INTERNET OF THINGS (IoT) DESIGN IN RUNWAY EDGE LIGHT TROUBLESHOOTING MONITORING SYSTEM USING THE BLYNK APPLICATION NODEMCU ESP 8266 BASED SMARTPHONES

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ABSTRACT

IoT or Internet of Think is a concept to expand the benefits of always- connected internet connectivity. Among them are the ability to share data and remote monitoring. One of its applications is used to monitor data on Runway Edge Light. Runway Edge Light is one of the equipment in the Airfield Lighting System (ALS), namely in the form of lights that are on either side of the runway along the runway at the airport. This final project aims to innovate a tool based on making it easier for technicians to monitor trouble source locations or where there are problems with runway edge lights at airports, because of the long distance and the number of lights along the runway at each airport which will be very time-consuming if it has to be investigated one by one when a problem occurs that causes the equipment to work less than optimally. This final project uses the NodeMCU ESP 8266 as its microcontroller, the data taken from the detection of the failure value of the lamp uses the Pzem-004t current sensor to detect current and the BH1750 light sensor to detect the lumen value of the lamp will then be processed first by NodeMCU ESP 8266 before being sent to the blynk webserver. NodeMCU ESP 8266 sends data to the blynk webserver through the help of a wifi signal. Then the blynk application on the smartphone will display monitoring data from the sensor readings sent by NodeMCU ESP 8266. The research results of this tool only show monitoring the status of the lights on or off from the runway edge light prototype and the lumen on the runway edge light prototype which can be monitored using a smartphone with the help of the blynk application so that with this innovation if implemented it will help technicians' performance become faster and more efficient. According to system testing, the interface on the smartphone can read the status of the runway edge light on or off during operation along with its lumen value.

Keywords: runway edge light, NodeMCU ESP 8266, PZEM-004T, BH1750, blynk, smartphone.

1. INTRODUCTION

According to Law no. 1 Concerning Aviation of 2009 and PM.69 of 2013 concerning National Airport Arrangements, an airport is an area on land and/or waters with certain boundaries that is used as a place for aircraft to land and take off, board passengers, load and unload goods, and places for intra and inter-modal transfers of transportation, which are equipped with aviation safety and security facilities, as well as basic facilities and other supporting facilities. Aviation safety and security must be implemented in all fields, including in the field of transportation or operation of airport air transportation, air navigation support, visual aids, maintenance and repair and training in accordance with International Civic Aviation Organization (ICAO) regulations. The aviation safety system relies heavily on the performance of visual aids and navigational aids, one of the airport visual aids which has an important role for flight safety is the Airfield Lighting System (ALS). ALS is a runway lighting system at airports. Every ALS lighting equipment definitely requires a power supply that comes from a Constant Current Regulator (CCR). The constant current regulator (CCR) is a constant current power supply used for Airfield Lighting System (ALS) equipment. (Shahid. 2011).

The system on the runway edge light is in the form of an arrangement of lights on the right and left sides of the runway, which are useful for guiding pilots to land or take off, where if there is an airplane landing at night the pilot can find out the runway path visually with the center so that does not go off the track and is also used as a benchmark for the length of the runway after the plane lands. In this case, the continuity of the work of the lighting system on the runway edge must be of great concern considering that the function of the runway edge light is very important for the safety and comfort of passengers at the airport. Annex 14, Volume I, Chapter 5 provides specifications for runway edge lights. These lights are intended primarily to determine the lateral runway limits for aircraft during the final approach. However, Annex 14, Volume I in particular emphasizes that runway edge lights must be visible at all angles in azimuth when they are intended to provide circling guidance. Low-intensity lamps used for operation in clear night skies are generally omnidirectional and therefore comply with these requirements. High intensity lights used for operations under poor visibility conditions are usually bidirectional but can also be designed to emit a low intensity omnidirectional light capable of providing circling guidance. If circling guidance is to be provided by this type of light fitting, it is necessary to ensure that the required low intensity output can be achieved when the high intensity light is operated at the low output normally used in clear night skies. This is normal practice to avoid glare problems during final approach and landing. The output of 50 cd at maximum brightness (maximum brilliancy) will be reduced to less than 0.5 cd when the night setting is used for high intensity lighting. When low-intensity omnidirectional lights are not included in high-intensity lights, additional lights must be installed along the edge of the runway to provide circling guidance. If these auxiliary lights are high-intensity lights, their beam must be unidirectional at right angles to the center line of the runway and directed away from the runway. The color of this lamp is preferably white, but yellow light such as that emitted by some forms of gas discharge may be used. The brightness of a light depends on the impression of contrast it receives between the light and the background. If the lights are useful to a pilot during the day on approach, they must have an intensity of at least 2,000 or 3,000 cd, and in the case of approach lights an intensity of the order of 20 000 cd is desirable. In very bright daylight conditions it may not be possible to provide a light of sufficient intensity to be effective. On the other hand, in clear weather on a dark night an intensity of the order of 100 cd for approach lights and 50 cd for runway edge lights can be considered suitable. Even then, because of the closer visibility, pilots sometimes complained that the runway edge lights seemed too bright.

