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Automatic Street Lighting Controller with Anti-Theft Alarm

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Abstract. ***In times when security is the topmost priority of every community, the provision of adequate and functional streetlights is deemed necessary as one of the measures to protect life and property. In this study, the researchers designed and constructed a prototype device Automatic Streetlight Controller with anti-theft alarm using a Light-dependent resistor (LDR) and Photodiode – Infrared LED tandem. This study was conducted to assess the qualitative description, functionality, and level of acceptability regarding the constructed Automatic Streetlight Controller with Anti-theft device in terms of its performance as to device and simulator/trainer, the convenience of use, safety, assembly of parts, and cost. A mixed research design was used that includes both qualitative and quantitative research design. The qualitative description of the device was presented in narrative form and assessed using a focused-group discussion. Quantitative research design is done using quasi-experimental in testing the functionality, trials were made to assess its functionality and descriptive survey method was used to assess the level of acceptability. Probability sampling was also used thru the lottery method to get the two (2) selected groups of respondents: the 3rd year BSIT- Electricity block B students and community barangay officials of Calunasan, Calape, Bohol. T-test was used to test its significance using the 0.05α. Results have shown that on testing the device has 100% good performance and is rated as it functions well. The acceptability level was rated "very high" which means highly acceptable by both respondents. Therefore, the device can be used if implanted in existing street lights or newly built ones to improve the condition of our street lights to properly illuminate the streets for an improved security system.***

Keywords: ***Acceptability, Anti-Thief Alarm, Controller, Functionality,***

I. INTRODUCTION

Nowadays, street lights are one of the major requirements in today's life for safety purposes and avoiding accidents during the night. The security of our environment which includes the protection of life and property is part of the priorities of every nation. A street lighting is any electrical lighting that is fixed outside the house for the illumination of the environment or a raised source of light on the edge of a road or walkway, which is turned ON at a certain time every night. Street lighting is very important as it aids in the illumination of our streets and serves for beautification of the environment at night-time. Failure and irregularities in power supply hinder the continuous illumination of our streets due to manual operation of the streetlights results in increasing crime on our streets and support for evil activities. The streetlight ensures safe, fast, and efficient movement of people and goods from one place to another. Street lighting in particular is one of the critical concerns for both public authorities and places like Barangay Calunasan, Calape, Bohol. The strategic importance and to reduced crime rates, accidents, and other evil activities that take place at dark hours is the vital priorities of the said locations. Inefficient lighting could waste a significant yearly loss of financial resources. The poor lighting activities create unsafe public safety conditions. In a properly managed society, the manual control street lighting systems consume quite a large sum of the power supply, which is obviously due to its constant operation during the night, and more so some of these streetlights shine into the day because of their manual nature. Manual control is prone to errors and leads to energy wastages and manually dimming during midnight is impracticable. The current trend is the introduction of automation solutions to control street lighting. This project development conceptualizes the importance of having an Automatic Street lighting controller with an anti-theft alarm which focused on an Automatic Street lighting control system using LDR and alarm system. An LDR is a component that has a variable resistance that changes with the light intensity that falls on it. It works on the principle of photoconductivity which allows them to be used in light sensing circuits. Whenever there is sufficient light falling on the LDR, it exhibits high resistance and acts as an insulator and in darkness, the LDR behaves as a low resistance path and allows the flow of electricity.

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Using the LDR in the streetlight control system eliminates manual effort as it will automatically switch ON when the sunlight goes below the visible region of our eyes and switches OFF when an ample amount of sunlight is available. While the alarm system uses photodiode and infrared LED tandem in which it triggers when a LED bulb was intentionally taken out by a thief. This study is beneficial as it enhances human sight for those pedestrians on the walkways at night and for drivers which leads to reduce accidents, reduced crime/robbery, and improve social and economic benefits of the people.

II. OBJECTIVES

This study aims to construct a prototype simulator on Automatic Street lighting controller with the following indices as to qualitative description of the performance of the devices as to preparation, design, diagram, materials, and costs, assembly, operation, parts and quantitative description that includes the functionality as to operations, and safety (both device and human), and acceptability level and its level of significance.

