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LIGHT RELIANT CIRCUIT AS AN EMERGENCY LIGHTING SYSTEM

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ABSTRACT

One of a person's essential needs is light. This study focuses on the feasibility of using light reliant circuits as an emergency lighting system. The product of the study is an emergency lighting system that substitutes the needed light in times of unexpected power outage. With this, the emergency lighting systems consisting of 12v strip LED lights, light resistor, battery holder, light reliant circuit, alligator clips, heat controller, metal mosfet, and ohm resistor were developed. The process requires assembling, soldering the light-dependent resistor to the gate and source of the IRF740 mosfet to provide connection to the sensor. Following the device's development, its functionality would be evaluated in terms of its coverage range, activation time, and light intensity. The researchers used a lux meter and a tape measure to determine the range of coverage of the emergency lighting system, resulting in a distance cap of 50 lux at the lowest intensity. Results of the study showed that the emergency lighting system projected the appropriate lux at a distance of 156.3 cm (5 foot 1 inch) on average, indicating the recommended height or distance allowing the intensity to give more than a decent aid to brownout situations. Further examination of the findings reveals that there was only one alteration, which was a 0.02 millisecond difference between trial 1 and trials 2 and 3. Based on the trials, the average time length is 0.107 milliseconds. With this time length, it's a conclusion that this emergency lighting system is responsive enough at needed times and situations and in unexpected times. The average light intensity of 86,851 lux can be detected by the emergency lighting system. The light intensity would be critical in calculating the emergency lighting system's proper distance of measurement. Therefore, it is duly recommended for the household to install the product as it yields good results based on the tests conducted.

KEYWORDS: Light Reliant Circuit, Emergency Lighting System, Duration, Circuit, LED (Light-Emitting Diode)

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1. INTRODUCTION

Emergency lighting answers an emergency situation when the main power supply is cut and normal electrical illumination fails. The loss of main electricity could be the result of a fire or a power cut. Without emergency lighting this could lead to sudden darkness and possible danger to occupants, either through physical danger or panic. Emergency lighting is normally required to operate fully automatically and give illumination of a sufficiently high level to enable all occupants to evacuate the premises safely. (Fire Safety Advice Center, November 11, 2019).

Brownouts are a common event that appears to disturb the normal voltage of an electrical light source; they occur when the availability of electrical power in a specific area is decreased and restricted; electricity continues to flow to your home during a brownout, but at a lower voltage than usual. Brownouts can last anywhere from a few minutes to three to four hours, and they are caused by high electrical demand that is close to or exceeds a utility's production capacity (Direct Energy, 2021). Barry (2020) stated that incorporating emergency lighting can literally save lives. It is designed to make sure that in the event of the normal power supply failing, illumination is provided promptly, automatically and for sufficient time. This will ensure that occupants are able to evacuate safely. The Our World in Data Organization (2020) reported that approximately 940 million people or 13% of the total population lacks, or does not have any access to any electricity, causing no light and main energy. Weinhold (2017) stated that basic light brightens the surroundings in our houses or other facilities, artificial light sources such as light bulbs, lamp posts, and flashlights are required. Artificial light, as opposed to natural light, refers to any light source produced using electricity. Internal and external variables may have an impact on its effectiveness and performance because it is powered by electricity. Over time, these electrical light sources are prone to breakdown and power loss. This is also where the motivation for doing the study is stated. The goal of an emergency lighting system is to ensure that, in the event of a power outage, lighting is provided quickly, automatically, and illuminates for a long period of time. Utilizing different scraps and extra home materials, LED lights, and the light reliant circuit, this study will cater to a variety of users in providing a light source. The key benefit of emergency lighting is its effectiveness as it provides constant lighting specifically, its light intensity. Light intensity is how fervent the light of the emergency lighting can get as for the use of bringing light. Finio, B. (2019) stated that a lux is a unit of measurement that represents how much light falls on a specific area. (This is not to be confused with a lumens unit, which indicates the total quantity of light emitted by a light source.) As you travel further away from a light source, the quantity of lux decreases. When you consider it, a light bulb appears considerably darker when you stand 100 feet away from it than up close, despite the fact that it emits the same total quantity of light in lumens. These govern the strength and capability of emergency lighting systems. The vigor of emergency lighting systems is determined by the lux unit of measurement. Using a lux meter the

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study proves its effectiveness as to light intensity which is considered a major factor to emergency lighting systems using light reliant circuits.

A light-controlled photo-resistor (LDR) is similar to the light-reliant circuit which is a type of photo-resistor that detects light and changes the circuit functioning based on the amount of light sensed. That is why it is referred to as a light-sensitive device. They're usually composed of high-resistance semiconductor materials. The resistivity of an LDR is a function of the amount of radiation it receives. LDRs are obvious for emergency lights since they can be light detectors when light is required, such as when darkness occurs. It is the LDR's function to commence. (Electronics Hub, October 8, 2018).

