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Development of Arduino Lighting System for Classroom Used

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Abstract

This project proposes a smart lighting system based on human presence. Pyroelectric Infrared (PIR Sensor) will be utilized to detect the human presence and the Light Dependent Resistor (LDR Sensor) will be used to measure the surrounding light intensity which will manage to fix the lamp light based on the surrounding light intensity. The dimmer principle is based on Pulse Width Modulation (PWM) which will control the light intensity. In this system dual modes are used, which is auto and manual modes. In the manual mode, the system will be controlled using mobile app which will be connected through Bluetooth to the system. Meanwhile, for auto mode, the system will operate based on the human presence in the place.

Keywords: - Arduino Uno, light intensity, automatic, manual, light system

1. Introduction

In today's era, energy efficient systems and devices are the needs of the times. Humans waste too much power by not turning off lights, when they're not in use. To overcome this problem, a device was developed that can be installed classroom. This device will detect the presence of a person and automatically turn the device on and off and controllable with phone's application (Maswoodhur, Salah & Walled, 2021). The paper also discusses using IoT to control light intensity and turn lights on and off anywhere as needed (Said, Abdullah & Basir, 2020). This concept not only increase electrical efficient, but also extends the life of light components.

Electricity efficiency can be increased by using the suggested system because electrical appliances will be automatically turned ON or OFF based on the presence of a human being using a PIR sensor (Kamthe et al., 2020), there is no need to turn off or turn on the electrical appliances prior to departure or upon arrival in your cabin. This is the primary improvement of the projected system. (Indeevar et al., 2017). The authors of the paper presented the concept of home automation using IR sensors and LDR. The system is connected to the Internet through a local area network (LAN). Development of Arduino Lighting System for Classroom demonstrated using Android app through Arduino microcontroller via Bluetooth. Vibhuti et al. (2018) proposed a system that uses relay control and the WAGO PLC (Programmable Logic Controller) and Arduino Uno. Devices such as tube lights can be switched on and off spontaneously using a PIR sensor and environmental conditions. Automatic control is provided by sensor data in real-time implementation, while manual control is provided by an Android application. However, the difficulty in this paper is the control and monitoring of devices done with an

Arduino Uno. These operations are possible with only an Arduino Uno. In addition, research was conducted using a vacancy sensor (Ajay et al., 2016), which is a direct replacement for standard wall switches. These sensors are combined with passive infrared technology to detect the presence of personnel in the room as well as voltage switching in a single package. If a room is left empty for 5-10 minutes, this system will turn off the lights. These sensors are mounted on the ceiling and have a 180 and 360 degree filed view, covering an area of up to 1000 square feet. However, these sensors have some drawbacks, including limited range (one sensor may not cover an entire room) and the need for a lot of additional wiring in the case of wired sensors.

Thus, due to that, this project was built to reduce the limitation happen in previous paper and will be used for classroom application, where it can detect people and turn on the lights automatically. Not only that, the lights will go off if the user leaves the classroom. Moreover, this project can detect the surrounding brightness and adjust the brightness of the lights with the surroundings replace the light switch by using a smartphone.

The proposed project also uses an Arduino system and MIT app inventor to work. Compared to a traditional classroom, the proposed project has an automatic system and can control the brightness. The limitation for the traditional room is the brightness of the lights in the room cannot be controlled and adjust the brightness with the surroundings. For example, if it is raining, the room will look a little brighter and if it is noon, the lights will be a little bit dimmer. This function cannot be found in a normal classroom, which is user with the brightness of the atmosphere.

The light switch in the room is opened and closed manually with another view, that is, it does not have an automatic system. The automatic system can facilitate us so that we can open the lamp automatically. This is the problem author have and want to solve it. No remote control. This problem causes the user to always go to the place of the switch to open or close the lamp. If there is a remote-control system, the user only needs to use the control to open or close the lamp in any place.

The project is suitable in rooms that use manual switches and need to control the brightness of the lamp, including: i. Classrooms, ii. Laboratory and iii. Meeting Room. As mention in Table 1, for the ordinary or traditional room, normally, the switch is stick on the wall, it may cause the inconvenience of the room user to switch on or off the light compared to the light system, which able to remote control the light as can determine by the room user. Furthermore, the lack of the ordinary room that mostly cannot be adjusted brightness of the room compare to the light system which able to adjust surrounding brightness by remote way. Furthermore, in a common room the light required room user to turn off or on else the light will remain idle compare to the light system, the room will run automatic mode when it set. The lights will turn on or off depending human presence via PIR motion sensor in the room. Whenever no human presence is detected in the room, the lights will turn off for in a minute. The delay time setting depends on it needs. Thus, due to that, the new lighting system is proposed in this paper.

Table 1: Differences between ordinary room and light system room

Ordinary Room	**Light System Room**
The switch is on the wall	The light system is used as a remote control
Brightness cannot be composed	Brightness can be adjusted according to the surroundings
A switch is required to turn off or on by manually	Automated systems to runs sensors.

2. Methodology

The architecture of the proposed system is shown in Fig. 1. In this paper, two major components will be used, which are hardware and software.

