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Design, Development and Evaluation of Smart Lighting System for Physically Challenged Person

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Abstract: *This study determined the effectiveness of the propose project smart home lighting system for physically disabled person. Specifically, it deals the main usage of the proposed project, its functionality, applicability, durability and safety and how this project works properly in other to help people as a new innovation. The project is tested out of 20 respondents that has knowledge regarding electricity, enough to understand the flow of the project its material used, functions, usage and how it works. The proposed project has a very good application. It helps physically disabled person to use the device even if they are alone without the help of others. Device allow users can customize lighting environment.*

The conclusions are drawn based on the findings of the study. Enhanced control smart lighting systems provide individuals with physical disabilities the ability to control their lights using voice commands or mobile applications. Energy efficiency often incorporate energy-saving features, such as LED bulbs and automated scheduling. Physically impaired person this device had a very important usage by providing them with convenient and accessible control over their lighting environment. Future researchers are encouraged to conduct studies similar to the present investigation in their domain school..

Keywords: Smart Lighting, Design and Development, Automation, Controller System

I. INTRODUCTION

As the world gradually advances its way towards innovative modern ways of living, many inventions have been made and some have even been considered to be the most significant creations of the human race(Progress Mtshali and Khubisa 2019). The term smart home also referred to as intelligent buildings, automated home or integrated home systems refers to a structure that can gather and use information about its occupants and their surroundings in order to meet comfort and efficiency goals and design intelligent homes that better suit the needs of the users. Also, they are everywhere throughout the world(Ibrahim, Hassan, and Ali 2022).Automation, application of machines to tasks once performed by human beings or, increasingly, to tasks that would otherwise be impossible. Although the term mechanization is often used to refer to the simple replacement of human labor by machines, automation generally implies the integration of machines into a self-governing system. Automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it(Swamy, …, and 2020 n.d.).Automation performs an increasingly vital role in daily Experience and global economy. Engineers strive to Combine automated devices with mathematical and Organizational tools to create complex systems for a Rapidly expanding range of applications and human activities(Soheilian et al. 2021). The concept of home automation has been around since the late 1970s. But with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home, and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems(Chandrakar et al. n.d.). A home automation system means to grant the end users to Manage and handle the electric appliances. If we look at Different home automation systems over time, they have Always tried to provide efficient, convenient, and safe Ways for home inhabitants to access their homes(Vanus et al. n.d.). Regardless of the change in user's hope, growing Technology, or change of time, the appearance of a home Automation system has remained the same.

Smart home technology generally refers to any suite of devices, appliances, or systems that connect into a common network that can be independently and remotely controlled. When home electrical network, namely: the thermostat,

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lights, audio speakers, TVs, security cameras, locks, appliances, and more are all connected into a common system, which can be controlled from a smart phone(Anh Khoa et al. 2020).Wi-Fi based home automation system mainly consist three Modules, the server, the hardware interface module, and the software package. The figure shows the system model Layout. Wi-Fi technology is used by server, and hardware Interface module to communicate with each other(Swamy, …, and 2020 n.d.). The Same technology uses to login to the server web-based application. The server is connected to the internet, so remote users can access server web-based application through the internet using compatible web browser or specified app(P Mtshali, Information, and 2019 n.d.). Locally, the Philippines could use this technology as an opportunity for sustainable developmental living. According to TSP Smart Spaces, Smart Homes and its technology offer environment friendly solutions as per the lighting, window, climate control, and many more as it decreases energy consumption. In this light, the researchers hope for this study to serve as an avenue for ideas to open new doors towards aiding the human civilization one step further towards embracing and maximizing the most out of modernity, all while making certain to be tapping on to the aspects of efficiency, convenience, sustainability, among others. This study allows you to personalize the lighting in your home to fit any mood or activity and to have greater control of your energy use. The benefits of home automation include safety, convenience, control, comfort, and energy savings. With automated home lighting systems, you can ensure you're getting the right amount of light as and when you need it.

