Analysis of the Effect of Battery Voltage Drop on Light Intensity on LED and Hologen Type Main Lights in Gentayu UNDIP Electric Cars to Get Good Lighting

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***Abstract*— The Gentayu UNDIP electric car requires a lighting system, especially the main lighting system, namely the headlights, which must have sufficient light but must be economical in power consumption because the power used uses a battery that is separate from the main battery for propulsion. So that with a separate battery, the available power is limited, a separate mechanism is made for charging the battery, and it can be charged simultaneously with charging the main battery for the Gentayu UNDIP electric car. We will try to do a special analysis of the intensity of light in the main lighting system to get data on the effect of battery power on light intensity. The test was carried out by observing the decrease in light intensity on two types of lamps, namely LED lamps and halogen lamps. 1x10 lux every 15 minutes, with an average voltage drop of 0.06 volts every 15 minutes. Meanwhile, for halogen type lamps, the average decrease in light intensity is 6x10 Lux every 15 minutes with a voltage drop of 17 volts, so even though the use of LED type lamps has low power consumption, a decrease in light intensity when used for a long time cannot be avoided, so it is necessary to make a mechanism for the Gentayu UNDIP electric car so that the battery voltage is maintained when the lighting electrical system is used.**

Keywords— LED, lument, voltage.

I. INTRODUCTION

The development of vehicle technology begins with the development of electric vehicles [1–2]. Initially, electric vehicles were more popular than oil-powered vehicles. The US Department of Energy's The History of Electric Cars reveals that the weakness of electric vehicles is that they have a short range. However, when compared to steam-engined vehicles, electric vehicles have a longer range [3]. The oil crisis that occurred in the United States was due to the OPEC embargo on oil exports to America [4] and the issue of exhaust emissions. Even in the last twenty to twenty-five years, the issue of the availability of energy sources and the impact on the environment Electric motorized vehicles are currently being developed because they are environmentally friendly and emit zero emissions [11]. This makes electric motorized vehicles possible. In Indonesia, the development of electric cars can be said to have taken a long time. Wahyu Perdana P., in his paper "Development of National Electric Cars," revealed that Indonesia had started designing and manufacturing electric cars in 1997. In 2009, LIPI converted fuel-fueled cars into electric cars in the form of "Old Kijang (Kijang LSX)". In 2010–2011, LIPI made a concept prototype of an electric sports car and a passenger bus. In fact, in the last three years, researchers and several conceptualists have made the "Tucuxi" luxury electric car, followed by the development of "Selo and Gendhis" by Ricky Elson and Mario Rivaldi, who concentrated on electric motors [5].

A brushless DC electric motor (BLDC) is a type of electric motor used by the Gentayu UNDIP electric car. The history of BLDC motor development begins with the discovery of permanent magnets in the 1980s. At the end of the 1980s, Robert E. Lordo of the POWERTEC Industrial Corporation created a larger BLDC motor than had previously been developed. The power it has is almost ten times that of the previous brushless DC motor. The application of this motor is developed in industry as a linear motor, a servo motor as a servo machine or drive for robots, actuators for robots in industry, and extrude drive motors to drive gear for CNC machines [6]. Apart from the industrial world, the development of BLDC motors is also applied in the automotive world. Appleyard researched and revealed that electric vehicles use BLDC motors as propulsion. The choice of BLDC drives is due to their good efficiency, low cost, and minimal maintenance. For performance, besides being able to reduce dimensions and sizes, it is also able to reduce motor noise when working. Control is also very easy and more varied [7]. Faiz Jawed et al. compared BLDC motors with PMSM (permanent magnet synchronous motor) and argued that BLDC motors have better advantages and disadvantages, namely high efficiency values and high power density. The loss of brushes on the motor results in the motor's ability to rotate at high speeds with a much smoother sound [8]. Wu Qiangpin pointed out the advantages of BLDC motors, which have small dimensions, light weight, high efficiency and energy savings, easy speed control, a simple structure, reliable performance, and easy maintenance. Widely applied in industry [15]. However, bearing in mind the problem that permanent magnet materials on earth are becoming scarcer, Wu Qiangpin designed a permanent magnet based on the dsPIC30F4012 control system. The control of this system uses permanent magnets developed by Microchip Technology Inc. with a three-phase, six-circuit control [9]. The application of BLDC motors in vehicles is increasingly being developed because of the excellent capabilities of BLDC motors. Accordingly, in 2001, Akiosaki applied an ultra-slim BLDC motor to the vehicle to optimize the location between the engine and transmission. By utilizing a narrow location, efficiency and motor safety from water and foreign objects can be maximized [10].