Because the distance between the lights is far from the power plant and checking the lights is always done manually, it takes a long time. Therefore, it is necessary to have a facility that can help monitor the technicians before leaving for inspections that can be accessed from the power house easily and the technicians can find out where the runway edge lights are off and also monitor the lumens of the runway edge lights that have gone down due to lifetime and need to be replaced. For this reason, from the background of the problems that have been explained in the problem cases on Runway Edge Light, then the author presents solutions and ideas in the form of a final project with the title“INTERNET OF THINGS (IoT) DESIGN IN RUNWAY EDGE LIGHT TROUBLESHOOTING MONITORING SYSTEM USING THE BLYNK APPLICATION ON NODEMCU ESP 8266-BASED SMARTPHONES”.

2. METHODS

In the research on Internet of Things (IoT) Design in the Runway Edge Light Monitoring Troubleshooting System Using the Blynk Application on a NodeMCU ESP 8266-Based Smartphone, it was designed with the hope of being able to provide solutions to help electricians work while in the field which aims to shorten both time and time. power and costs of car fuel used for vehicles.

The method used is the prototype method because the system applied clearly has a clear concept and description of field application that can be developed to be applied to original runway edge lights on runways.

Hardware components :

1. Miniatur Runway Edge Light

Miniature runway edge lights are made with simple materials that function as replicas of the original runway edge lights that are used as monitoring objects.

2. NodeMCU ESP 8266

NodeMCU is developing an open source IoT platform from ESP8266 with e-Lua-based firmware, NodeMCU uses the Lua programming language which can be programmed via the Arduino IDE with additional library configurations.

3. Sensor PZEM-004T

The Pzem-004t sensor has an operating principle that works at an AC voltage of 80 – 260V, a power of 100A/22,000W, and a frequency of 45 – 65Hz.

4. Sensor BH1750

BH1750 is a sensor IC that is used to measure the intensity of ambient light in lux or units, this sensor is commonly used in research aimed at monitoring or measuring lumen values in light bulbs.

5. Dimmer

Dimmer is one of the additional tools to adjust the brightness of the lamp, the operation of the dimmer consists of capturing the received AC signal and then converting it into a phase for the power to be used.

6. LCD 16 x 2

Liquid Crystal Display (LCD) is a display device that is widely used today, 16 x 2 itself, which means that the size of the LCD is 12cm long and 2cm wide.

Software Components :

1. Arduino IDE

In making this prototype using NodeMCU ESP 8266 as the microcontroller, then this Arduino IDE software is a tool needed to program and to give commands to the tool after coding through this Arduino IDE application.

2. The Blynk App

To support the monitoring process on this tool, it is necessary to use the blynk application, this application is used to monitor the reading values of the two sensors along with providing information on the status of the lights.

Tool Design

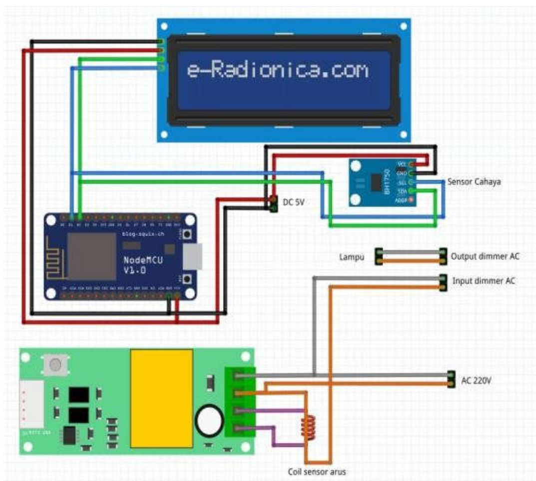

Figure 1 Wiring Diagram

In the picture above is a wiring diagram of this prototype planning. The wiring shows if a 220V AC voltage source is connected to the Pzem-004t sensor, but before entering the Pzem-004t sensor the wiring is jumpered to the dimmer input, then the voltage from the dimmer output will enter the lamp. Then in this serieswe see an adapter with a capacity of 5V to supply voltage to the NodeMCU ESP 8266 microcontroller and the BH1750 sensor.