II. REVIEW OF LITERATURE

Studies of Smart Home Lighting system

Smart home technology generally refers to any suite of devices, appliances, or systems that connect into a common network that can be independently and remotely controlled. When home electrical network, namely: the thermostat, lights, audio speakers, TVs, security cameras, locks, appliances, and more are all connected into a common system, which can be controlled from a smart phone. Residential and business buildings account for approximately 20% of the overall world-wide energy consumption, with an increasing trend over time(Leporini and Buzzi 2018). The major energy consumers in buildings are space heating and conditioning, water heating, lighting, and the use of computers and other electronic devices. It reveals that lighting is significant among energy consumers in buildings for it consumes massive quantity of the energy(Amoran et al. 2021). The lighting source could be wasted or overuse in some cases. Smart switching unit niftily enables home-owners optimize usage of energy with amazing results, viz: easy of control, flexibility for new devices and appliances, maximizing home security, remote control of functional units, increased energy efficiency, improved appliance functionality and home management insights. However, with the growth of networks in homes, electronic products can automatically send periodic signals about its status. With enhanced awareness there may be a need for increased cyber security and privacy to prevent the activities of hackers(Rashid, Louis, and Fiawoyife 2019).

Automation system.

The term automation had existed for many years. It began with a student connecting two electric wires to the hands of an alarm clock in order to close a circuit of a battery and light bulb. Other companies later developed automated systems of their own to control alarms, sensors and cameras thereby creating the first automated buildings(Chan et al. 2008). Earlier smart devices are smart home automation system (SHAS) of Thakur and Sharma which proposed voice control and Zigbee based home automation system where user has to give voice command to control in-home appliances. Zigbee is used to communicate between base station and remote station. A global system for mobile (GSM) based home automation system (HAS) can control in-home appliances by sending SMS to an HAS placed in home environment via GSM modem which interfaced with switching module through a microcontroller. A GSM and ZigBee based communication and control for home appliances has been presented by many researchers. However, the drawback of these systems is that, in ZigBee, range plays important role while a GSM requires adequate coverage of GSM mobile signal.

Recent home switches have tendencies to incorporate embedded devices and consumer appliances into software systems. The possibility of having access to many devices within a building from anywhere at any time solves a lot of problems of the user often saving significant amount of resources. It also boosts security in a building. Access could be

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achieved from many different digital devices given that network hierarchy has been lowering rapidly in the chain towards smaller and more personal devices using internet of things. With exponential growth of the internet and telecommunication technology, home automation is experiencing an accelerated growth based on different kinds of residential network. The role of GSM wireless transmission in setting up home automation system cannot be overemphasized. And its cost implication is relatively low when compared to other modes of communication. GSM-related monitoring and control systems have been implemented in the past for automation of irrigation water controller system, management of digital energy meter, highway vehicle traffic monitoring system and others, incorporating several wonderful features. Of concern in this study are the conservation of energy at homes and offices by developing an automated switching system with the capability to monitor and regulate energy usage within a remote building with the ultimate aim of optimizing usage of available energy resources and also to design a platform whereelectrical consumers can control their household appliances from any location with mobile phones.

The development of an Internet-based system to allow monitoring of important process variables from A distributed control system (DCS). This paper proposes hardware and software Design considerations which enable the user to access the process variables on The DCS, remotely and effectively Potamitis, et.al G. (2003) suggested the use of Speech to interact remotely with the home appliances to perform a particular Action on behalf of the user. The approach is inclined for people with Disability to perform real-life operations at home by directing appliances Through speech. Voice separation strategy is selected to take appropriate Decision by speech recognition In the year 2006, S. M. Anamul Haque,S. M. Kamruzzaman and Md. Ashraful Islam Proposed a system entitled "A System for Smart-Home Control of Appliances Based on Time and Speech Interaction" that controls the home appliances using The personal computer. This system is developed by using the Visual Basic 6.0 As programming language and Microsoft voice engine tools for speech Recognition purpose. Appliances can be either controlled by timer or by voice Command. Ciubotaru-Petrescu, Chiciudean, Cioarga, and Stanescu (2006) present a design and implementation of SMS based control for monitoring systems. The paper has Three modules involving sensing unit for monitoring the complex applications. A processing unit, that is microcontroller and a communication module that Uses GPRS modem or cell phone via serial port RS-232. The SMS is used for Status reporting such as power failure. Jawarkar, Ahmed, Ladhake, and Thakare (2008) propose remote monitoring through Mobile phone involving the use of spoken commands. The spoken commands are Generated and sent in the form of text SMS to the control system and then the Microcontroller on the basis of SMS takes a decision of a particular task. Prof. Era Johri Dept. Of Information And Technology K.J.Somaiya College Of Engineering VIDYAVIHAR, MUMBAI "Remote Controlled Home Automation Using Android Application via Wi-Fi Connectivity".

