

Comparative Study of Internet of Things (IoT) Platform for Smart Home Lighting Control Using NodeMCU with Thingspeak and Blynk Web Applications

Marina Artiyasa
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
marina@nusaputra.ac.id

Ilman Himawan Kusumah
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
Ilman.himawan@nusaputra.ac.id

Anang Suryana
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
anang.suryana@nusaputra.ac.id

Edwinanto
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
edwinanto@nusaputra.ac.id

Aryo De Wibowo Muhammad Sidik
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
aryo.dewibowo@nusaputra.ac.id

Anggy Pradiftha Junfithrana
Electrical Engineering
Nusa Putra University
Sukabumi, Indonesia
anggy.pradiftha@nusaputra.ac.id

Abstract—Today's technology has developed rapidly with the Internet of Things (IoT) which is a concept that aims to expand the benefits of continuously connected internet connectivity. Internet of Things (IoT) is a development of network communication of interrelated objects connected through internet communication and can exchange data, turning it into information. Many tools are created to ease human work and even replace human work. Controlling room lights in a house using NodeMCU is one of the Smart Home technologies based on the Internet of Things (IoT). This research can provide information about the differences, advantages and disadvantages of Web, Thingspeak and Blynk applications for Smart Home devices to turn on and off house lights via the internet using laptops and smartphones. NodeMCU is a microcontroller that can be analogous to the Arduino ESP8266 board. NodeMCU includes ESP8266 and is packaged in a compact board with various features such as a microcontroller, WiFi access capabilities, and a USB data cable extension chip, which is used as a data cable and charging cable for Android smartphones. From the analysis results using the three platforms, it is known that Blynk is superior to the other two platforms because the way to create and operate is easier and more efficient.

Keywords—IoT, NodeMCU8266, Web, Thingspeak, Blynk.

I. INTRODUCTION

Along with the times and the increasing human need for technology, there is more and more encouragement for humans to think creatively, explore discoveries, and maximise existing technologies' performance to ease human work. Today's technology has developed rapidly. Many tools were created to ease human work and even replace human work. Controlling room lights in a house using NodeMCU is one of the Smart Home technologies based on the Internet of Things (IoT). A Smart Home is a home that provides comfort and energy efficiency for the home.

Internet of Things (IoT) is a development of network communication of interrelated objects connected through

internet communication and can exchange data, turning it into information. The Internet is a medium of communication and control of a device remotely as long as it is still connected and connected.

NodeMCU is a microcontroller that can be analogous to the Arduino board of the ESP8266. The NodeMCU includes the ESP8266 and is packaged in a compact board with various features such as a microcontroller, Wi-Fi access capabilities, and a USB to serial communication chip. So, to program it, you only need a USB data cable extension, which is precisely what is used as a data cable and an Android smartphone charging cable.

Thingspeak is an IoT Platform that allows us to collect, store, analyze, visualize and act on data from sensors or actuators, such as Arduino, Raspberry Pi and other hardware devices. For example, with Thingspeak, we can create sensor-logging and location tracking applications. Thingspeak functions as a data collector that collects data from device nodes and allows data to be loaded into the software environment for historical analysis of the data.

Blynk is a Platform for Mobile OS applications (iOS and Android) which aims to control Arduino modules, Raspberry Pi, ESP8266, and similar modules via the internet. This application is a creative place to create a graphical interface for projects that will be implemented only by the drag and drop widget method. From this application platform, we can control any equipment remotely, wherever we are and at any time, with a note connected to the internet with a stable connection.

So in this final project, the author will discuss the comparison of Internet of Things (IoT) technology via the Internet (Website), Thingspeak application and Blynk application with NodeMCU equipped with a relay as a switch to turn the lights on and off.

