Design and Implementation of a Smart Versa - Light Energy Device

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Abstract: ***The Smart Versa - Light Energy Device was primarily developed to help communities look for a better alternative source of electrical energy. It was developed and tested using ISO 25010 standards which are functional suitability, reliability, portability, usability, performance efficiency, compatibility, and maintainability. This study made use of developmental type of research with 30 participants. The results of the study revealed that in all of the ISO 25010 characteristics the participants strongly agreed to the developed system. Weighted mean, Standard Deviation and Likert scale with verbal interpretation were used to analyze and evaluate the system. It is then concluded that the device was found to be helpful and beneficial to the people of the communities.***

Keywords: Sustainable energy, smart devices, emergency power, renewable energy, ISO 25010

1. Introduction

Technology transmutes simple lifestyles into high - tech modern living. that creates impact to human. Frequently, Smart Devices increasingly allowing their user to become productive in different aspects of life.

The light creates bridges that are responsible for the life functions as well as the light plays a role in the different features of human lives which lighten the field of an area or workplace it is essential to establish a good environment and create a good flow of work process that enable to open a visible field which simply allows us to see any external environment around us. The Smart versa - light energy device will allow the users to get the power and light that are necessary for their homes (Bani, et al, 2018).

Power sources very indispensable in provinces. Candles and lamps that lighten homes in mountainous areas which mostly powered by one power source, is not enough to enrich their state for a long period of time.

A smart device provides light and produce power sources for small gadgets at home in terms of power outage due to natural disaster. It also contributes to make environment becomes sustainable. Its resources are friendly to nature and the energy comes from the sun, salt water and hand crank that generates power.

The drift advancement of the technology brought an ease to the daily activity of human. Most of these lamp technology devices being developed commonly applied to the modern homes are commonly used for good dim lighting for studying, and used as a house design which is powered by direct electrical current from the outlet. There are also various lamps used for emergency which are powered by Solar, Salt solution mixture, and etc. However, these devices are not enough to supply energy in a long period of time.

Thus, this study was conceptualized, to address some issues especially in generating electrical energy in areas where electricity is not present.

General Objective

To design and develop a Smart Versa - light Energy device to have accessible lamp device in the time blackout and outage power and establish a better interaction between user and the device.

Specific Objectives

To generate Smart Versa - light energy device to produce a light for the basic need in the time emergency;

1) To apply an IOT for better interaction between the user and device using Arduino uno;
2) To integrate renewable three features such as mechanical, solar and salt solution into one device;
3) To design a portability device such that has (bail) and the solar has elastic rubber or rope holder that can use to place the solar panel where the sun are more attracted it can take indoor and outdoor;
4) To yield a lamp that has alternate choices to generate power source which may use depending to an environment scenario;
5) To provide each home temporary light in the time outage source of energy and in any scenarios of emergency such as natural disaster;
6) To innovate existing emergency lamp devices;

Conceptual Framework

Smart Versa - light Energy Device is aim to utilize the lives of everybody and contribute to eco - friendly lifestyle specially to those community experiencing the outage power interruption wherein their money is enough for essential necessity and homes in remote areas cannot reach power of electricity as well as in the time of emergency there will be a Lamp kit device that will guide them to provide a power source in small devices. The major feature of the system there will be three power source and a power energy provider which will be design for eco - friendly and renewable energy as well as applying IOT feature. Thus, switching to one another, if one of the features resources will not available in a certain environment then there will be another feature to use.

2. Methodology

This chapter presents the method will be use and activities will be done by researchers in the development process of

Smart Versa - light Energy Device. In this study the methodology will be use is general research strategy that indicates the standard procedure to be undertaken on a study and the methods, are tools in collecting data that have integral role to help the study to explore more and understand, in order to seek answer for the inquiries.

