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IOT-Based Rotating Beacon Current and Voltage Monitoring Design Using Nodemcu Via Blynk Application At International Airport in Indonesia

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Abstract: *ATCs' who serve in the tower and technicians in the powerhouse only control ON/OFF Rotating Beacon. It is difficult to know if there is damage to the lights and drive motor Rotating Beacon. This study aims to determine how to design a Prototype Rotating Beacon using NodeMCU and PZEM sensors and how the tools can monitor current and voltage Rotating Beacon using Blynk applications in the smartphone. This study began with designing the tool and testing the tool. This circuit is designed for technicians to monitor rotating beacons. In this circuit's design, monitoring this failure detection uses NodeMCU Microcontroller media equipped with PZEM-004t sensor.*

Keywords: *Airfield Lighting System; Rotating Beacon; NodeMCU, PZEM-004t.*

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I. Introduction

International Airport in Indonesia has aviation safety and security facilities in guiding aircraft movements. The movement of aircraft in the airport area at the time of taxiing, takeoff, and landing requires the help of information from the airport personal so that the process can be done safely. In addition to information assistance from airport personnel, information assistance is also obtained from aids. There are two types of aids used to transmit aircraft information where. The first tool is a non-visual tool, or called ILS (Instrument Landing System). The second aircraft aid is visually or called AFL (Airfield Lighting System). This type of tool uses lights that are turned on in the International Airport area.

One part of the AFL at the International Airport is the rotating beacon. A rotating beacon is a lighting sign for the airport's location consisting of white and green lights opposite each other rotated by the driving motor. The current condition of the rotating beacon is located above the tower. ATCs who serve in the tower and technicians in the Power House (PH) only have control for ON/OFF Rotating Beacon, so if there is damage to the lights and drive motor rotating beacon, it is difficult to know by the technicians or ATC. Based on technological advances, the innovative idea of making Prototype Monitoring current and voltage rotating beacons by using NodeMCU as a microcontroller and Blynk application as a monitor medium.

Airfield Lighting System (AFL) or Aeronautical Ground Lighting (AGL) is a term used at airports to help and serve pilots visually using various types of lights when the aircraft takes off, landing, and taxis to move efficiently and safely. Airport lighting systems (ALS) give visible information to the aircraft. The airfield lighting system is designed to meet the latest ICAO (International Civil Aviation Organization) and FAA (Federal Aviation Authority) recommendations to guarantee the safety of airport operations. The airport usually uses switching devices to control the airfield lighting systems (Bumiller & Pirschel, 2003). This system consists of aircraft luminaires during the approach, landing, and taxiing operations (Sudjoko and Hariyadi, 2021).

Based on the Regulation of the Director General of Air Transportation (KP 326. 2019), in general, AFL lights in the main area of the airport (landing movement) are grouped into three types of lights, namely Runway lights, Taxiway lights, and Apron. Every type of AFL lamp has a different name according to the location of the lamp placement. The following is explained by the lights as follows:

Rotating Beacon

Rotating Beacon is a light beam of airport location instructions, consisting of two opposite light sources mounted on the rotating, so that it can emit rotating light in green and white to be landed, and the total frequency of blinking must amount to 20 to 30 per minute. In general, rotating beacons are placed in towers, and the rays emitted from the rotating beacons must be visible from all angles in the azimuth.

Figure 1. Rotating Beacon

Internet of Things (IoT)

IoT is anything or electronic device that can interact directly with the user used for monitoring or control needs on that device over the internet.

IoT works by utilizing a programming argument in which each command of the argument produces an interaction between machines that are connected automatically without human intervention and at any distance. The internet is the link between the two machine interactions, while humans only serve as regulators and supervisors of the work of the tool directly (AR, 2020; Cahyanti et al., 2020; and Fahrezi, 2020).

NodeMCU

According to the basic book MQTT Protocol Implementation Using Python and NodeMCU. NodeMCU is an open source IoT platform and develop prototype IoT products orlanguage to assist in prototyping IoT products or can use sketches with an adruino IDE. The development of this kit is based on the V3 module, which integrates GPIO, PWM *(Pulse Width Modulation),*IIC, 1-Wire and ADC (Analog *to Digital Converter)*all in oneboard. Gpio NodeMCU V3 NodeMCU is essentially a development of the ESP 8266 with e-Lua-based firmware.

NodeMcu is equipped with *a micro* USB port that serves the association and power supply. In addition, NodeMCU is equipped with *a push-button* that is a reset and *flash* button. NodeMCU uses the Lua systeming language, which is a *package* of esp8266. Lua language has the same logic and arrangement of formation with c only different syntax. If you use the Lua language, you can use the Lua *loader tool* or Lua *uploder* NodeMCU measuring 4.83cm long, 2.54cm wide, and weighing 7 grams. This board is equipped with WiFi and Firmware features that are open-source.