II. LITERATURE REVIEW

A. Internet of Things

Internet of Things or also known by the abbreviation IoT is a concept that aims to expand the benefits of continuously connected internet connectivity. As for capabilities such as data sharing, remote control, and so on, including objects in the real world. For example, foodstuffs, electronics, collectables, and any equipment, including living things, are connected to local and global networks through embedded sensors and are always active. Another similar meaning, the Internet of Things (IoT), is a concept or scenario where an object can transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT (Internet of Things) became known in 1999 when it was first mentioned in a presentation by Kevin Ashton, co-founder and executive director of the Auto-ID Center at MIT. With the development of internet infrastructure, we are heading to the next stage, where not only smartphones or computers can be connected to the internet. But various kinds of natural objects will be connected to the internet. For example, it can be production machines, cars, electronic equipment, wearables, and any tangible objects connected to local and global networks using embedded sensors and actuators.

B. Support Software

Based on the research, it can be concluded that the supporting software needed in the system development process to be carried out consists of three types of applications. The applications needed are Arduino IDE, the ESP8266 programming environment, Thingspeak as an open-source IoT platform, and Blynk OS Mobile (iOS and Android), which aims to control the ESP8266 module.

1. Arduino IDE

Arduino IDE (Integrated Development Environment) is software used to program various kinds of microcontrollers such as Arduino and NodeMCU ESP8266. Arduino IDE can run on all OS. Arduino IDE uses the C/C++ programming language and a compiler (Avr-g++). Arduino program code is usually called a sketch and is made using the C programming language. Programs or sketches that have been written in the Arduino IDE can be directly compiled and uploaded to the Arduino Board. In simple terms, Arduino sketches are grouped into three blocks, namely the header, setup, and loop.

2. Thingspeak

Thingspeak is an internet service that provides services for "Internet of Things" applications. Thingspeak is a service that contains applications and APIs that are open source to store and retrieve data from various devices using HTTP (Hypertext Transfer Protocol) over the internet or via LAN (Local Area Network). Using Thingspeak, one can create sensor logging apps, location tracking apps, and social networks of anything connected to the internet with status updates. This application can help us monitor lights, temperature and many other parameters remotely as long as there is an internet connection. We don't have to make challenging programs because the existing infrastructure has helped us. In this case, we can see a temperature graph according to the sensor and the parameters we want to know. In this study, we will monitor the lights at home. The tools used are NodeMCU temperatures and lamps. We have

to register an account first in Thingspeak. After we get it, we have to register our project, and we will monitor the temperature. After that, we copy the code we got from Thingspeak to the program in Arduino IDE.

3. Blynk application

Blynk is a server service used to support Internet of Things projects. This server service has a mobile user environment, both Android and iOS. Blynk Application as IoT support can be downloaded via google play. Blynk supports a wide range of hardware used for Internet of Things projects. Blynk is a digital dashboard with a graphical interface facility for manufacturing its products. Adding components to Blynk Apps using Drag and Drop makes adding input/output components easier without the need for Android or iOS programming skills. Blynk was created to control and monitor hardware remotely using internet or intranet data communications (LAN network). The ability to store and display data visually using numbers, colors or graphics makes it easier to create projects in the Internet of Things field. The Blynk application has three main components: namely, Application, Server, and Libraries. Blynk server serves to handle all communication between the smartphone 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 controlled with internet via Wifi, ESP8266 chip, Blynk will be made online and ready for the Internet of Things.

C. Support Hardware

1. NodeMCU ESP8266

NodeMCU is an open-source IoT platform and development kit that uses the C programming language to assist in prototyping IoT products, or you can use a sketch with the Arduino IDE. The NodeMcu is equipped with a micro USB port that functions for programming and power supply. In addition, the NodeMCU is also equipped with push buttons, namely the reset and flash buttons.

2. 5V Relay Module

The 5V Relay Module is a magnetic switch that disconnects and connects electric current. These relays are electrically operated, which allows switching circuits on or off using much higher voltages or currents than the NodeMCU can handle. There is no connection between the low voltage circuit operated by the NodeMCU and the high power circuit.