Innovation leads to creation of something that will truly impact humanity. The study made use of scrap materials to improvise an emergency lighting system from light reliant circuits. This is beneficial to provide a light source during power outages which could be a result of fire or sudden electrical fluctuations. The distance it covers or reaches is very important so as the illumination intensity and the time for the product to activate will test its effectiveness. Saving lives from panic and accidents during emergency situations due to the absence of light especially at night time can be answered in this study through the innovation as a product of the study.

Research Problem

The objective of this study is to create an emergency light reliant circuit with the use of a light dependent resistor. Specifically, this study aims to answer the following questions:

1. What is the distance that the emergency lighting system can cover in different trials?

2. How long will it take for the emergency lighting system to activate?

3. What is the light intensity of the emergency lighting system?

Alternative Hypothesis

H1: It is viable to create an emergency lighting system out of a light reliant circuit.

2. METHOD

The experimental research design was used in this study. According to QuestionPro (2020) Experimental research is a study that uses two sets of variables and is conducted in a scientific manner. The first set serves as a constant against which the differences in the second set are measured. Quantitative research

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approaches, for instance, are exploratory. Experimental design is the process of doing research in an objective and controlled manner in order to optimize precision and reach particular conclusions about a hypothesis statement. The goal is to figure out what effect a factor or independent variable has on a dependent variable. Experimentation is carried out in a controlled environment, while the researcher collects the data and analyzes it. This study will be utilizing a lux meter to determine the light intensity of the emergency lighting system in a dark room, and determine the distance of the coverage that the emergency lighting system can illuminate enough light in a room. To describe the amount of lux illuminated is through a foot candle scale, while the time is assessed through a digital stopwatch.

3. RESULTS

The prominent findings of the study are:

1. Range that the emergency lighting system can cover in terms of distance

Table 3 Distance of the coverage of the emergency lighting system

Trials	1	2	3
Photos			
Distance	153 centimeters or 5 feet	158 centimeters or 5.2 feet	158 centimeters or 5.2 feet

The researchers analyzed the range of the coverage of the emergency lighting system through the use of a lux meter and a tape measure to give a distance cap with the lowest intensity at 15 lux.

Table 3 shows the recommended distance as to when the emergency lighting system can project enough light to cover its surrounding. The data on table 4 was on a series of trials, specifically three trials for the distance. During the first trial, the emergency lighting system projected enough lux at a distance of 153 centimeters or 5 feet. During the second trial, the emergency lighting system projected enough lux at a

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distance of 158 centimeters or 5.2 feet. Lastly, during the third trial, the emergency lighting system projected enough lux for the coverage of 158 centimeters or 5.2 feet of distance.

Additionally, the emergency lighting system projected the desired lux at an average distance of 156.3 centimeters or 5 foot 1 inches in height, the findings show the recommended height or distance the emergency lighting system can be placed. According to Orlight (2014), in high-risk regions, the emergency sustained illuminance on the work plane (reference plane) must be at least 10% of the task's regular necessary illuminance. It should not be less than 15 lux and should not have any hazardous stroboscopic effects.

2. Time length for the emergency lighting system to activate

Table 4 Time length for the emergency lighting system to activate

Trials	1	2	3
Photos			
Time	0.10 milliseconds	0.12 milliseconds	0.12 milliseconds

The researchers assessed the time length for the emergency lighting system to activate after no light source was detected by placing the emergency lighting system on a surface with a manipulated light source and monitoring the time length using a stopwatch when that light source is turned off.

Table 4 shows the time length for the light reliant circuit to function after no light definite light is detected. Furthermore, table 4 depicts the output's various trials, to improve the accuracy and find the average time length. On the first trial, the light reliant circuit functioned after 12 milliseconds of no light source. On the second trial, the light reliant circuit functioned after 10 milliseconds of no light source. On the third and last trial, the light reliant circuit functioned after 10 millisecond again after no detected light source.

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Further observation of the findings shows that there was only 1 change which was from trial 1 to trials 2 and 3 which was only a 0.02 milliseconds difference. According to Ghosh, A. (2017) The average time length based on the trials is 0.107 milliseconds. There are special purpose LEDs with junction and bond-wire geometries designed to allow pulses of 800 picoseconds to 2 nanoseconds. Special purpose laser diodes, which are operationally similar to LEDs in many aspects, can produce pulses as short as 50 picoseconds. There's also a series of LED products with specialized optical beam shaping that have pulse lengths of 500 to 1000 picoseconds, as @ConnorWolf pointed out in the comments. Phosphor type LEDs have far slower turn-on and turn-off times than direct emission LEDs, in the tens to hundreds of nanoseconds. The inherent emission transition durations of LEDs are not the only determining variables for quick LED switching: The traces' inductance causes longer peak and fall times. Transitions are slower with longer traces.

