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The Design of an Automatic Saving System for Electric Energy in Microcontroller-Based PJU Lights

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LDR Sensor

ABSTRACT

At this time almost all Public Street Lights (PJU) still use the type of mercury and SON-T lamps, even though the mercury and SON-T lamps absorb a very large amount of electricity. Public street lighting is usually on almost all nights, and this is a waste of electricity. Public street lighting is usually on most nights, and thus us a waste of electricity. Usually, when it is past midnight the streets are quiet, so the streetlighting should be reduced in intensity to save electricity. Based on this problem, this research using an experimental method (Experiment) to create design to be able to make efforts in saving electricity. The method used includes electrical and systematic design. The steps taken include the stage of literature research then designing, manufacturing hardware and software integrating the system and testing and analyzing the system. Considering these theories, can know the programming of the microcontroller ATMega 328, Photocell Sensor, PIR Sensor, LED Lights, and Power Supply. This research using several tests, including testing Photocell Sensor, PIR Sensors, LDR Sensors, and LED Lights. Photocell sensor to detect conditions day or night. PIR sensor functions to detect movement, LDR sensor to detect movement, and LED lights are used to increase and decrease the intensity of light. For all the tests above, the results obtained when the PIR and LDR sensors have not detected any movement, the intensity of the LED lights will be dim, and after the PIR and LDR sensors have detected the movement of the LED lights, it will automatically bright.

1. Introduction

At this time almost all Public Street Lights (PJU) still use the type of mercury and SON-T lamps, even though the mercury and SON-T lamps absorb a very large amount of electricity. Public street lighting is usually on almost all nights, and this is a waste of electricity Usually w [1][2] then it is past midnight the streets are quiet, so the streetlighting should be reduced in intensity to save electricity [3][4][5].

In this research, the researcher made a design of an electric energy saver system when the condition is there are no vehicle on the road, the street light will still on with a dim intensity condition, and when there are some vehicles that pass later it will be detected by the PIR sensor and LDR. Furthermore, the intensity of the street lights will automatically increase to brighter until there are no vehicle and it will be dim again [6].

With the implementation of an automatic electrical energy saver system tool on PJU lights, it is expected that the use of electric power in Indonesia will be slightly reduced. From the background above, this research is entitled “The Design of an Automatic Saving System for Electric Energy in Microcontroller-based PJU Lights”. It is hoped that this research can be useful to reduce the use of electrical energy because natural resources are currently running out.

2. The Proposed Method/Algorithm

The method used in this research is electrical design, systematic, in order to obtain accurate data and information. In this design starts from collecting data, making design, making tools, testing and summarizing the results of the system. The following is a diagram block of an electrical energy saver system on PJU lights to increase the intensity of the lights when a vehicle is passing, and to reduce the intensity of the lights when there are no vehicles are passing.

