Design of a Light Intensity Regulator with Remote Control for Incandescent Lamps

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ABSTRACT

Research has been carried out on the design of a light intensity regulator with a remote control on incandescent lamps. This study aims to design and manufacture a light intensity controller that can be controlled remotely. This research uses Infrared Light Emitting Diode (LED) as transmitter and phototransistor module as receiver. The results of this study indicate that the tool that has been successfully designed and made can function up to a distance of 300 cm.

Keywords:
Transmitter
Receiver
Light intensity
Electronic Components
Electric Circuits and Current

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INTRODUCTION

Light technology in providing lighting today has helped many people’s activities in carrying out their daily work. Because the role of lamps is very important, many industries create various kinds of products and brands of lamps from cheap to expensive. The lamps that are often used today are fluorescent lamps and incandescent lamps. In fluorescent lamps the power output is small but provides a large intensity. While incandescent lamps produce light in accordance with the power issued by the lamp. Incandescent lamps can also be adjusted for power and light intensity by changing the current flowing into the lamp, for example when used in a series of dimmer lamps.

The advantage of this dimmer lamp circuit is that in addition to the low cost, the dimmer lamp circuit also provides a change in resistance value which is regulated by a continuous system. In addition, a series of dimmer lamps can also be developed, namely by designing a tool that can regulate the intensity of light by changing the current which can be controlled remotely. Besides that, this tool is also very important and has never been created before.

A rectifier circuit is a circuit that functions to change the voltage from AC to DC. In the rectifier circuit there is a diode that functions to change the voltage from AC to DC. Rectifiers are divided into two types, namely, half-wave rectifiers and full-wave rectifiers.
The output of the bridge rectifier is a pulsed DC voltage, so that before being used to provide power supply to electronic equipment, the pulsed voltage must be filtered or smoothed so that the output from the power supply is an almost steady voltage.

Luminous intensity is a basic physical quantity to measure the power emitted by a light source in a certain direction per unit angle. The SI unit of luminous intensity is the candela (Cd). In the field of optics and photometry (photography), the ability of the human eye is only sensitive and can see light with a certain wavelength (visible light spectrum) which is measured in this basic quantity.

**RESEARCH METHOD**

**Research time and place**
This research was conducted at the Basic Physics Laboratory of the State Islamic University (UIN) Alauddin Makassar Jalan Sultan Alauddin No. 36 Samata Gowa on 27 July to 28 October 2010.

**Research tools and materials**
The tools used in this research are: Soldering; Cutting pliers; Pasta; Multimeters; Lead; Lead Sucker.

The materials used in the design of this tool are: two IC 555; IC 7447 one piece; IC 7442 one piece; IC 74192 one piece; IC 7404 two pieces; One IC KIA 7812; IC L 7805 one piece; One 12 Volt 2A ankle transformer; 1 piece IR LED; Resistors 22 KΩ 1 piece; Resistors 1 MΩ 1 piece; Resistors 330 1 piece; Resistors 39 KΩ 2 pieces; Resistors 1 KΩ 2 pieces; Resistors 20 KΩ 1 piece; Resistor 56 1 piece; Resistors 5.6 1 piece; Resistors 350 7 pieces; Capacitors 1 F 3 pieces; 100 N capacitor 1 piece; 1 nF capacitor 1 piece; one transistor BD 139; Transistor BC 547 A 1 piece; Potentiometer 20 KΩ 2 pieces; 1 piece DIAC diode; TRIAC BT 137/800 one piece; Diode 4004 one piece; Fuse 1 piece; PCB / Circuit board 2 sheets; Phototransistor module 1 piece; Seven Segment 1 piece; One piece DC 12V/5 pole relay; Cables / Connectors to taste; Battery holder; Fittyng 1 piece; 1 piece incandescent lamp; Socket 1 piece; 9 rod bolts.

a.  **Tool Block Diagram/Tool Performance**

The block diagram of the light intensity regulator in incandescent lamps consists of: Infrared Transmitter Unit (Transmitter); Infrared Receiver Unit (Receiver); Digital Counter Unit; Relay Driver Units; Dimmer Units; Power Supply Unit.

b.  **Research Flowchart**

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    Mulai
       |__________________________
       |                      |
       |  Merancang Alat       |
       |    kendali jarak     |
       |_______________________|
                  |                 |
    Merangkai Alat|
       |                 |
                  |    Kendali       |
                  |    jarak jauh   |
       |__________________|
                  |                 |
    Menguji Sistem|
       |                 |
                  |    Kendali       |
                  |    jarak jauh   |
       |__________________|
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    Selesai
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RESULTS AND DISCUSSIONS

1. Infrared Transmitter Circuit (Transmitter)
This infrared ray transmitter circuit functions to emit infrared rays in the frequency range (38-40 kHz). Figure 2 this frequency interval is set by a variable resistance (VR).

The total amount of resistance for this frequency band is:

\[ (R_1 + 2R_2) = \frac{1,44}{f \cdot C_1} \]

IC NE 555 has a minimum output voltage of 2.75 Volts and a maximum of 5Volt when it is high for a 5Volt power supply, and 0 Volt when it is low. The infrared ray emitting diode has a voltage drop of 2.3 volts when conducting a current of 50 mA. To secure IC NE555 from a continuous source current of 50mA = 50 x 3 10− A, a transistor is installed at the output terminal of this IC as shown in figure 3:

The current required by the IR Led Figure 3 is the current through R3 and the collector current. The transistor installed is BD 139 with a maximum Collector 72 current of 1.5A with dc = 140.