A. Hardware

The main hardware components required for this project include Arduino microcontroller, PIR sensor, Bluetooth module (HC-05), LED strip 5630, LDR sensor, Transistor (TIP120), Power supply 12V, cables and jumper wires. The overall circuit connection is shown in Fig. 1 below and component labelling are shown in Table 1.

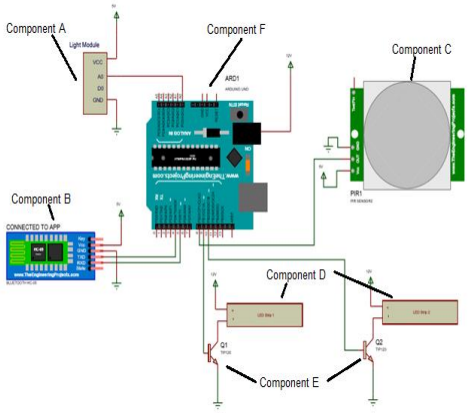


Fig. 1. Overall diagram connection components with Arduino UNO

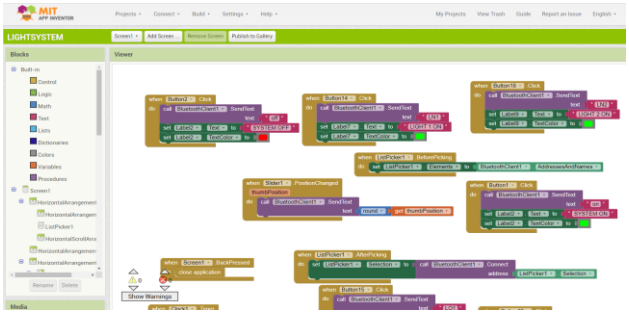
Table 1: Label component of proposed design

A	Light Dependent Resistor (LDR Sensor)
B	Bluetooth Module HC-05
C	Pyroelectric Infrared (PIR Sensor)
D	Led Strip 5V
E	NPN Transistor (TIP120)
F	Arduino UNO

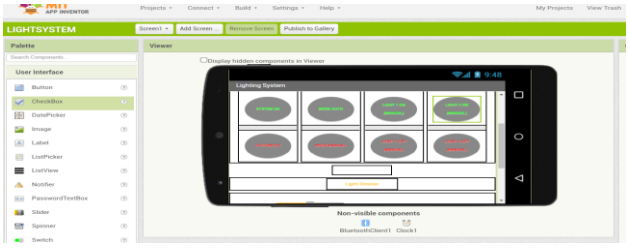
B. Software

Meanwhile, for the software components as shown in Fig. 2 (a) and (b) include Arduino IDE to program the Arduino UNO microcontroller using C/C++ language communication with MIT Inventor Application (Walter & Sherman, 2015). The Arduino UNO microcontroller is the central processing unit of the Arduino light system based on the requirements to determine the function it needs. The function of this microcontroller that has been programmed with the instructions is to analyze from the problem statements and to carry out the appropriate functions by solving those issues.

In this project 12V LED strip are use and Arduino board are connecting together with Bluetooth adapter, LDR module and PLR sensor. The maximum distance of Bluetooth is 15m. Meanwhile, for PIR sensor has a delay time from 5 seconds to 5 minutes. PIR sensor has a distance of 7m with 120 degrees to detect the user and LDR module uses 5V and its sensitivity can be changed.



(a)



(b)

Fig. 2. (a) Blocks as communicating with an Arudino UNO and (b) build icon, name and box of the proposed project

Fig. 3 show the flow chart of the proposed project and the description as follows:

- The system works, the circuit will perform manual or automatic operation.
- If the system is running an automatic operation, the system will run the PIR sensor will work and the Arduino will run the operation.
- If the system performs a manual operation, the system will run through the MIT app inventor and the Arduino will run the operation.
- The Arduino will run the intensity light system operation to turn on or off the LEDs.