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Driving at night requires adequate lighting so that the driver does not experience difficulties in driving the vehicle and avoids accidents due to insufficient lighting. As in general a four-wheeled vehicle, the Gentayu UNDIP electric car also requires a lighting system, especially the main lighting system, namely the headlights, which must have sufficient light but must be economical in power consumption because the power used uses a battery that is separate from the main battery for propulsion. So that with a separate battery, the available power is limited, for the battery charger, a separate mechanism is made, and it can be charged simultaneously with the main battery charging for the Gentayu UNDIP electric car. [13]

Based on the lighting needs of the Gentayu UNDIP electric car which must be sufficient so that the driver does not experience difficulties in driving, it is necessary to do a special analysis of light intensity in the lighting system section of the main lighting system where in previous research the author has conducted an analysis of the power consumption of the Gentayu UNDIP car lighting system when it rains and when it doesn't rain to get the type of lamp that has power efficiency [14] and in this study only focuses on efficient power consumption on the type of lamp used, therefore the author needs to carry out a special analysis of the intensity of light with the effect of the existing power on battery.

II. METHODS

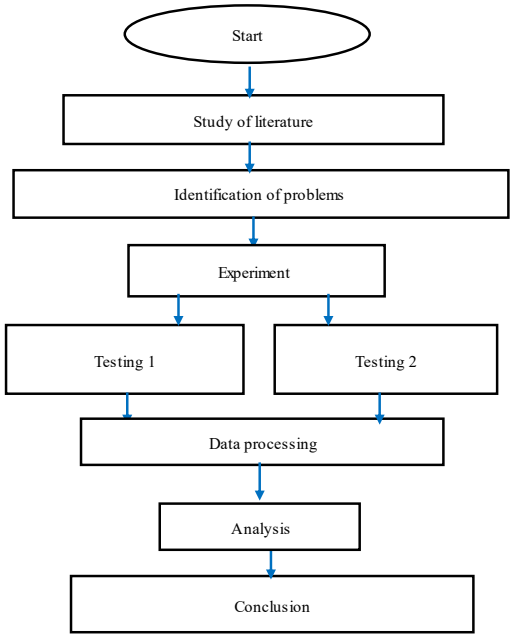

Fig. 1. Research flowchart

Because this research is continuing from previous research, the supporting material for this research is still the same as previous research, namely using the Gentayu UNDIP electric car with the main lighting system, the type of LED lamp, and the type of halogen lamp as the object of research. The implementation of this research was carried out in the Department of Mechanical Engineering, Diponegoro University, Semarang.

The measurement used is a digital Avo Meter type CD800A and a digital Light Meter type LX-101A, while the specifications for the LED lamps used are DC 12V/8–16 V H4 socket type for head lamps, DC 12 V/3 watt H6 socket type for headlights, and headlight clearance, while for halogen lamp specifications, DC 12 Volt 90–100 Watt H4 socket type for DC 12 Volt 21 Watt H6 socket type. [13-14].

This research is an experimental study that continues from previous research by making direct observations on the Gentayu UNDIP electric car, namely measuring the intensity of the light on the main light system using two different types of lights, namely LED type lights and halogen types, as a comparison. This test will observe the effect of battery power on light intensity in LED-type lamps and halogen-type lamps. The first experiment using this type of LED lamp is to turn on the headlights, clearance lights, and tail lights for 60 minutes, and when the battery voltage decreases, you will see a decrease in the intensity of the headlight every 5 minutes.

The second experiment used a type of halogen lamp by turning on the headlights, clearance lights, and taillights for 60 minutes, and when the battery voltage decreased, you would see a decrease in the intensity of the headlight every 5 minutes. After the experiment was carried out, it was concluded that the effect of battery power on the light intensity of two types of

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lamps The purpose of this study was to obtain data on the effect of battery power on light intensity to obtain data that can be used for planning the main lighting system for the Gentayu UNDIP electric car and for consideration of the voltage source used for the Gentayu UNDIP electric car lighting system. For more details, the research flow can be seen in the flowchart below.

III. Results and Discussion

To find out the effect of battery power on light intensity, the authors took two types of lamp samples, namely LED and halogen types, to be tested in the Gentayu UNDIP electric car.

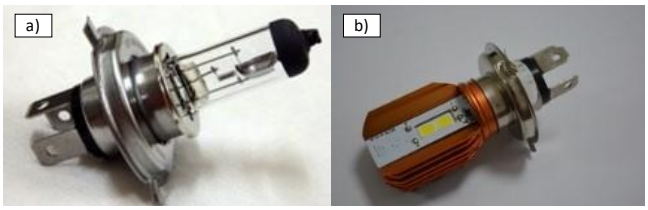

Fig. 2. (a) Trial LED type headlights (b) Halogen type headlights

The results of the light intensity test on the main lights of the Gentayu UNDIP electric car using a 12 volt, 40 Ah battery for this type of LED lamp with specifications of DC 12 volts (8–16 V for the H4 socket type) at the start of the measurement had a light intensity of 177x10 Lux with a battery voltage of 12.30 volts, and after being tested for 60 minutes, the intensity of the light became 155x10 Lux with the battery voltage dropping to 12.9 volts. Furthermore, for halogen type lamps, the initial light intensity was 85 x 10 Lux at a voltage of 12.30 volts, and after testing for 60 minutes, the light intensity became 72 x 10 Lux with the voltage dropping to 11.86 volts. The test results can be seen in the table below.