2. Infrared Ray Receiver Circuit (Receiver) and Monostable Multivibrator Timer Circuit
The infrared receiver circuit uses a phototransistor module which is connected to a voltage source, the output of the transceiver phototransistor module is connected to the monostable timer circuit input. The circuit image can be seen in Figure 4 below.
Design of a Light Intensity Regulator with Remote Control for Incandescent Lamps (Akhmad Yani)

The timer circuit in this design is built from IC 555 with monostable operation, which means this device will be stable in one condition (high or low) in a few moments. When the Infrared receiver circuit is active, it will provide an input signal to the monostable circuit to trigger IC 555. With IC555 triggered at pin 2, the timer circuit is active, which will then trigger the counter circuit. The capacitor must be charged through the resistor, the greater the time constant $T=RC$ the longer the capacitor voltage to reach $+\frac{2}{3}V_{cc}$, in other words the RC time constant controls the width of the output pulse, the length of this output pulse is given in the equation:

$$T = RC = 1000000 \times 10^{-6} = 1 \text{ s}$$

So in this circuit we can use a resistance of $1 \text{M} \Omega$ and a capacitor of $1 \mu\text{F}$.

3. Rangkaian Pencacah

In this counter circuit, IC 74192 is used which is an Up-Down Counter IC. This IC has separate Up-Down inputs, on pin 4 for counting down and on pin 5 for counting up.

IC 74192 will count up what if the input on pin 5 gets a low input signal (low) while the input pin 4 gets a high signal input (high). And vice versa when counting down, then input pin 4 gets a low signal (low) and input up gets a high signal (high). This IC does not work if both pins 4 and 5 get high or low input.
The output on IC 74192 is connected to IC 7447, this IC is an IC that will convert the results of the count from binary to decimal form, which will be displayed on the Seven Segment Display. From the display of seven segments which are connected to the output of IC 7447 through a 330 barrier that functions as a current limiter on the seven segment display, the decimal designation value/number will be known.

4. Counter to Decoder and Inverter Circuit
As explained earlier how the IC 74192 works, the output of the IC 74192 is not only connected to the IC 7447, the output of the IC 74192 is also connected to the decoder IC 7442. This IC functions as a binary code converter to decimal. IC 7442 has 4 inputs (Input) in binary form and 10 outputs (Output) in decimal form. The output of IC 7442 is in low condition (low). So to get the output in the form of a high signal (high), then the IC 7442 output is connected to the IC 7404 as an inverter.

![Counter circuit 74192, BCD 7447, Display of Seven sections Decoder 7442 and Inverter 7404](image)

5. Relay Driver Circuit

![Relay Driver Circuit](image)

The Relay Driver circuit functions to control the mechanical relay in the On-Off position, which is in accordance with the changes received by the counter circuit, this circuit uses a BC 547A transistor and a 12V/5 pole DC relay and a diode used IN 4002/ IN4004. The resistance in this type of relay is 400Ω. While the switching transistor BC 547A has a maximum collector current of $I_c(\text{mak}) =$
200mA with a gain gain (hfe) of 250. To make the transistor work as a switch, the base must be supplied with current or voltage.

6. Dimmer Circuit
In this circuit using Triac BT 137/600 as switching AC current. The triac works when it gets the pulse amplitude at the gate pin. Setting the brightness of the incandescent lamp is regulated by the resistance given to the TRIAC. The brightness of the lamp is based on the amount of resistance given, the greater the resistance given, the smaller the current flowing into the lamp, causing the lamp to dim, and vice versa if the resistance is small, the current flowing into the lamp becomes large, causing the lamp to be bright. The picture of the dimmer lamp circuit can be seen in Figure 8.

![Figure 8. Dimmer Circuit](image)

7. Power Supply Circuit
In the DC power supply circuit, the transformer used is a step down transformer with a primary input of 220 volts and a secondary output of 12 volts.

The 0 Volt and 220 Volt terminals on the primary side are connected to the PLN grid. While the 0 Volt, 5 Volt and 12 Volt terminals on the secondary side are connected to the bridge rectifier circuit. The type of rectifier circuit used is built from a IN 4002 type diode. This diode has a current capability of 1 A and a peak current of 30 A, while the ability to withstand a voltage of 50 Volts.

The DC voltage after passing through the filter capacitor is almost flat, but this voltage will be affected by the ups and downs of the PLN grid or changes in the load. To further stabilize the output voltage of this DC power supply, an integration circuit is used in the form of a positive regulator IC LM 7812 and LM 7805.

CONCLUSION

From the results of the design of a light intensity regulator for incandescent lamps, the following conclusions can be drawn: A light intensity regulator with remote control in incandescent lamps has been designed, consisting of an infrared transmitter circuit, an infrared ray receiver circuit, a digital counter circuit, a circuit relay driver, dimmer circuit and power supply circuit. Testing of the light intensity regulator can be done by making the entire circuit needed in the design of this tool. The light intensity control device on the incandescent lamp after testing can function properly up to a distance of 300 cm.
ACKNOWLEDGEMENTS

After designing a light intensity regulator with a remote control for incandescent lamps, several suggestions were made including: To further maximize student creativity, it is recommended that in each final project it is recommended that it be more directed to applicative work (design or manufacture of tools).

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