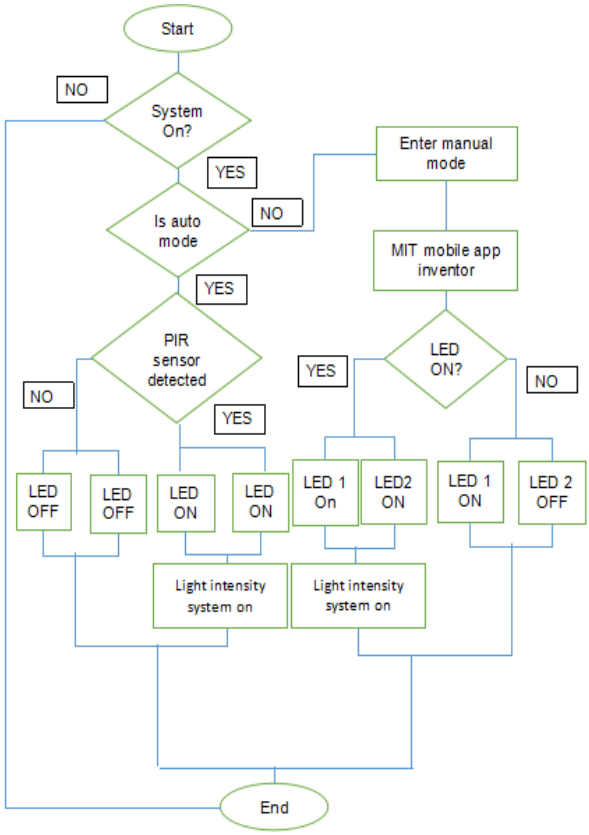


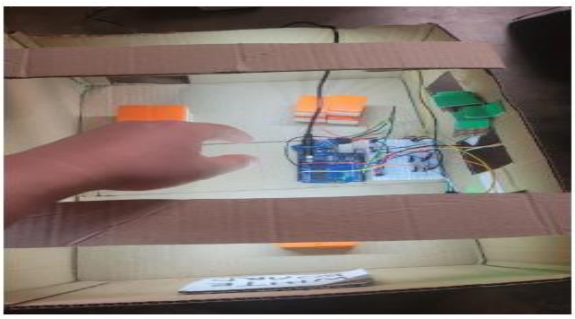
Fig. 3. Flow chart of development Arduino lighting system for classroom

3. Result and Discussion

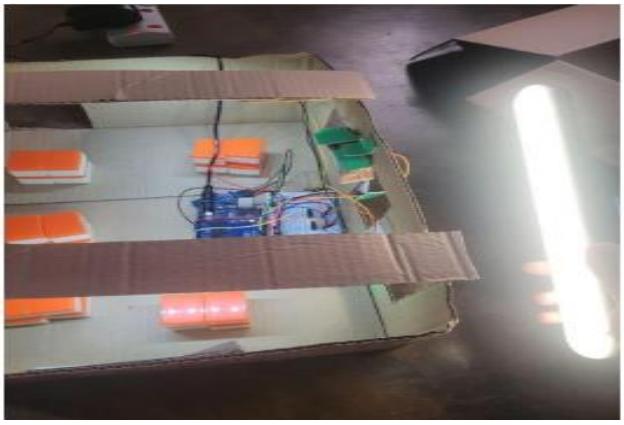
In this part, three sections will be discussed.

a) Prototype of Project

Fig. 4 shows the overall prototypes of proposed project. Fig. 4 (a) shows, whenever PIR sensor detect human presence, the room light will turn on. Once everyone is left the light will turn off after 20 seconds based the setting has set. Meanwhile, Fig. 4 (b) shows, when the project is in the remote mode, the day light is received from outdoor, microcontroller will automatically adjust the light based on the brightness of the room.



(a)



(b)

Fig. 4 Simulation project environment (a) detect human presence and (b) receive outdoor light

In Fig. 5, the user uses the MIT App to control the front and rear lights. Additionally, the user choose the desired light level.

Fig. 5: Simulation project to control the front, rear and level lights

b) Analysis of Current Consumption

As shown in Table 2, a light intensity for how much current that use for the lights based on the time of day at 9am, 12pm, 3pm and 5pm for a week is analyzed. From the analysis, the current consumption is depending on the current time (day and night). For example, when the time is at 9 am, then the current consumption is around 20.3 mA and when the time is at 3pm, the current consumption is around 9.7 mA. It will show that, no lighting is ON during mid-night.

Table 2. Time zone for the current consumption

Time	Current (mA)
9am	20.3mA
12pm	14.8mA
3pm	9.7mA
5pm	19.5mA

In the second analysis, a one-week data analysis and results according to the table 3 are made. The factor might be different if the location of the LDR sensor is place on different area due to light spot angle. The manual control light brightness on how much current accordingly use for 0%, 25%, 50%, 75%, and 100% for recording the results.

c) Analysis on The Brightness Control

Table 3. Comparison the brightness control versus the current use

Brightness control in percentage	Current
0%	1.97mA
25%	6.12mA
50%	9.83mA
75%	18.2mA
100%	24.9mA

From the Table 3, its shows that, by controlling the brightness of the light intensity, it may result in how much current of the lamp are uses, and the greater the current, the greater the brightness of the lamp. Most rooms are not able to use automatic systems and control the brightness of the lights. Therefore, in this project, Arduino Classroom Light Up System has been produced to overcome the problem. This project is able to facilitate use because it has two systems, automatic and manual. Arduino inventor to perform functions such as sensors, Bluetooth adapters and so on.

Among the advantages of using this Arduino UNO board is that programming is easier to do. In addition, the inputs and outputs available on the Arduino UNO board are also compatible with what is used. Furthermore, this Arduino also has many inputs and outputs. Therefore, if there are improvements on this project, the addition of the pin number can be done on the Arduino board without changing a new board.

4. Conclusion

From the conclusion, all objectives were achieved; the lights were turned on automatically. Using of "PIR SENSOR" help perform the operation of opening and closing the lights in the classroom with the presence of people in the classroom. In addition, the brightness of the lights has been successfully controlled with "DIGITAL LIGHT INTENSITY SENSOR MODULE" according to the brightness in the classroom and outside automatically and manually. Mobile phone apps have managed to function automatically and manually. With this application, all objectives have been achieved by controlling the brightness of the lights, the lights are turned on and off.

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