III. CONCEPTUAL FRAMEWORK

This study is Automation Lighting System Device is carefully planned, constructed, tested, and efficient when using at home The concept of this study is shown in Figure 1. The figure represents the flow of the study. The first box represents the knowledge and skills to create the project, materials, tools and equipment in assisting on making the project. The second box represents the designing of the project, before proceeding in fabricating and assembling the materials provided, after assembling the device should be tested and evaluate in order to know if the device is in good condition. The third box represents the finish product of the project created by the team which is the Smart Home Lighting Automation System.

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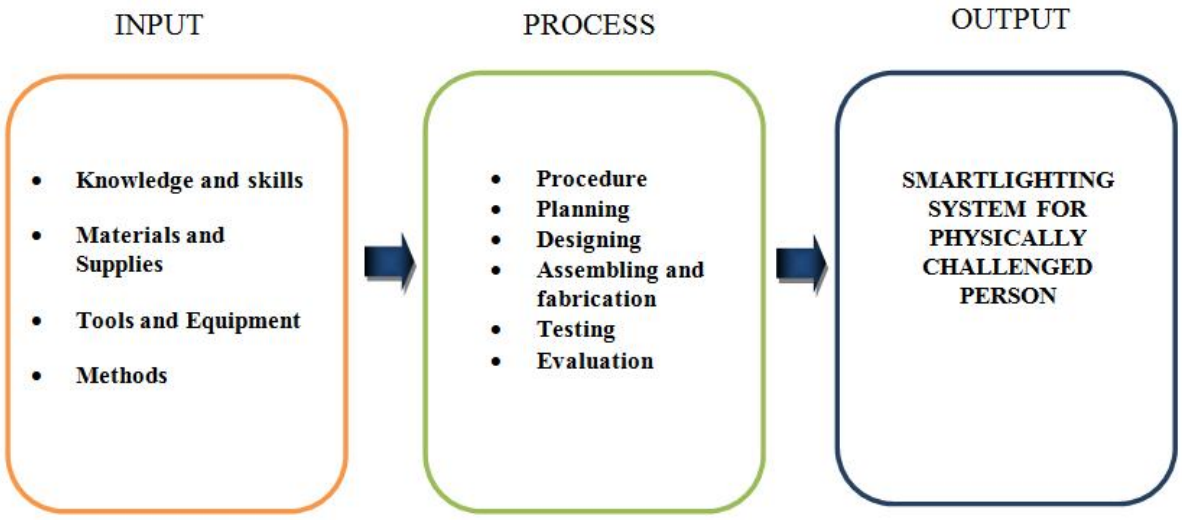

Figure 1: Conceptual Model of the Study

Objectives of the Study

The main thrust of this study is to develop a smart home lighting automation system. Specifically, this study aimed to achieve the following objectives

1) To develop and design a smart home lighting automation.
2) Design circuits and their corresponding interfaces.
3) Determine the acceptability of the device in terms of:
a) functionality
b) Applicability
c) Workability
d) Durability
e) Safety
4) Develop User Manual

Significance of the Study

This study aims to develop a smart home lighting automation system with regards to the modern Technologies, the purpose of a home automation system is to streamline how your home functions. Consider some of these benefits: Remote access: Control your home from mobile devices, including your laptop, tablet, or smartphone. Comfort: Use home automation to make your home a more comfortable and livable space.

The following are the beneficiaries of the study to be conducted by the researchers:

- **Students**. This study will help them in their daily life activities, to make it way more convenient.
- **Teacher.** This study will help the proof to have a convenient lighting automation System in their respective classrooms.
- **Families**. This study will help the whole family to have a convenient lifestyle and way easier than what does the past Technologies did.
- **Future Researchers**. This research can be a reference of a new study to the future researchers. This will serve as a 'ground zero' for uphold in.

Project Design

Below is the design of the research project or the prototype design of a smart home lighting automation System, included the labeled parts of the research project.

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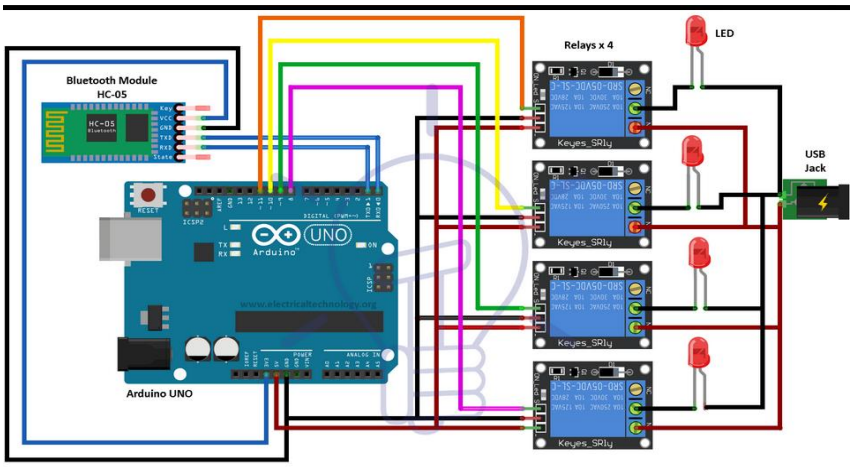

