/ [Accessed August 16, 2020].

[2] "Solar elevator: renewable energy on every floor!", Living Circular, Veolia, July 29, 2016. [Online]. Available: https://www.livingcircular.veolia.com/en/city/solar-elevator-renewable-energy-every-floor [Accessed August 15, 2020].

[3] "Elevator Industry", Prismatec, 2018. [Online]. Available: https://www.prisma-tec.com/elevator-industry/ [Accessed August 16, 2020].

[4] Prisco. J, "A Short History of the Elevator", CNN Style, Feb 9, 2019. [Online]. Available: https://edition.cnn.com/style/article/short-history-of-the-elevator/index.html [Accessed August 15, 2020].

[5] "Solar Powered Elevator Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2019 – 2027", Transparency Market Research. [Online]. Available: https://www.transparencymarketresearch.com/solar-powered-elevator-market.html [Accessed August 15, 2020]