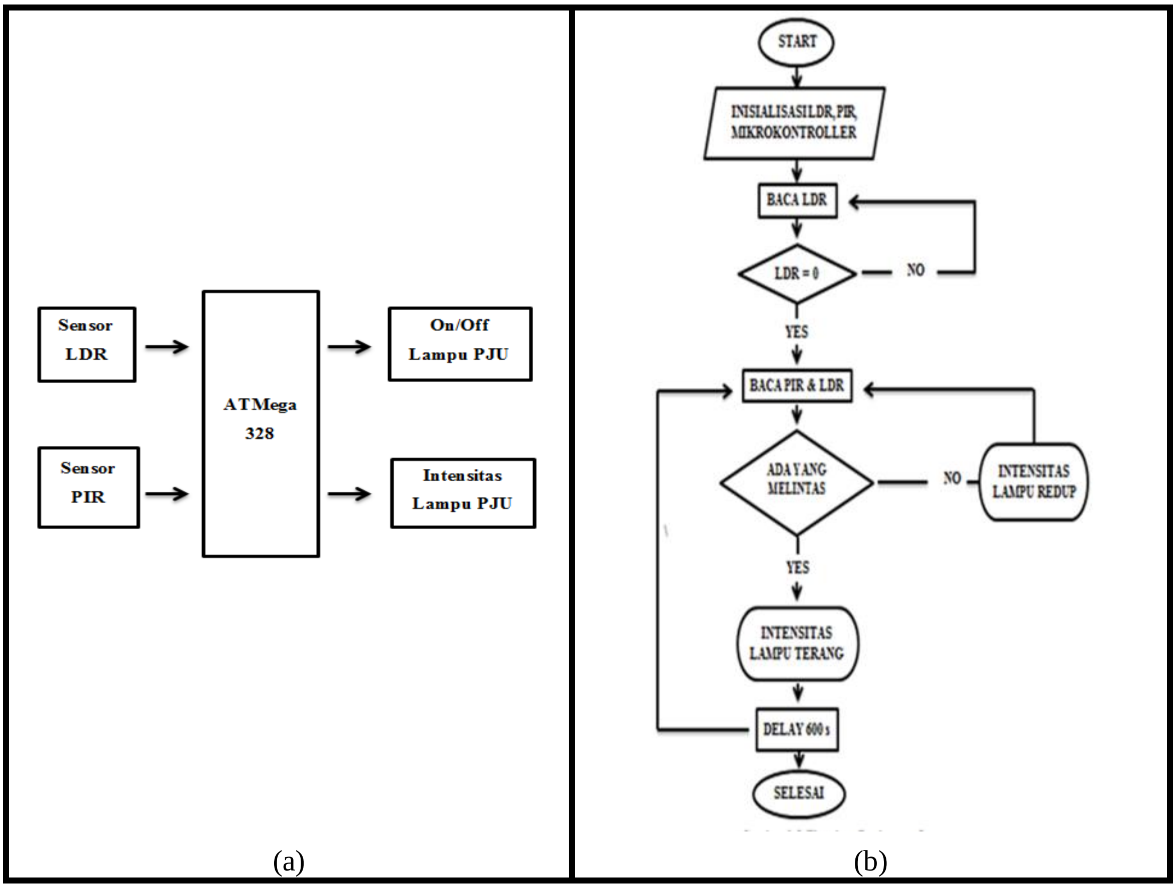

Fig 1. (a) Tools Design Diagram Block, (b) Sensor Reading Flowchart

1. Literature Study Stage

   At this stage of the literature study, several journals and reference books are used as a basic source for data processing. Literature study in this final project covers the following matters:

   a. Study of the ATMega 328 microcontroller operating system;
   b. Study of PIR sensor;
   c. Study of motion detection systems.

2. Hardware Design and Manufacturing Stage

   In this stage the design is adjusted to the function of the components that will be used, so that it can be realized and the system can run well [7][8].

   a. Software Design and Manufacturing Stage;
      At this stage Software testing has been made, before Hardware and Software are integrated into the whole system to run system.
   b. System Integration;
      Integrate between Hardware and Software that has been compiled into a whole system to run the system running well.
   c. System Testing and Analysis Stage.
      Test the system that has been integrated as a whole for further analysis according to its function. Flowchart system design software work as shown in Figure 1 (b).

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3. Result and Discussions

3.1. PIR Sensor test results

Fig 2. Serial Print of PIR Sensor Reading

From the Figure 2. abobe the serial print shows the number 0, the PIR sensor does not detect any movement, and when the serial print shows the number 1, the PIR sensor detects movement. From the results of testing the PIR sensor shows the sensor can detect movement well [9][10].