In this study, the observational research method and Developmental Method will be used to collect data. This method comprise different forms of observation which are natural observation, participant observation, case studies wherein these forms are important to be undertaken depending to the structure of data that will be conduct of the researchers it allows to take view specifically to the respondent's characteristics to conduct observation to a certain group of people to seek answers, evidences and analyzing the relationship of variables to the study. The researcher observes through disguised or undisguised interaction, asking questions, observes the social structure, lifestyle, behavior and observes in structured way of observation. This method amplifies the study about, which help to create a better path of understanding.

Research Design

In Systems Development Life Cycle (SDLC), the researcher choose a model base in Predictive Life Cycle Models. The researcher used prototyping model of system development life cycle which a desired prototype is build, tested and reworked until an acceptable design is achieved. It contains six prototyping model phases includes Planning, Analysis, Design, Develop/Build, Test, Deploy/Release and Maintain. Wherein the scope of the project is predictive.

The Samples

The samples of this study were taken from the random family in a community in Culasi, Antique, Philippines.

Whereas, five random respondents in every each one of six Barangays has been chosen wherein a total of 30 respondents evaluated the system.

Table 1: Profile of the Evaluators

Respondents	N	%
Brgy. Carit - an	5	16.67
Brgy. Poblacion	5	16.67
Brgy. Bitadtun Sur	5	16.67
Brgy. Centro Norte	5	16.67
Brgy. Naba	5	16.67
Brgy. Buhi	5	16.67
Total	30	100

The Instrument

In the preliminary of the development of the system the instrument we use to conduct data to analyze the state of the problem of the community we used.

1) What instrument or tool did you use in time of blackout or power interruption? (Be specific) ______________________ Is it Renewable based? YES NO Is it, can power other small devices Yes NO
2) The tool you used, is it expensive or costly in daily use ______________________________________
3) How the tool helps your problem in the time that there is no light? ____ ____ ____ ________________________
4) How everyone in the family immerse in the state of the situation problem?______________________________________ ____ ________________________
5) Are they satisfied to the tool for temporary solution and are they overcome the state of problem for temporary? ____ ____ __________________________
6) How many hours or time last of the temporary solution? ____
7) Is it worth using that tool or instrument to overcome the state of your situation in the time of power interruptions? ____ ____ ______________________________

The Five - Point Likert Scale used for evaluation

In this study the instrument being used by the developers was the evaluation form. It has 5 – items statement that is used to evaluate the system in terms of functionality, reliability, usability, efficiency, maintainability and portability of the system. A (1.00 - 5.00) Likert's Scale was used in this study. A rating of 4.21 - 5.00 - Very Good; 3.41 - 4.20 - Good; 2.61 - 3.40 - Acceptable; 1.81 - 2.60 - Poor; 1.00 - 1.80 - Very Poor.

The result of the evaluation was answered through the mean to measure the functionality, usability, efficiency, maintainability and portability of the Smart Versa Lamp Energy Device.

Development of the Study

In the beginning process of the system development, researchers step into an action to gathered data after the analysis the result is key to determine and understand the state of the problem of the respondents among community in order to form a concept solution regarding to a proposed system for the respondents.

The development of the study was divided into different stages:

Stage 1: Planning

In this phase of system planning, the researchers started to brainstorming about the field of the topic that will use for a basis of problem. After the researchers chose a field of topic, then they analyze the external and internal problem occurrence in a particular field to determine problem that relevant and significant. And they conduct preliminary interview to random community to understand the state description of the problem of the community to have basis knowledge in order to formulate an idea for the system then they list concepts of the system, then each of researchers contribute their own ideas about the feature that will be input in the system. And they expound the functionality of these features that will put in system. And each everyone agreed for chosen system title

During system planning we examine the require tasks, then discuss and decide on the dependencies between task. We also allocate the independent task to team members. Communicating frequently with our team members is a must in order to update the progress and ask their ideas and opinions about the study. We let each other know when a task or piece of functionality is complete and discuss frequently.

Stage 2: System Analysis
In this phase involves gathering requirements for the system. It focuses on what the system will do. Within this phase, the analyst is discovering the fact finding, the analyst must meet with the end users to understand what the users need are and to learn about the problems in order to make a new and more efficient system.