Figure 2: Schgematic Diagram

Scope and limitations

This study will be conducted in Surigao Del Norte State University. The main objective of this study is to provide a convenient lighting automation System to the selected classrooms inside SNSU, and to experience the modern Technologies inside the classrooms.

Definition of Terms: The following terms are operationally used in this study:

- **Smart Home**. A smart home is a residence that uses internet-connected devices to enable the remote monitoring and management of appliances and systems, such as lighting and heating.
- **Automation.** The technique of making an apparatus, a process, or a system operate automatically." We define automation as "the creation and application of technology to monitor and control the production and delivery of products and services.
- **Wi-Fi.** A facility allowing computers, smartphones, or other devices to connect to the internet or communicate with one another wirelessly within a particular area.
- **Wi-Fi Wireless Switch.** Wireless switching is changing the way wireless networks work. Instead of access points (APs) bridging traffic directly onto a wired network, wireless switching creates a virtual overlay network on top of an existing wired infrastructure**.**
- **Remote.** Conducted or working away from a usual workplace or location, making use of communications technology.

Project Description

Smart-home devices can sometimes feel almost magical. They allow you to turn on lights without having to touch a switch, answer the front door from your bedroom (or a hotel room), and tweak your thermostat with a simple voice command. For many people, those capabilities are a convenience or a luxury. But for those who live with accessibility challenges, smart-home technology can be a powerful enabler, one that allows them to live a more independent and empowered life. The proposed project is described under Figure 3. It shows flow design and description on how the proposed project being assembled and connected. It also shows the connection set up and the whole of connection diagram that described every point detail on the said project.

Project Structure

The project structure of this design entails the process or steps in completing the project. It shows the detail process how project being done starting from the gathering of material, tools to be use and including the desired outcome design. Below is the structural procedure of this project showing every step until the project completion.

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Project Development

The following are procedural steps in making the project.

1. Gather all necessary material needed in making the said project.
2. Check and make sure that all the devices to be use is functional and not defective.
3. Connect all the wirings starting from the male plug to wireless switch and to the receptacle and install the bulb. And set the pairing System with the intended remote.
4. Check all the wiring components if it is exactly connected
5. Test the components if it is functioning will. After setting all the components, checking the proper wiring connections, now the smart home lighting automation is ready to use.
6. The Research Study includes consideration on the following method of operation:

Installation: Fasten the wires to the male plug and connect the other tips of the wire to the input of the wireless switch and add other wires to the output of the wireless switch and simply connect into the receptacle and attach the bulb. And follow the pairing procedure of a wireless switch to the remote-control system.

Operation Procedure

In determining the performance of the device, the following procedure was followed:

1. Check the whole system whether all the components are correctly installed.
2. Inspect wiring connections that would possibly make up accidents.
3. Prepare the required materials for the conduct of operation
4. Observe proper or correct installation.

Testing Procedure

In order to assure that every part of the device is working properly, the following test procedure should be done:

1. Testing all the materials to be used in making the project.
2. Check each connection points.
3. Check the wireless switch using Multi tester to identify it produce exact amount of electricity
4. Test the device and conduct an assessment and efficiency on it.

Evaluation Procedure

Evaluation is a way to determine the acceptability of the proposed project. Selected people were asked to rate the performance of the device. These respondents were composed of selected residents in Surigao Del Norte State University, SNSU' selected classrooms. Prior to the actual demonstration/evaluation of the device, the researcher explained the function of the device as well as its specification of the prototype. Before the evaluation sheet was given to the respondents, its content was discussed by the researchers. When the evaluation has been accomplished, the result was tabulated and computed to find the mean of every criterion as well as the overall mean.The respondents will then evaluate the said proposed project based on usability, quality of design, functionality, safety, and efficiency. The evaluation sheet is provided where respondents can write their comments and suggestions for further improvement of the device.

IV. RESULTS AND DISCUSSIONS

Evaluation result of the study is based on the instruments made by the researchers. Each variable in the instruments reflect on the project that caters the process of propose project.