Table 1. PIR Sensor Distance Testing Results

No.	Testing	Distance (cm)	Results
1	1	10	1 (High)
2	2	20	1 (High)
3	3	30	1 (High)
4	4	40	1 (High)
5	5	50	1 (High)
6	6	60	1 (High)
7	7	70	1 (High)
8	8	80	1 (High)
9	9	90	1 (High)
10	10	100	1 (High)
11	11	200	1 (High)
12	12	300	1 (High)
13	13	400	1 (High)
14	14	500	1 (High)
15	15	600	0 (Low)

From the table [11] the test results above show that the PIR sensor on *Prototype* can detect objects at the farthest distance is 5 m, and in this case the PIR sensor can work and fuction properly.

3.2. Photocell Test Result

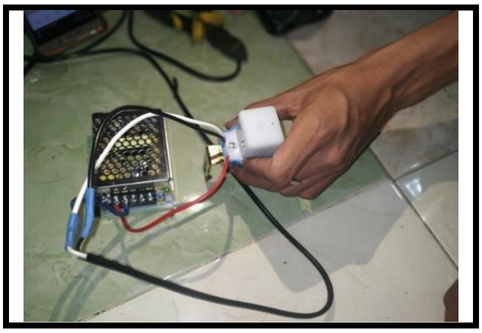

Fig 3. Photocell testing in bright conditions

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In Figure 3. photocell testing when exposed to light rays, so that the LED indicator on the power supply is still not lit. Because in this case indicates that the conditions around are still bright.

Fig 4. Photocell Testing in Dark Conditions

In Figure 4. Photocell testing when not exposed to light rays, so the LED indicator on the power supply lights up. Because in this case indicates that the surrounding conditions are dark.

3.3. LDR Sensor Testing Result

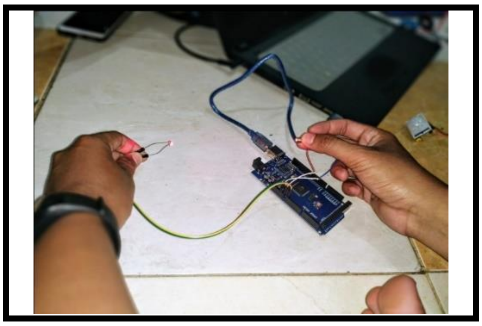

Fig 5. Testing the LDR sensor with Arduino Laser

In testing the LDR sensor is done to determine the existence of passing movement so as to cut off the laser beam that is received by the LDR sensor. To get good results in this test the LDR sensor and the Arduino laser will be connected to the microcontroller which is given a voltafe of 5-12 Volts and the program is inserted.

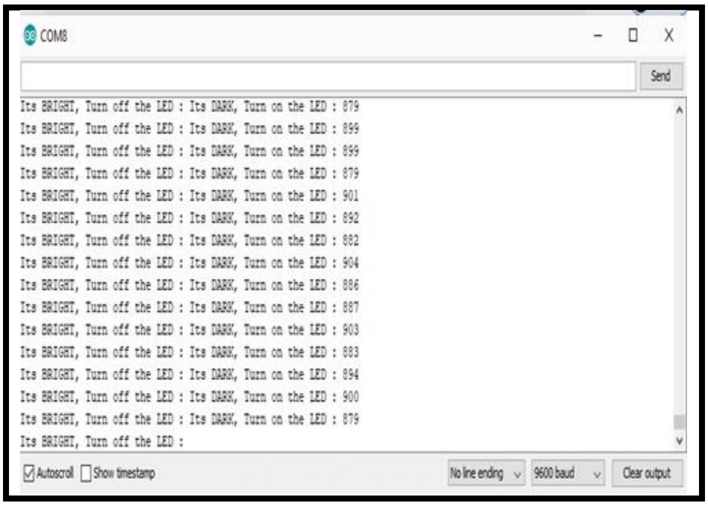

Fig 6. Serial Print LDR Sensor Test Results

In this serial print test results show a high voltage value, the laser beam received by the LDR sensor has been interrupted, so in this case indicates that the movement has cut off the laser beam received by the LDR sensor.