For the BH1750 light sensor in series near the lamp, the aim is to read the lumen value of the lamp with a tolerance with a point distance of 0 from the lamp, the lamp lumen value will be final. From the BH1750 sensor it will be connected to a microcontroller to process the reading data and the microcontroller is connected to the LCD so that data from sensor readings has been processed by NodeMCU ESP 8266 and can also be displayed on the LCD.

How the Tool Works

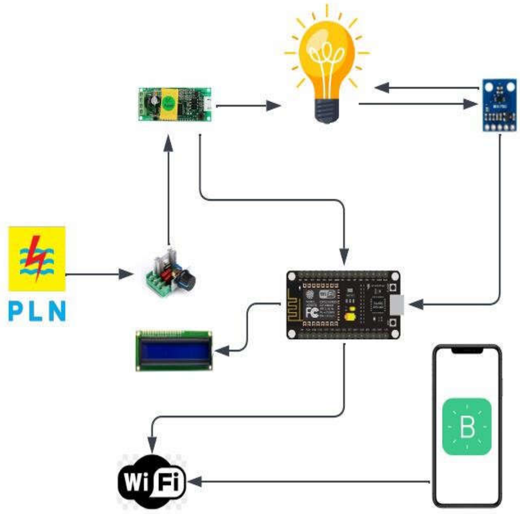

Figure 2 Blok Diagram

This tool uses a BH1750 light sensor and a PZEM-004T current sensor that utilizes miniaturesrunway edge light as the measurement object of the two sensors. The current flowing from the source can be set high and low which will then be forwarded to the lamp using a dimmer. Continuing on, the current passing through the dimmer will be read by the current sensor using PZEM-004T as if the dimmer is rotated to the left, the current flowing to the lamp will be smaller than if the dimmer is rotated to the right, the current flowing out to the lamp will be greater , with the ability of the PZEM-004t sensor which can read current and voltage values but in designprototype this PZEM-004t sensor is only set to work reading values just current in the lamp. Then for the light produced on the lamp according to the brightness that can be adjusted through the dimmer when it is on, the lumen of the lamp will automatically be captured and measured by the BH1750 light sensor which is installed by adjusting it near the object of the lamp so that the value of the measurement results will be more optimal.

3. RESULTS AND DISCUSSION

This chapter covers the testing of the prototype and the system created. This test is carried out because it involves system performance and determines whether the system provided is in accordance with the expected requirements.

Overall Tool Test Results

a. Miniature Runway Edge Light Testing

Figure 3 Miniatur Runway Edge Light

The first test is on a miniature runway edge light, after testing it can be concluded that the miniature runway edge light that has been made in this prototype design can work and function properly as shown in the picture above.

b. Pzem-004T Sensor Testing

Testing on this sensor is to find out whether the Pzem- 004t sensor in the design of this tool can function and work properly, then the task of this sensor is to measure the input current from the lamp and the results of the Pzem-004t sensor readings will be displayed on the LCD and the blynk application. The following is a table oftest results from the Pzem-004t sensor:

Tabel 1 Data Hasil Pengujian Sensor Pzem-004t

Percobaan	**Hasil Pengukuran**	
	Multimeter	**Sensor Pzem-004T**
Pertamaa	0,57 A	0,57 A
Kedua	0,64 A	0,64 A
Ketiga	0,77 A	0,77 A

c. BH1750 Sensor Testing

Testing on this sensor aims to test whether this sensor can function and work normally without following the output current from the dimmer, but this sensor can measure realtime from the light produced from a miniature runway edge light. The following is a table of BH1750 light sensor test results:

Tabel 2 Data Hasil Pengujian Sensor BH1750

Percobaan	**Hasil Pengukuran**	
	Lux meter	**Sensor BH1750**
Pertamaa	2680 lm	2677 lm
Kedua	3490 lm	3497 lm
Ketiga	3630 lm	3636

d. ESP 8266 NodeMCU Testing

Testing on this microcontroller aims to determine whether the NodeMCU ESP 8266 microcontroller can function and work properly or not. The following is a test table of the NodeMCU ESP 8266 Microcontroller:

Tabel 3 Data Hasil Pengujian NodeMCU ESP 8266

PIN VDC dan PIN GND	**NodeMCU ESP8266**
2 volt	Mati
5 volt	Nyala

e. Arduino IDE

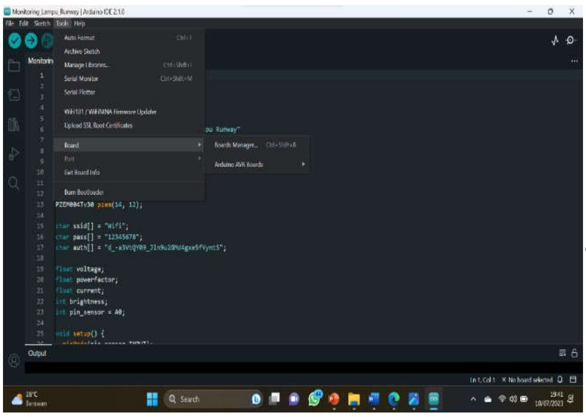

Figure 4 Selection of ESP8266 board in the application

Testing on the Arduino IDE aims to find out about the coding that has been made and entered on the microcontroller and to find out if the coding made inthis application is in accordance with the performance ofthe microcontroller. After the coding of all hardware components is complete, the next step is to compile the coding data. This compile is needed to ensure that the coding data entered is correct or there are still errors in the coding. After compling the data has been completed, it is confirmed again that the data is actually compiled.

f. Blynk Application Interface

This test was carried out with the aim of ensuring that Blynk on this smartphone that has been set can monitor the prototype that has been made with a tolerance distance of the hotspot range on the smartphone, namely max 30m, is successful and functions properly. And monitoring from the two sensors is able to be read and entered in the Blynk application with the same accuracy as it appears on the LCD screen on the prototype.

4. CLOSING

Conclusion

The conclusions in this test and research which are based on the explanation of the chapters and sub-chapters, in the previous chapter can be concluded as follows:

1. In the previous prototype design, it was an innovation in designing tools that could facilitate and alternatives that would allow technicians to work more efficiently in terms of time and energy, especially when carrying out inspections of Airfield Lighting System (ALS) equipment to runway edge lights. Therefore, with the current development of modern technology, the author implements the Internet of Thing (IoT) system into this tool system, and then develops it based on a smartphone so that monitoring runway edge light is designed through the blynk application on a smartphone remotely.

2. As explained in the flowchart and the design of the design of this tool in the previous chapter and sub- chapter, this prototype design uses two sensors, namely the PZEM 004T type current sensor and the BH1750 type light sensor and uses the NodeMCU ESP8266 as the microcontroller. So the blynk application on a smartphone in the design of this tool is a container for the values of the readings of the two sensors for monitoring, then to support the work of this tool by using the NodeMCU ESP8266 module as the microcontroller to process data from the readings of the two sensors. Then after the microcontroller inputs data from the sensor and then the results of the processing of the processed data will be sent to the blynk application, so that monitoring data can be viewed through the blynk application on a smartphone.

3. In this research, the main idea is to innovate the design of a prototype runway edge light monitoring tool, and in principle its work as a monitoring of runway edge lights, if for example one of the runway edge lights has one or two lights off then it can be monitored at a distance away via the blynk app on a smartphone. Therefore to monitor the status of the runway edge lights can be accessed using the blynk application on a smartphone remotely.

Suggesstion

Then for suggestions based on the conclusions above, there are several tools based on the tools that have been made so that in the future it can be developed further, as follows:

1. The use of the blynk application as a container for each port in blynk can only monitor one light, whereas with a maximum number of ports in blynk only 50 ports, with that much value it is less in monitoring the entire runway edge lights. The author suggests that further development is needed in the future to seek access that is just as easy as the blynk application but with more capacity.

2. The author suggests that there are additional sensors that can help when this research is developed to be implemented in the field, it is necessary to have sensors that can support the microcontroller to help send data to the web/application without the need to create a wifi signal near the microcontroller, because if implemented in the field, it is certain that the range of the wifi signal from the airport terminal does not reach as far as the runway.

3. For the development of this prototype design in the future, the author's suggestion can be made to add to the number of miniature runway edge lights so that in testing the development of this research later it can further complement the workings of this tool that in testing if one of the lights goes out then will be monitored and can be seen in the application if the number light says the status is off.

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