III. LAMP CONTROL SYSTEM

A. Light Control System with IoT

The home lighting controller in this study uses the Web, Blynk and Thingspeak, which is processed by the NodeMCU 8266 microcontroller with Arduino IDE as programming software. The following are block diagrams and flowcharts regarding this research and tool system:

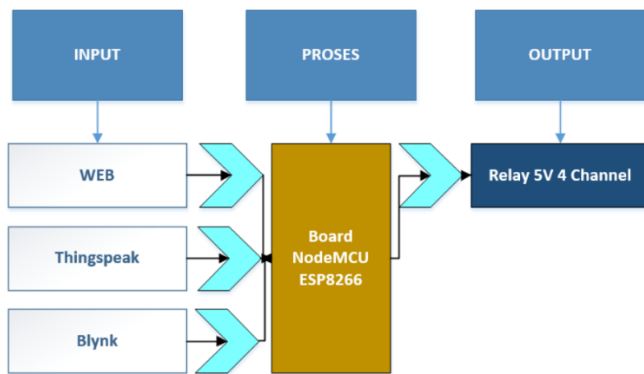


Figure 1. Tool Work Block Diagram

The lamp controller uses a Web, Blynk and Thingspeak system with NodeMCU as a microcontroller connected to Wifi as connectivity between the IoT Platform and NodeMCU, then produces a 5-volt relay output which is connected to home lighting. This study will compare three platforms, namely Web, Blynk and Thingspeak, in terms of system creation to speed in controlling home lighting.



Figure 2. Flowchart of Lighting Control System with IoT

The system working on this tool is the first to collect data and study literature for hardware and software design materials. Hardware design will be discussed at the stage of making the tool. The hardware and software used are NodeMCU ESP8266, the tool is tested to find out how far the tool's success rate is.

B. Light Control Using Web

In the control system using the Web in this study, one must first create a program on the Arduino IDE software, upload it to the NodeMCU 8266 Board and open the serial monitor on the Arduino IDE to find out the IP Address that will be used to access the Web. The following is a block diagram and flowchart of controlling lights using the Web.

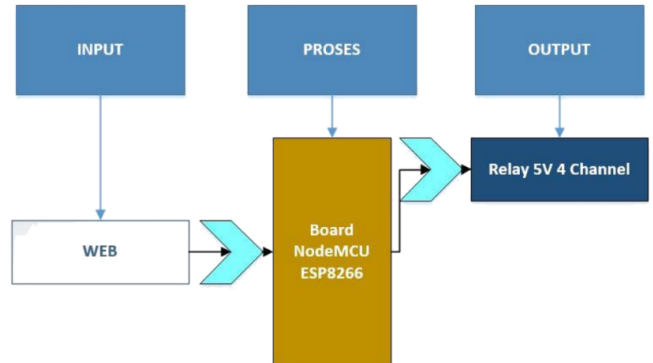


Figure 3. Block Diagram of Lighting Control Using the Web

The intelligent home tool works to turn on and off the house lights, namely using the web or the internet as input that functions to provide data to the NodeMCU ESP8266. This system also has an output in a relay module to turn on and off the house lights. To connect and control the NodeMCU ESP8266, use the IP address on the Arduino IDE serial monitor, access it to the web browser, and a new page will appear in the form of a control visualization display to turn the house lights on and off.

C. Light Control Using Blynk

In the control system using Blynk in this study, first, download the Blynk application on the play store, then create an account to get the token number that must be entered in the Arduino IDE software program and then upload it to the NodeMCU 8266 board. The following are block diagrams and flowcharts for controlling lights using Blynk.