III. METHODOLOGY

This study used the mixed-method research design particularly, the quantitative and qualitative research design. In qualitative research design, is the presentation of thematic analysis for the qualitative description of the product, for quantitative research design quasi-experimental method, was used to assess the functionality of the device as to testing different trials to run its efficiency. A descriptive survey method was also used to assess the level of acceptability of two identified adopter respondents of the study. This study was conducted in the two identified research adopter's locale for the students in Bohol Island State University, Calape, Bohol, and barangay residents of Calunasan, Calape, Bohol, Philippines. The researchers identified the two (2) sets of respondents based on the purpose of the study to assess the level of perceptions in terms of their perceptions on the effectiveness of the product. There were four (4) selected experts and 30 respondents for adopters. The researcher used 40% sampling in selecting respondents.

The composition of the research questionnaire was done through a series of research questions constructions according to the prescribed theme, validity, reliability, and face validity of the sets of questions before its distribution to the final respondents. Constant communication from the adviser and English critic for corrections. After the final corrections and suggestions, it was reconstructed. The sets of questions were derived from the specific problems of the study. The questionnaires were divided into two (2) parts. Part A composed of a demographic profile like the name which is optional, age, sex, and status/professional. Part B is the sets consisting of statements to be answered using Likert scale from very high acceptable to not acceptable according to the mode of the study.

Assembling the automatic street lighting controller was done using the following step preparations like a sketch of the product, tools, and materials needed in constructing the product. During the construction, a rectangular base of the product with an appropriate measurement scale was prepared with the construction of a street light pole using a welding machine and grinder. Schematic diagrams and building up the circuit using the electronic components and soldering iron and led were prepared and made. Then, the combined base, pole, and installation of the circuit were done to complete the product. The painting was also done to enhance the quality of the developed product prior to testing its functionality.

A series of trials were conducted to test the efficiency of the product and to measure the performance under various conditions of diverse conditions. The area where the researchers conducted the trials is located in Barangay Calunasan, Calape, Bohol, Philippines. The researcher's questionnaire includes the purpose of the study, respondent's demographics, instruction and the data from trial one (1) to trial three (3) functionality test to ensure accurate response from the set of experts and adopters as respondents.

The distribution of the questionnaire includes showing the prototype automatic street lighting with an anti-theft alarm so that the respondents can witness and assess the physical appearance of the product. The researchers conduct a brief overview of the study before the distribution of the questionnaire including the reading of the questionnaire content and its instruction. The researchers' interview one by one of the respondents from the set of experts and adopters. Gathering/ retrieval of the questionnaire is done after the respondent is satisfied with their response. The respondent's preference is followed when gathering the questionnaire, it can be distributed now retrieve later to give enough time to the respondent's assessment of the product or distribute now to make a response and retrieve after a while.

Data were analyzed using the SPSS as official statistical software in analyzing data for social researches.

IV. RESULTS AND DISCUSSION

Qualitative Description. This includes the illustration of the results of the prototype automatic street light controller with an anti-theft alarm. Below is the illustration of the schematic diagram and perspective of the device.

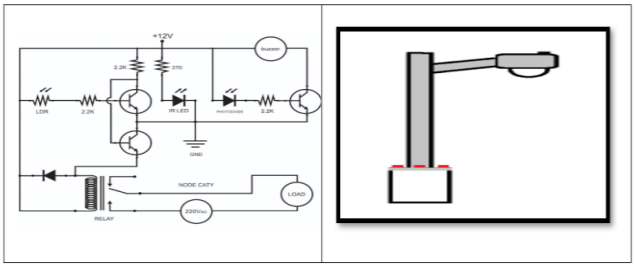

Figure 1. Schematic diagram of the automatic street lighting controller

Figure 1 shows schematic diagram of the automatic street lighting controller with anti-thief alarm. The researcher uses only simple electronic components such as LDR Light dependent resistor, Infrared LED, photovoltaic diode, resistors, GP transistors, GP diode, 12v power supply, Relay, and buzzer.