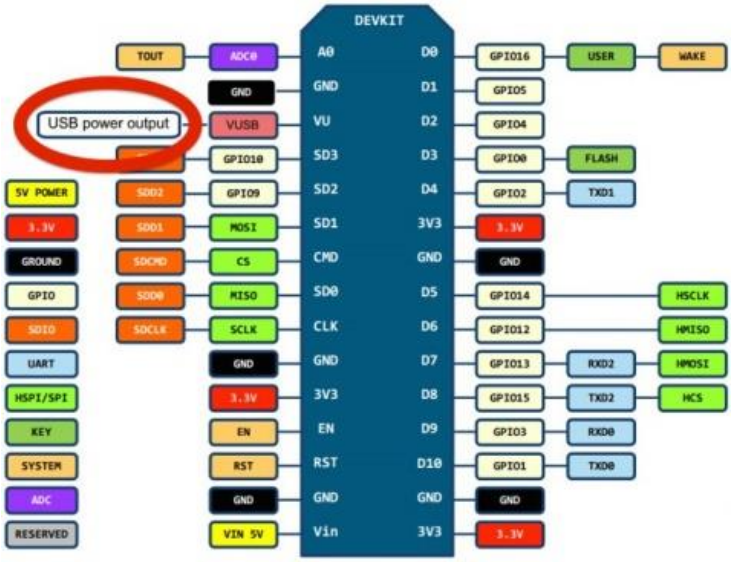

Figure 2. GPIO NodeMCU ESP8266

Blynk

Blynk is an app for iOS and Android OS to control Arduino, NodeMCU, Raspberry Pi, and the like over the Internet. This application can be used to control hardware devices, display sensor data, store data, visualize, and others. Blynk applications have three main components, namely Applications, Servers, and *Libraries.* Blynk server serves to handle all communication between smartphones and hardware. Widgets available on Blynk include *Button, Value Display, History Graph,* Twitter, and Email. Blynk is not tied to some microcontroller but must be supported by the selected hardware. NodeMCU is controlled with the Internet over WiFi, ESP8266 chip, Blynk will be made online and ready for the Internet of Things.

Arduino IDE

IDE stands for *Integrated Development Environment*, or simply an integrated environment used for development, referred to as an environment because it is through this software that Arduino does programming to perform functions immersed through programming syntax. Arduino uses its programming language that resembles the C language.

PZEM-004t

PZEM-004T is an electronic module that measures: Voltage, Current, Power, Frequency, Energy, and Power Factor. This module is equipped with voltage sensors and current sensors (CT) that have been integrated. With the completeness of this function/feature, the PZEM-004T module is ideal for use as a project or experiment of power gauges on a power grid such as a house or building.

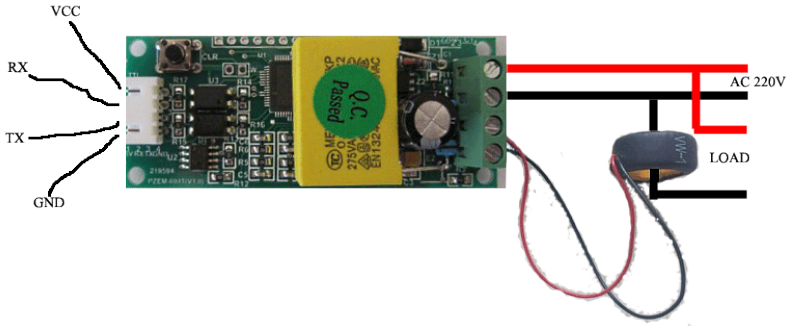

Figure 3. PZEM-004T V3.0

LED Strip

LED strips are defined as lamps with an array of SMD LED chips attached to a long circuit. The shape is flexible and has a strong adhesive on the back of the lamp. Strip lights were created with waterproof capabilities. Diverse colors. Strong adhesive. A choice of several types of SMD chips. Constant or *flexible* current and voltage regulator.

Figure 4. LED Strip AC

Motor AC

A synchronous motor is an alternating current motor in which, at a tunak state, the rotation of the shaft is synchronized with the frequency of the supply current; The rotation period is exactly equal to the integral number of alternating current cycles. Synchronous motors contain multiphase alternating current electromagnets on motor stators that create magnetic fields that rotate in time with the oscillation of line currents. Rotors with permanent magnets or electromagnets rotate in line with the stator plane at the same speed and, as a result, provide a second synchronized rotating magnetic field from an alternating current motor.