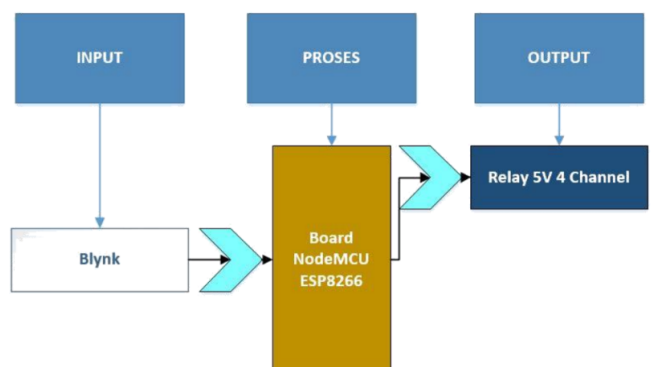


Figure 4. Block Diagram of Light Control Using Blynk

The Smart Home tool works to turn on and off the house lights by using the Blynk application as an input, which functions to provide data to the NodeMCU ESP8266. This system also has an output in a relay module to turn on and off the house lights. To connect the NodeMCU ESP8266 with the Blynk application, use the char token in the email when registering with the Blynk application. When the NodeMCU ESP8266 is connected to wifi and the Blynk

application, the android phone can control turning on and off the house lights through the Blynk application.

D. Light Control Using Thingspeak

In the control system using Thingspeak in this study, one must first create an account on Thingspeak to get API Keys, then input it on the Arduino IDE software and then upload it to the NodeMCU 8266 Board and open Thingspeak to find out the URL that will be accessed for control. The following is a block diagram of controlling the lights using Thingspeak.

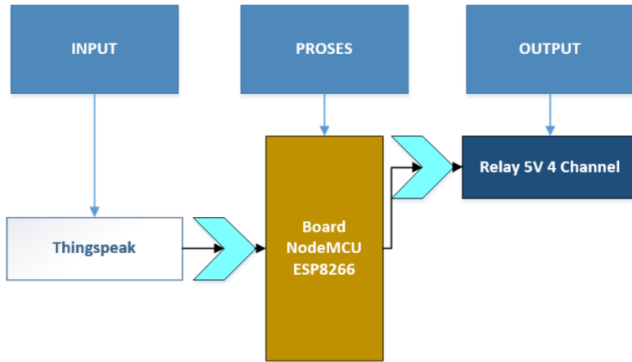


Figure 5. Block Diagram of Lighting Control Using Thingspeak

The Smart Home tool works to turn on and off the house lights, namely using Thingspeak as an input that functions to provide data to the NodeMCU ESP8266. This system also has an output in a relay module to turn on and off the house lights. To connect and control the NodeMCU ESP8266, use the URL from Thingspeak and access it in a web browser.

IV. DEVICE DESIGN

A. Software Design

The software design for controlling the lights is to install Arduino IDE on the PC/Laptop that will be used. The following is the Arduino IDE software. Arduino IDE is proper as a text editor for creating, editing and validating program code. It can also be used to upload to the Arduino Board. The program code used on the Arduino is called the Arduino "sketch," also called the Arduino source code, with the Arduino source code extension. After installing the Arduino IDE software, install the NodeMCU 8266 Board on the Arduino IDE, then adjust it to the board used by selecting file/preferences/enter URL/ then go to tools/board manager then search for esp8266 then install.

B. Hardware Design

The hardware design for this device is to connect all components, starting with connecting the pins on the NodeMCU ESP8266 with a four-channel relay module. Then install the output on the four-channel relay module to each lamp.