Assembly

The assembly of the device was done by systematic planning using a schematic diagram, budgeting, design planning, a listing of materials, and research references. All the materials were purchased and were ready before the construction. The controller and alarm circuits were made first using transistors, resistors, diodes, relay, photovoltaic diode, infrared LED, power supply buzzer, and LDR. The construction of a concrete base pole with one mast arm bracket using a welding machine.

The construction of luminaire together with arrangement of the circuits inside of it. The construction of base and other product accessories. An installation of circuit breaker and the connection of all circuits. Continuity testing and functionality test of the device. Finalization and beautification the device.

Operation

This device is a prototype simulator which demonstrate the basic operation of the real automatic street lighting controller with anti-theft alarm. To operate the device; first, the device must plug into the outlet and the circuit breaker must be switch on. There should be a night modifier covered into the LDR or sensor switch in order to switch on the bulb automatically. When the LDR or sensor switch is uncovered the bulb is automatically switch off. Likewise, the bulb would automatically switch on when the time sets on 5:00 to 6:00 PM and the bulb would automatically switch off when the time sets on 5:00 to 6:00 AM. Once the bulb uninstalled, it triggers the alarm to buzz.

Parts and functions

The components that the researchers used in the device are shown in the figure below. Each of the following is defined according to their function.

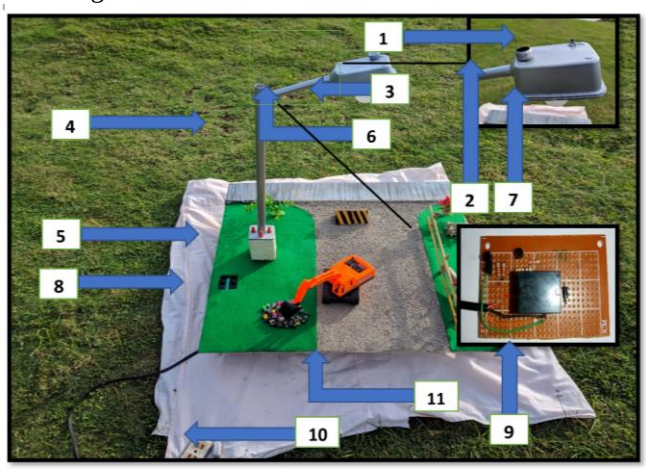

Figure 2. Illustration of the parts and functions of the device.

Testing the functionality

Below are the records as evident of testing the functionality of automatic street lighting controller. Each member of the researchers was made to give choices as Function well, slightly function, fair, non-slightly function and non-function at all. The numerical weights were 5, 4, 3, 2, and 1 respectively to measure the functionality of automatic street lighting controller. Some of the trials and descriptive statement made are according to its operation. The operation number 2, 3, 6 and 9, switch on the bulb at 6:00 PM to 6:30 PM, switch on the bulb at 6:30 PM to 7:00 PM, switch off the bulb at 5:30 AM to 6:00 AM, and uninstall the bulb obtained the highest rating of 5 weighted mean rated as "Function well". Moreover, the safety number 1, 2, and 3, followed by the standard operating procedure like turn on the breaker or plug-in, plug-in to the outlet and turn on the breaker obtained the highest rating of 5 weighted mean rated as "Function well". Meanwhile the operation no. 7, Touch the bulb obtained the lowest rating of 1 weighted mean rated as "non-function well". Majority of ratings are function well, therefore the functionality of automatic street lighting controller has a good performance.

Table I. Functionality of the automatic street lighting controller as to operations and safety.