Figure 1. AC Motor

Jumper Cable

A jumper cable is an electrical cable to connect between components in the breadboard without soldering. Jumper cables generally have connectors or pins at each end. The connector for the stabbing is a male connector, and the connector to be pierced is a female connector. The cable jumper is divided into 3, namely: Male to Male, Male to Female, and Female to Female (Yusuf and Asep, 2018).

II. RESEARCH METHODS

Research Design

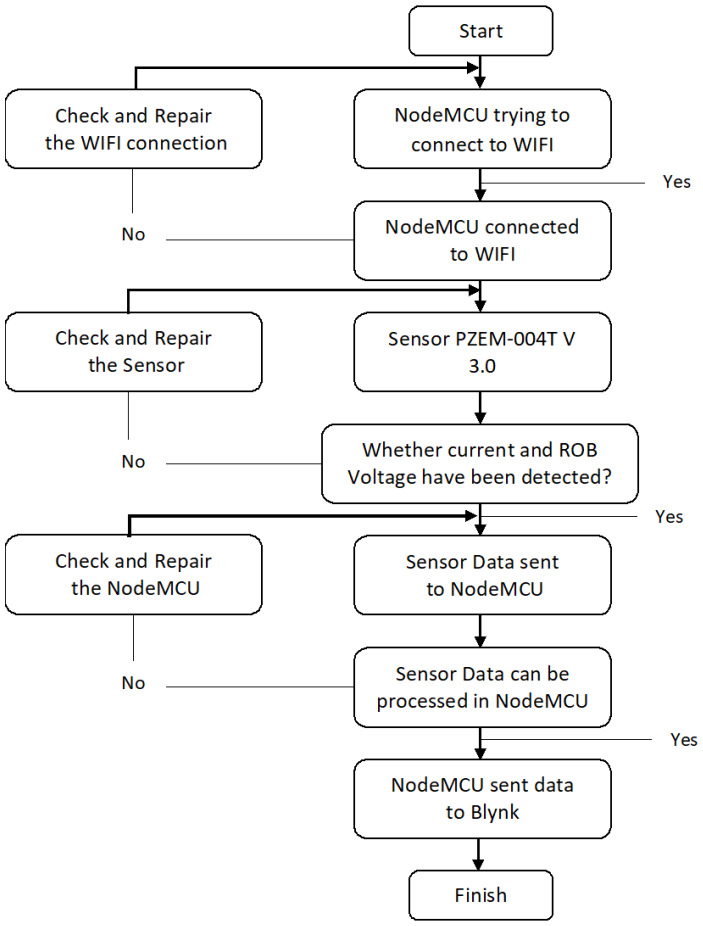

Figure 6. Diagram Flowchart

In the flowchart diagram describing how the tool works. First NodeMCU ESP8266 performs connectivity to the wifi network, if it cannot connect to the wifi network, then checks and improvements are made on the wifi connection, and if it can connect with the wifi connection then the PZEM sensor starts working. If the PZEM sensor does not obtain the data, it is necessary to check and repair the sensor. But if the sensor manages to obtain the data, then the data will be sent to NodeMCU. After that NodeMCU tries to process sensor data, if NodeMCU cannot process the data then it is necessary to check or repair the component. But if NodeMCU can process sensor data it will be sent to the Blynk application. Data already in the Blynk application can be accessed on condition that the user has a smartphone or gadget connected to a wifi connection. Then the android smartphone must download the application in the app store. After that the user can monitor the current and voltage on the Rotating Beacon through the Blynk application.

Tool Planning

PZEM-004T sensor module as voltage and current detection. In this system, NodeMCU is the center of work of this tool, LED Strip AC as Rotating Beacon lamp, AC Motor(Synchronous)as ROB light drive motor. All of these components are related to each other to produce a correct automation work system.