Functionality

Criteria	Mean Score	Verbal Interpretation
Function of the device is meet as it expected.	4.46	Very Good
The device performs the task effectively.	4.45	Very Good
The device has a minimal error.	4.45	Very Good

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The device can be enhanced or updated.	4.13	Very Good
Over-all Mean	4.37	Very Good

Table 1. illustrates that the rating of respondents on smart home lighting system for physically disabled person is **Very Good** and got the over-all mean of 4.37. The result implies that aspect of functionality of the device is high. Among the four items the highest item is "function of the device is meet as it expected" which obtained the mean of 4.46. Thus, it means that the device work in accordance to its desired output.

Applicability

Criteria	Mean Score	Verbal Interpretation
The device has a specific application	4.13	Very Good
The device accommodates the specific needs of its users.	4.23	Very Good
The device meets the safety standards.	4.2	Very Good
Over-all Mean	4.19	Very Good

In applicability, Table 2. indicates the result on how applicable the proposed device is. All item shows a desirable result and earned high scores that with over-all mean of 4.19 and interpreted as **Very Good.**

Workability

Criteria	Mean Score	Verbal Interpretation
Availability of materials	4.27	Very Good
Availability of expertise	4.10	Very Good
Availability of tools and machines for fabrication	4.07	Very Good
Over-all Mean	4.14	Very Good

In Table 3. device workability is being measured as to its materials availability, available of experts to examine the prototype, and tool and other related machines used for fabrication are available. In the premise the output result shows the over-all mean of 4.14 and rated **Very Good.** This also implies that the device can be adjusted or repaired using materials present in the locality.

Durability

In all aspect of any device this criterion plays a crucial rule. It could not be denied that durability of certain device is more often seen as a leading edge as to its development.

Criteria	Mean Score	Verbal Interpretation
Resistance for deformation	4.10	Very Good
Quality of the design.	4.17	Very Good
Endurance of the unit to high temperature.	4.23	Very Good
Over-all Mean	4.17	Very Good

Table 4. suggest that the durability aspect of the proposed device. This show the device characteristics as to resistance for deformation, quality of design and its endurance to high temperature which garnered a 4.17 over-all mean. This means only that the proposed device is high acceptable as to its durability and with a Very Good interpretation

Safety

Criteria	Mean Score	Verbal Interpretation
Absence of sharp edges	4.33	Very Good
Absence of toxic materials	4.2	Very Good
Provision for protection	4.27	Very Good
Over-all Mean	4.27	Very Good

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Table 5. indicates the acceptability of the device that is rated on the Safety aspects. This shows the device can be used perfectly as it precedes to its expectation. The prototype obtained a rating of 4.27 over-all mean and rated Very Good. Also, the device is safe due to absence of sharp edges and with complete protection.

Summary

Table 6. Summary on the Acceptability of Over and Under Voltage Controller system.

Criteria	Mean Score	Verbal Interpretation
Functionality	4.74	Very Good
Applicability	4.19	Very Good
Workability	4.14	Very Good
Durability	4.17	Very Good
Safety	4.27	Very Good
Over-all Mean	4.30	Very Good

Presented in Table 6. The summary of ratings of respondent's smart home lighting system for physically disabled person on the aspects of functionality, applicability, workability, durability, safety which the result indicates functionality is the highest rated aspect with a mean of 4.74 followed by safety with a mean of 4.27, applicability with a mean of 4.19, and durability with a mean of 1.17. The lowest aspect is workability with a mean of 4.14. All aspects are rated **Very Good**.

This study determined the effectiveness of the propose project smart home lighting system for physically disabled person. Specifically, it deals the main usage of the proposed project, its functionality, applicability, durability and safety and how this project works properly in other to help people as a new innovation.The project is tested out of 20 respondents that has knowledge regarding electricity, enough to understand the flow of the project its material used, functions, usage and how it works.

V. FINDINGS

The findings of the proposed project are listed below:

1. The proposed project has a very good application.
2. It helps physically disabled person to use the device even if they are alone without the help of others.
3. Device allow users can customize lighting environment.

VI. CONCLUSIONS

The following conclusions are drawn based on the findings of the study.

1. Enhanced Control: Smart lighting systems provide individuals with physical disabilities the ability to control their lights using voice commands or mobile applications.
2. Energy Efficiency: Smart lighting systems often incorporate energy-saving features, such as LED bulbs and automated scheduling.

VII. RECOMMENDATIONS

1. Physically Impaired Person: This device had a very important usage by providing them with convenient and accessible control over their lighting environment.
2. Future Researchers. They are encouraged to conduct studies similar to the present investigation in their domain school.

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