Indicator	Strategy	Mean	Descriptive Rating	Remarks	
Operation	**Sensor Test:**				
	1. Switch on the bulb at 5:30 PM to 6:00 PM.	4.60	Function well	92% Performance	Good
	2. Switch on the bulb at 6:00 PM to 6:30 PM.	5.00	Function well	100% Performance	Good
	3. Switch on the bulb at 6:30 PM to 7:00 PM.	5.00	Function well	100% Performance	Good
	4. Switch off the bulb at 4:30 AM to 5:00 AM.	3.80	Slightly function	76% Performance	Good
	5. Switch off the bulb at 5:00 AM to 5:30 AM.	4.80	Function well	96% Performance	Good
	6. Switch off the bulb at 5:30 AM to 6:00 AM.	5.00	Function well	100% Performance	Good
	Anti-thief alarm test: 7. Touch the bulb.	1.00	Non- function well	20% Not Performance	Good
	8. Destroy the bulb.	1.60	Non- function well	32% Not Performance	Good
	9. Uninstall the bulb	5.00	Function well	100% Performance	Good
Safety	1. Follow the standard operating procedure like turn on the breaker or plug-in.	5.00	Function well	100% Performance	Good
	2. Plug-in to the outlet.	5.00	Function well	100% Performance	Good
	3. Turn on the breaker.	5.00	Function well	100% Performance	Good

Acceptability level of the automatic street lighting controller

The acceptability level of automatic street lighting controller. The students and community were made to give choices as Very High, High, Acceptable, and Not acceptable. The numerical weights were 4, 3, 2, and 1 respectively to measure the acceptability level of the automatic street lighting controller. All of the items in performance as a device were rated descriptively as very high acceptable by the students and community. Moreover, the students noted item number 3, capability to function the alarm when bulb uninstalled into the socket obtained the highest weighted mean of 3.87. Also, the community noted items numbers 2 and 3, a protection device for short circuits and efficient material useful for any environmental disturbance and capability to function the alarm when bulb uninstalled into the socket obtained the highest weighted mean of 3.93. All of the items in performance as trainer section were also rated descriptively as very high acceptable. Moreover, the students noted item number 4, which enhances the ability of the students on the basics of the innovation of the automatic street lighting controller device obtained the highest weighted mean of 3.87. In addition, the community noted that the items number 3 facilitates the teaching and learning process for more comprehensive ideas on anti-thief alarm using Photodiode and Infrared LED tandem obtained the highest weighted mean of 3.87.

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For items convenience of use, section was rated descriptively as very high acceptable. Moreover, the students noted item number 5, which promotes security alert by applying an anti-thief alarm obtained the highest weighted mean of 4. The community noted that the items numbers 2 and 5, eliminates impracticable manual control which leads to wastage of energy and promotes security alerts by applying an anti-thief alarm obtained the highest weighted mean of 4. All of the items in the safety section were rated descriptively as very high acceptable. Moreover, the students noted items numbers 1 and 4, availability of protection device as safety preventive measures for short circuits and ensure the proper connection of wirings and properly enclosed obtained the highest weighted mean of 3.93. The community noted the items numbers 1, 2, 4 and 5, availability of protection device as safety preventive measures for short circuits, ensures that the wiring connection of the device does not have loose contact, ensures the proper connection of wirings and properly enclosed, and ensures that the device can handle high voltage ranging from 110-250 volts obtained the highest weighted mean of 3.93. In assembly of parts section were rated descriptively as very high acceptable. Moreover, the students noted items numbers 2, ensures that parts that have been installed are in good condition and immovable obtained the highest weighted mean of 3.93. Based on the weighted means, all of the descriptive rating were very high acceptable. Therefore, the automatic street lighting controller were obviously accepted from the community and the students who were the respective respondents of the study.