Stage 3: System Requirements
In this step, you actually define system requirements obtaining the investigation that starts during system planning and involves various facts technique such as interviews, survey, observation sampling.

Stage 4: System Design
In this phase, the researchers visualize the two layers of the system, the internal and external layer to create the possible prototype design, they drawn and contemplated the structure This phase is concerned with the physical construction of the system. Included the design or design of UI (users' interfaces) on how will provide the users a good interface view of physical design and UX (user experience) on how will provide a good utilization for the users. which is valuable and necessary for user used to establish a well - structured system. In this phase, the researchers, use all the gather information regarding on what would be the necessary data to be inputted and the function to be added to the interface and the design for the user's interface. The researchers are developing the system for the business so the design should be presentable.

Stage 5 Develop/Build
In this phase researchers started to assemble the components of the system. The system composed of 2 layers which have sub layers the following:
External Layer
Physical structure
Components
Internal Layer
Codes
Application

In the external layer, the physical structure, the body made of plywood and top is made acrylic plastic in a Kubo shape inspired with compartments divided for the features of system that has power button, USB ports and hand crank, battery, and solar.

The physical structure front and back width is 38 cm, while on the side width is 37 and the height is 26cm. In the other portion of structures of every compartment, for solar it has 36 front width and side width is 34cm, for the battery compartment it has 17cm height with a width 21cm, for Arduino compartment it has a 16cm front and back width, side width is 20cm and height is 13cm. The total height of the system is 58cm.

Stage 6. Testing
In this stage, all system components or parts connected to the system are required to check to have a guarantee are well functioned before releasing, there is no assurance that all components are stable at first assemble that this will help to determine the defective components and error and it will be conducive to ensure the flow of function and data communication of components are running good.

3. Results and Discussion

Table 2: Functional Suitability of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Completeness	21	9				4.7	0.46	Excellent
Correctness	17	13				4.5	0.49	Excellent
Appropriateness	17	13				4.5	0.49	Excellent

Reflected in Table 2 are the results of the evaluation as to functional suitability of the system with regards to completeness, correctness, and appropriateness. The mean scores of 4.70, 4.56, 4.56 which were interpreted as Excellent would attest that the system is functional which were also supported by the results of the computed standard deviation.

Table 3: Reliability of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Maturity	12	17	1			4.37	0.53	Excellent
Availability	15	14	1			4.47	0.56	Excellent
Fault Tolerance	20	7	3			4.57	0.66	Excellent
Recoverability	15	11	4			4.36	0.71	Excellent

Presented in Table 3 are the results of the evaluation as to reliability of the system with regards to maturity, availability, fault tolerance, and recoverability. The mean scores of 4.37, 4.47, 4.57, 4.36 which were interpreted as Excellent would affirm that the system is reliable which were also supported by the results of the computed standard deviation.

Table 4: Portability of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Adaptability	15	10	5			4.33	0.75	Excellent
Durability	12	15	3			4.30	0.64	Excellent
Installability	18	8	4			4.33	0.75	Excellent
Replaceability	13	12	5			4.27	0.73	Excellent
Affordability	17	12	1			4.53	0.56	Excellent

The data in Table 4 are the results of the evaluation as to portability of the system with regards to adaptability, durability, installability, replaceability, and affordability. The mean scores of 4.33, 4.30, 4.33, 4.27, and 4.53 which were interpreted as Excellent would support that the system is portable which were also supported by the results of the computed standard deviation.

Table 5: Usability of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Appropriateness/ Recognizability Learnability	13 22	14 7	3 1			4.33 4.70	0.65 0.53	Excellent Excellent
User Error Protection	18	8	4			4.47	0.71	Excellent
User interface aesthetics	14	13	3			4.37	0.70	Excellent
Accessibility	17	11	2			4.50	0.68	Excellent

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Reflected in Table 5 are the results of the evaluation as to usability of the system with regards to appropriateness/ recognizability, learnability, user error protection, user interface aesthetics, and accessibility The mean scores of 4.33, 4.70, 4.47, 4.37, and 4.50 which were interpreted as Excellent would prove that the system is usable which were also supported by the results of the computed standard deviation.