3.4. Overall Testing Results.

Table 2. Overall Testing Results

No.	Testing	Results
1	Photocell Sensor	Able to detect environmental conditions in dark or bright conditions to turn on the system.
2	PIR Sensor	Able to detect movement to increase LED light intensity. From the results of testing the PIR sensor is able to detect objects with a maximum distance of 5 m.
3	LDR Sensor	Able to detect vehicle movement to increase the intensity of LED lights.
4	Lamp Intensity Testing	From the result of testing the intensity of the light generated during dim conditions generated voltage of 7 Volts with a lumen value of 47 Lux, while when the light conditions generated voltage of 11 Volts with a lumen value of 173 Lux.

In the whole Test when the Photocell sensor detects that the environment is dark, the light will automatically turn on. But the condition of the lamp is tsill dim yet bright because it has not detected any movement. From the test results above the voltage generated from the lights when the conditions are dim is 7 Volts. From the results of the Lumen lamp measurements made on the prototype, obtained the value of the intensity of the lights when the lowest dim conditions is 47 Lux. In this measurement using the Lux Meter application.

From the test when the LDR or PIR sensor detects movement, the light will automatically turn on brightly with a 10 minute delay, and when the delay process does does not detect any movement, the light will return dim. The voltage generated by the lamp when the conditions are bright is 11 volts. From the results of Lumen lamp mesurements made on the prototype, it is obtained the value of the intensity of the lights when the brightest conditions are highest is 173 Lux. In this measurement using the Lux Meter application.

Fig 7. Direct test results on 220 Volt electricity before using the tool.

Based on the test results of this system which is applied directly to 220 Volt electricity without using this design system, the resulting voltage is 228 Volts with a light intensity of 338 Lux. From the test results the voltage becomes 228 Volts because it passes through the Arduino Dimmer which has the function to increase and decrease the intensity of the light, but the Arduino Dimmer has not been connected to the microcontroller so hat the voltage rises.

Fig 8. Test results directly on 220 Volt electricity after using the tool before there is movement

Then in the next test the design tool is installed directly on 220 Volt electricity, generated voltage when it has not detected any movement of 62 Volts with a light intensity of 240 Lux.

Fig 9. Test results directly on 220 Volt electricity after using the tool and there is movement

Then in the next test the design tool is installed directly on 220 Volt electricity, generated voltage when it detects a movement of 219 Volts with a light intensity of 332 Lux. Based on the results of these tests can result in saving efforst of:

Known : Month I = 1725 Watt

Month II (after savings) = 1035 Watt

Questions : Saving ?

$$Saving = \frac{(month\ I - month\ II\ (After))}{Month\ \ I} \times 100\%$$

$$= \frac{1725\ Watt - 1035\ Watt}{1725\ Watt} \times 100\ \%$$

$$= 40\ \%$$

So from the calculation of the percentage of power savings obtained savings of 40 %.

4. Conclusion

The prototype design of the electric energy saver on PJU lamps was designed using several components such as the Photocell sensor, Arduino uno, PIR Sensor, LDR sensor and integrated LED. So that the PIR and LDR sensor when reading the movement will increase the intensity of the lamp automaticaaly. From the test results show the PIR sensor is able to detect objects farthest away from 5 m.

PIR and LDR sensors function by accepting a movement, which in turn will increase the intensity of the lamp by automatically becoming bright, within 10 minutes the lamp will return to its original condition when it does not detect movement ie dim again. From the results of testing the voltage generated from the lights when the conditions are dim is 7 Volts. With the Lumen value of the lamp produced from the lowest measurement of 47 Lux and at the time of the light conditions the voltage generated from the lamp is 11 Volts with the Lumen value of the lamp produced from the highest measurement of 173 Lux. In this system when applied directly using 220 Volts electricity results are obtained when the dim conditions of the generated voltage are 62 Volts and the light intensity is 240 Lux, while during light conditions the generated voltage is 219 Volts and the light intensity is 322 Lux. And from the results of the comparison when using tools and not using tools obtained an effort of saving 40%.

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