Table- II: Acceptability level of the automatic street lighting controller

Description/Indicators	Students		Community	
	Mean	**DR**	**Mean**	**DR**
Performance as a device				
1. Performance that can stay longer at a maximum of 24 hours in a day.	3.80	Very High	3.87	Very High
2. Protection device for short circuits and efficient material useful for any environmental disturbance.	3.73	Very High	3.93	Very High
3. Capability to function the alarm when bulb uninstalled into the socket.	3.87	Very High	3.93	Very High
4. Ability to switch on automatically when night time sets on 5:00 PM to 6:00 PM.	3.80	Very High	3.80	Very High
5. Ability to switch off automatically when daytime sets on 5:00 PM to 6:00 AM.	3.80	Very High	3.87	Very High
Performance as trainers				
1. Increases the knowledge of the students, teachers, and the community about automatic street lighting controller as a device.	3.80	Very High	3.80	Very High
2. Facilitates the teaching and learning process for more comprehensive ideas on sensor LDR Light Dependent Resistor use as switching device.	3.67	Very High	3.73	Very High
3. Facilitate the teaching and learning process for more comprehensive ideas on anti-thief alarm using Photodiode and Infrared LED tandem.	3.47	Very High	3.87	Very High
4. Enhances the ability of the students on the basics of the innovation of the automatic street lighting controller device.	3.87	Very High	3.73	Very High
5. Makes students skillful in the latest trend of technology.	3.73	Very High	3.80	Very High
Convenience of Use				
1. Promotes automatic controller as an instant operation without hassle and wastage of time.	3.80	Very high	3.93	Very high
2. Eliminates impracticable manual control which leads to wastage of energy.	3.67	Very high	4.00	Very high
3. Eliminates failure and irregularities in power supply hinders the continuous illumination of streets.	3.67	Very high	3.87	Very high
4. Ensures safe, fast, and effective street lighting controller to all beneficiaries.	3.87	Very high	3.93	Very high
5. Promotes security alert by applying an anti-thief alarm.	4.00	Very high	4.00	Very high
Safety				
1. Availability of protection device as safety preventive measures for short circuits.	3.93	Very high	3.93	Very high
2. Ensures that the wiring connection of the device does not have loose contact.	3.80	Very high	3.93	Very high
3. Ensures that the device has a water and heat shield that can resist high and low temperatures.	3.60	Very high	3.87	Very high
4. Ensures the proper connection of wirings and properly enclosed.	3.93	Very high	3.93	Very high
5. Ensures that the device can handle high voltage ranging from 110-250 volts.	3.80	Very high	3.93	Very high
Costs and Availability of Materials				
1. The automatic street lighting controller device has a total cost of PHP 5,150.00. Other materials are recycled.	3.80	Very high	4.00	Very high
2. Ensures reliable and good quality materials are being used.	3.87	Very high	3.93	Very high
3. Parts and accessories are all available and common in the market.	4.00	Very high	4.00	Very high

DR-Descriptive Rating 1.0-1.8 poor 1.9-2.5 average 2.6-3.2 high 3.3- 4:00 Very high

Test of Significance

Results were interpreted at a 0.05 level of significance. Gadget's performance section, trainer performance section, the convenience of use section, safety section, and assembly of a part section of the source of variation from both respondents decided to accept the null hypothesis and interpreted as not significant both adopters have the same level in perception but acceptable to them. Furthermore, the cost section indicated that both respondents decided to reject the null hypothesis and interpreted it as significant, therefore the respondents differ its level of perceptions as to the degree of its acceptability.

Table- III: Test of Hypothesis

Source of Variation		df	t-stat	t-crit	p-value	Decision	Interpretation (.05α)
Students' vs Community	Gadgets Performance	1	-0.447	12.71	0.73	Accept null	Not significant
	Trainer Performance	20	0.814	2.09	0.43	Accept null	Not significant
	Convenience of Use	26	2.13	2.06	0.43	Accept null	Not significant
	Safety	28	1.56	2.05	0.13	Accept null	Not significant
	Assembly of Parts	28	0.557	2.05	0.58	Accept null	Not significant
	Cost	21	1.871	2.08	0.07	Reject null	significant

V. CONCLUSION

Both adapters highly accept the product as evident in the statistical result at 0.05 level of significance in terms of performance as to device and simulator, the convenience of use, safety, assembly of parts, and costs. The idea of the product was acceptable and accessible to the environment which promotes security, safety purposes, and avoiding accidents during night. This is a potential indicator that the propose prototype automatic street lighting controller is ready for adoption.

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