Table 6: Performance Efficiency of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Time Behavior	16	12	2			4.47	0.67	Excellent
Resource Utilization	17	12	1			4.53	0.69	Excellent
Capacity	26	4	1			4.20	0.75	Very Satisfactory

Reflected in Table 6 are the results of the evaluation as to performance efficiency of the system with regards to time behavior, resource utilization, and capacity. The mean scores of 4.47, 4.53, and 4.20 which were interpreted as Excellent would verify that the system is efficient which were also supported by the results of the computed standard deviation.

Table 7: Security of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Confidentiality	21	7	2			4.47	0.61	Excellent
Integrity	13	16	1			4.40	0.56	Excellent
Non - repudiation	14	13	3			4.37	0.66	Excellent
Accountability	15	13	2			4.43	0.61	Excellent
Authenticity	20	9	1			4.63	0.55	Excellent

Shown in Table 7 are the results of the evaluation as to security of the system with regards to confidentiality, integrity, non - repudiation, accountability, and authenticity. The mean scores of 4.63, 4.40, 4.37, 4.43, and 4.63 which were interpreted as Excellent would confirm that the system is secured which were also supported by the results of the computed standard deviation.

Table 8: Compatibility of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Co - existence	13	14	3			4.33	0.65	Excellent
Interoperability	16	12	2			4.47	0.62	Excellent

Reflected in Table 8 are the results of the evaluation as to compatibility of the system with regards to co - existence and interoperability. The mean scores of 4.33, 4.47 which were interpreted as Excellent would validate that the system is compatible to other related devices which were also supported by the results of the computed standard deviation.

Table 9: Maintainability of the System

Indicators	5	4	3	2	1	$\bar{X}$	SD	Interpretation
Modularity	17	10	3			4.47	0.67	Excellent
Reusability	17	12	1			4.53	0.56	Excellent
Analyzability	19	11				4.63	0.49	Excellent
Modifiability	21	8	1			4.67	0.51	Excellent
Testability	18	11	1			4.57	0.56	Excellent

Reflected in Table 9, are the results of the evaluation as to maintainability of the system with regards to modularity, reusability, analyzability, modifiability, and testability. The mean scores of 4.47, 4.53, 4.63, 4.67, and 4.57 which were interpreted as Excellent would authenticate that the system is maintainable which were also supported by the results of the computed standard deviation.

4. Summary

The study was conducted in order to help communities look for another source of energy utilizing the resources present. Interviews were conducted in order to gather sufficient data that could really help improve the study. Search for enough literatures and related studies was done so as to substantiate the study. Systems Development Life Cycle (SDLC) tool was utilized for this is really fitted in the development of the study. Moreover, descriptive statistics was utilized in order to analyze and interpret the results of the study where Likert scale was also used as basis in the said interpretation. Furthermore, appropriate programming languages were also considered for the furtherance of the developed system. Lastly, there were 30 respondents who evaluated the system based on ISO 25010 standards.

5. Findings

The system was found to be beneficial for the people of the community. It is really a big help to the residents especially during electrical brownouts. Also, the system was found to be a better alternative source of energy especially in the far - flung areas where the study was conducted.

6. Conclusions

Based on the above - mentioned findings, the researcher concluded that the developed system has really helped the residents look for a better alternative of energy. The expectations were met with regards to the characteristics of the software such functional suitability, reliability, affordability, feasibility, performance efficiency, security, compatibility, and maintainability.

7. Recommendations

Considering the above findings and conclusions**,** the developers offered the following:

1) The community should have this kind of system so that in case there are electrical brownouts they could have the power to light their houses.
2) The Department of Science and Technology should help improve the system for commercialization.
3) Future researchers may utilize the results of the study for the improvement of such similar research undertaking.

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