Tool Design

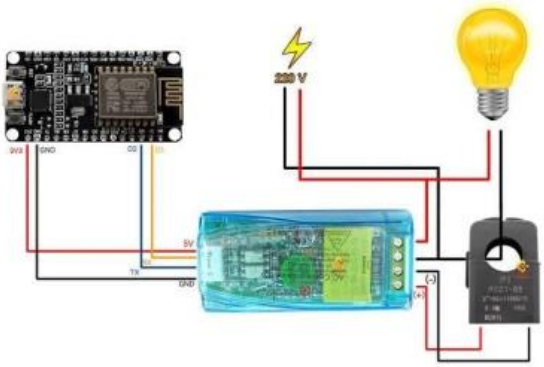

Figure 7. Wiring monitoring lights

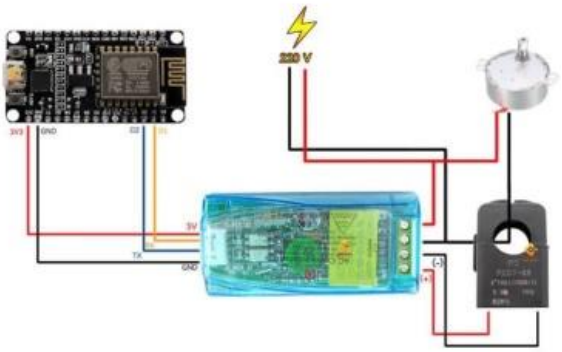

Figure 8. Wiring monitoring drive motor

Tool Testing Techniques

In the design of current and voltage monitoring equipment on *the Rotating Beacon* has been completed in installation then the following test steps are as follows:

a. Connect the entire network.
b. Then connect the smartphone with NodeMCU over the internet network.
c. Then kilk on / off on the selector switch then *rotating beacon* will turn on / off.
d. After that, the lights and drive motor will get a voltage of ±220 V.
e. The sensor will read the light and motor's voltage and send the reading results to the smartphone.
f. The tolerance of the PZEM 004T sensor is 1.0%.

So the result of the voltage obtained by lights and motors is ±220 volts. Where for the power supply needed microcontroller is 5V with ampere ±2 A. When connecting smartphones and NodeMCU requires an internet network.

III. RESULTS AND DISCUSSION

Results

This research was conducted to know the results of the design that has been made in chapter 3. Testing the entire design is useful for knowing how the performance and success rate of the system. From the results of the test, it can be analyzed the performance of each part of the design that interacts with each other so that a prototype rotating beacon monitoring system is formed using NodeMCU.

Discussion of Research Results

a. Testing at *rotating beacons* under normal circumstances

When the switch is on, the drive motor rotates, and the lights on *the Rotating Beacon* will turn on. The Blynk application will display a reading of the current and voltage of the lights and the drive motor at the time of *rotating the beacon* on. For more details, you can see in Figure 9.

Figure 9. Display when ROB is normal

b. Testing at the time the *Rotating Beacon* lights go off

When the switch in the ON drive motor rotates but the lights on *the Rotating Beacon* turn OFF, at that very moment, the Blynk application display will display a reading of voltage and current on the drive motor, but the voltage and current on the lamp are not readable in the Blynk application. Therefore we can know that the lights on the *Rotating Beacon* are off.

Figure 10. Display when the ROB light is off

c. Testing at the time the *Rotating Beacon* drive motor died

When the switch in ON lights will turn on but the drive motor on *the Rotating Beacon* is OFF, at that time the Blynk application display will display a voltage and current reading on the lamp but the voltage and current on the drive motor are not readable in the Blynk application. Therefore we can know that the driving motor on the *Rotating Beacon* is dead.

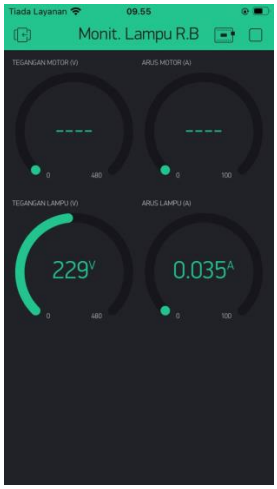

Figure 11. Display when the ROB motor dies

IV. CONCLUSION AND RECOMENDATION

This design uses NodeMCU microcontrollers as the sender of current and voltage data of lights and drives motors read by PZEM sensors on *rotating beacons.* This monitoring design can still be used using a smartphone if the smartphone has a charger battery so that the Blynk application can still be used. With the planning of this tool monitoring, the current and voltage lights and drive motors on *the Rotating Beacon* through NodeMCU microcontrollers and PZEM sensors using the Blynk application can make it easier for electricians to monitor *rotating beacons* through smartphones remotely so that it becomes more efficient.

The author realizes the design of this tool sometimes still experiencing interference with the Blynk application because it must be accessed through a smartphone whose weakness if the smartphone charger runs out then it cannot be monitored and Blynk's connection must be connected to wifi, therefore it is expected for the monitoring display made so that it can be accessed using smartphones and PCs that are always connected to Wi-Fi. In addition to monitoring through the Blynk application can also be added *siren / buzzer* as a marker alarm when the lights or driving motor *Rotating Beacon* is damaged. It is necessary to add control ON/OFF in the Blynk application to no longer use *selector* switches.

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