3. Light intensity of the emergency lighting system

Table 5 Light intensity of the emergency lighting system

Trials	1	2	3
Photos	 8,880.8 Fc	 7,971.5 Fc	 9,203.2 Fc
Intensity (lux = Fc x 10)	Intensity at 88,808 lux	Intensity at 79,715 lux	Intensity at 92,032 lux

The researchers were able to assess the light intensity projected by the emergency lighting system through the use of a lux meter at a specific distance which is 1 inch away from the emergency lighting system.

In Table 5, the emergency lighting system was able to project high intensity in 3 different trials. During the first trial, the emergency lighting system was able to project an intensity of 88,808 lux with a direct projection to the lux meter. In the second trial, the emergency lighting system was able to project an intensity of 79,715 lux with a direct projection to the lux meter. Lastly, with the third trial the emergency lighting system was able to project an intensity of 92,032 lux with a direct projection to the lux meter.

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Unicamp (1999) Emergency lighting should give a minimum of 15 Lux and should provide 10% of the normal illumination level at the hazard. (In fact, this minimum is unlikely to ever be a problem because it applies only if the risk area's typical illumination level is less than 150 lux.)

In conclusion, the emergency lighting system can detect an average light intensity of 86,851 lux. The light intensity would be essential in determining the proper distance of measure of the emergency lighting system

Alternative Hypothesis

It is viable to create an emergency lighting system out of a light reliant circuit. Based on the results of the study, it is viable to create an emergency lighting system out of a light reliant circuit. First and foremost, the emergency lighting system proved its range to be a great use in places where it is needed the most, the range has proven that it can luminate room level at a point where it can substitute disintegrated light at brown-out times. The emergency lighting's time length has proven to be effective and responsive which has an average of 10.67 milliseconds as tested. As for its light intensity, it stands heavy-duty and is able to stand with or against existing emergency lighting systems. With all this answers our hypothesis that it is viable to create an emergency lighting system out of a light reliant circuit.

4. DISCUSSIONS

The following findings are based on the experiments conducted. Table 4 shows the results of a series of experiments, specifically three distance trials. The emergency lighting system provided enough lux at a distance of 153 centimeters (5 feet) in the first experiment. The emergency lighting system provided enough lux at a distance of 158 cm (5.2 feet) in the second testing. Finally, during the third testing, the emergency lighting system produced enough lux to span a distance of 158 cm (5.2 feet). Furthermore, the emergency lighting system projected the appropriate lux at a distance of 156.3 cm (5 foot 1 inch) on average, indicating the recommended height or distance for the emergency lighting system. The time length for the emergency lighting system to activate after no light source was identified by placing it on a surface with a controlled light source and using a stopwatch to time how long it took after that light source was turned off. After 12 milliseconds with no light source, the light-dependent circuit functioned in the first try. After 10 milliseconds with no light source, the light-dependent circuit worked in the second try. The light-dependent circuit functioned after 10 milliseconds on the third and final attempt, even though no light source was detected. Based on the data found, the findings proved that the time length for the emergency lighting system to activate stands kindred to existing emergency lighting systems. Based on the finding of Ghosh, A. that based on the trials, the average time length is 0.107 milliseconds. Special purpose LEDs are available with junction and bond-wire designs that allow pulses ranging from 800

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picoseconds to 2 nanoseconds. Special purpose laser diodes, which operate in many ways like LEDs, can generate pulses as short as 50 picoseconds.

Lastly, for the light intensity of the emergency lighting system, the researchers concluded that the findings make the emergency lighting system suitable to stand with and againsts current emergency lighting systems. As stated by PhilippePayne (2021) The least amount of lux that an emergency lighting system should offer is 15, and which they expounded whether it be in escape routes, anti-panic/open areas, staircases, moving stairways and walkways, junctions/intersections, final exits, fire assembly points, reception areas, first aid rooms, and kitchens. With the findings stating that the average lux of this study is 86,851 lux, this verifies the strength of the emergency lighting system. The emergency lighting system was able to project an intensity of 88,808 lux with a direct projection to the lux meter during the first experiment. With a direct projection to the lux meter, the emergency lighting system was able to project an intensity of 79,715 lux in the second testing. Finally, the emergency lighting system was able to project an intensity of 92,032 lux with a direct projection to the lux meter in the third testing, averaging with the light intensity of 86851.67 lux.

Based on the experimental findings of the study, the following are recommended: The Philippine School Doha (PSD) is recommended to use the light reliant circuit as an emergency lighting system, it is just as salient to the school for the provision of emergency light is unpredictable and unforeseeable situation for the safety and security of all is the top most concern. The researchers are open to the expansions and proliferations of this study, most especially at it being a change and improvement to existing emergency lighting systems that are currently available. Future Researchers have the availability to utilize the results of this experiment as a guide for other researchers if their subject is similar to the subject of this study, most specifically if the study has a light reliant as one of their main components. The researchers also recommend the future researchers to have a direct comparison into the findings to see how much it can be improved for future studies. This study can also be used as an inspiration for different types of emergency lighting sensors.

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