Fig. 3. (a) Process for testing types of LED lamps in the Department of Mechanical Engineering, UNDIP (b) Process for testing types of halogen lamps in the Department of Mechanical Engineering, UNDIP

TABLE 1. TABLE OF LIGHT INTENSITY AND VOLTAGE DROP OF LED TYPE LAMPS

LED Type Lights		
Time	Light intensity	Voltage
(Minute)	x 10 Lux	Volt
0	169	12.30
5	165	12.28
10	165	12.26
15	164	12.24
20	164	12.22
25	164	12.20
30	164	12.19
35	164	12.17
40	163	12.16
45	161	12.14
50	161	12.13
55	160	12.12
60	160	12.10

TABLE 2. TABLE OF LIGHT INTENSITY AND VOLTAGE DROP OF HALOGEN TYPE LAMPS

Halogen Type Lamp		
Time	Light intensity	Voltage
(Minute)	x 10 Lux	Volt
0	85	12.30
5	83	12.19
10	79	12.13
15	79	12.07
20	77	12.02
25	76	11.99
30	75	11.96
35	75	11.94
40	75	11.92
45	74	11.90
50	73	11.89
55	73	11.87
60	72	11.86

After testing, it can be seen that the LED lamp has a greater light intensity than the halogen type lamp. With testing for 60 minutes for both LED lamp types, the average decrease is 1x10 Lux every 15 minutes, with an average voltage decrease of 0.06 volts every 15 minutes. As for the halogen type lamp, the average decrease in light intensity is 6x10 Lux every 15 minutes with a voltage drop of 17 volts.

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In previous research trials [15], LED-type lamps had lower power consumption, but the resulting light intensity was higher than that of halogen-type lamps, which had lower light intensity and higher power consumption. The graph of the decrease in light intensity in testing LED and halogen types of lamps can be seen more clearly in Figures 4 and 5.

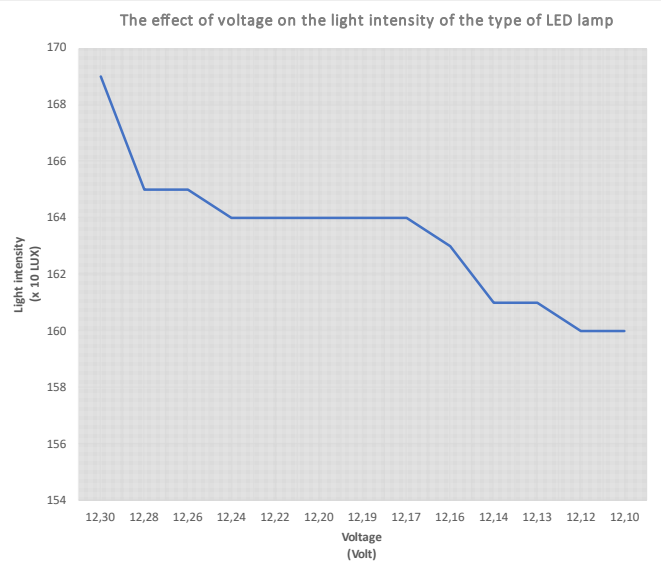

Fig. 4. Graph of the effect of voltage on light intensity on LED type lamps

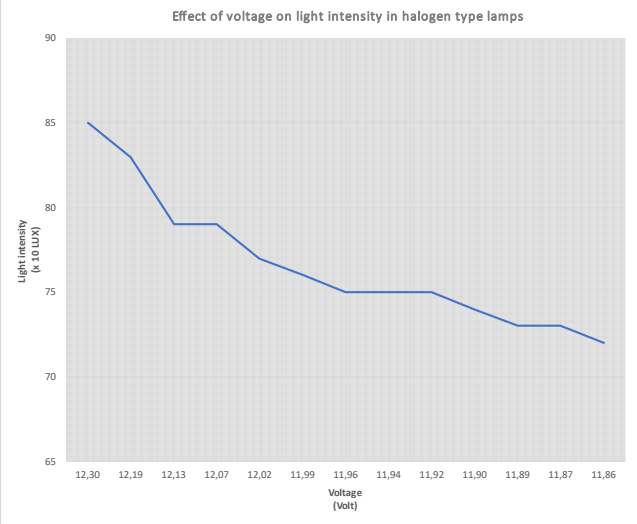

Fig. 5. Graph of the effect of voltage on light intensity on Halogen type lamps

IV. Conclusion

From the results of testing the light intensity of the two types of lamps, namely LED type lamps and halogen type lamps, it can be concluded that LED type lamps have a higher light intensity, a longer reduction time than the halogen type, and also lower power consumption. At the time of the previous research, it was recommended to use LED type lights, even though the use of LED type lights has low power consumption. But when using LED type lights for a long time, a decrease in light intensity is unavoidable, so it is necessary to make a mechanism on the Gentayu UNDIP electric car so that the battery is stressed and remains awake when the lighting electrical system is used.

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