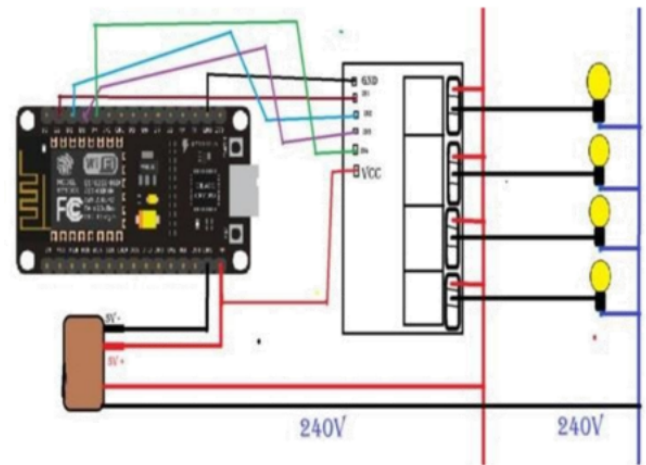


Figure 6. Circuit Schematic

C. Lamp Control Design

1. Light Control with Web

In this study, the author uses the Web, which is used for Smart Homes to turn on and off IoT-based home lights. The first step is to make a program on the Arduino IDE and then compile it to determine if the program is correct. If the IDE program is correct, we upload it to the NodeMCU 8266 Board. After the program has been verified, a done compiling will appear, which means the program is correct and there are no errors. The next step is to send the program to the NodeMCU 8266 Board by uploading the program.

2. Light Control with Thingspeak

In this study, the author uses Thingspeak, which Smart Homes uses to turn on and off IoT-based home lights. The first step is to create an account on Thingspeak. Then you will get API keys to be input into the Arduino IDE program, then send the program to the NodeMCU 8266 Board. After that, open Thingspeak and access the URL provided. Then we enter digital input 1 or 0 on the URL. On Thingspeak, a graph and indicator of the lights being controlled will appear. In creating a Thingspeak account, you need an email address and verify your Thingspeak account via the registered email. After the account is registered, the next step is to create a new channel for lighting control and monitoring.

3. Light Control with Blynk

In this study, the author uses Thingspeak, which Smart Homes uses to turn on and off IoT-based home lights. The first step is to download the Blynk application on the Play Store and create an account on Blynk. Then you will get an Auth Token to be input into the Arduino IDE program, then send the program to the NodeMCU 8266 Board. After that, open the Blynk application and add a widget button for controlling the lights.

V. Result

A. Testing Using the Web

In testing the IoT Web Platform, when the Arduino IDE Program has been successfully uploaded to the NodeMCU 8266 board, wifi connectivity and IP addresses will appear, which we will access via a web browser. Control begins with all outputs low (off), for the speed of controlling the lights is very fast because This web platform is not affected

by internet speed or poor internet signal because the web platform uses wifi connectivity and IP address which does not require internet.

B. Testing Using Thingspeak

In testing the Thingspeak IoT Platform, when you have created an account on Thingspeak and the Arduino IDE program has been successfully uploaded to the NodeMCU 8266 board, a connected wifi connection will appear. Then we can access the URL in Thingspeak to convert the numbers into digital input. On Thingspeak, indicators and graphs will appear where the lights turn on and off, but the control using Thingspeak is greatly affected by internet speed because basically, our control command must go to the Thingspeak server first and after that only to the nodemcu board, then the new output can change. At Thingspeak, we can change the display publicly so that other people can see it, or it can be private, which we can only access ourselves then, Thingspeak supports remote control even though it uses different connectivity from nodemcu on the condition that we use login with a registered Thingspeak account.

C. Testing Using Blynk

In testing the Blynk IoT Platform, when the system has been created and opens the Blynk application, there are four buttons to control four lights. There was no delay when turning on or off the lights in this study, and Blynk was disconnected if it was out of range or the internet network died.

D. Test Against Distance

The Web platform has a control distance limit of 30m or the maximum wifi distance received by nodemcu 8266, and the internet signal does not affect controlling the lights. The control distance can be increased by using a wifi repeater which serves to strengthen the wifi signal if the distance is close to the limit and the extra distance is about 15 m, so the total light control distance using the web is a maximum of 45 m on condition that you use a wifi repeater.

The Thingspeak platform does not have a control distance limit because Thingspeak can use a different network provided that nodemcu 8266 is connected to wifi that has an internet signal and a Thingspeak account log in with an account that has been registered with the Arduino IDE program, this is an added value for remote light control not affected by the location of the user who may be able to control the lights anywhere on the condition that the 2 points above are met.

On the Blynk Platform, users can only use light control via a smartphone, meaning they cannot use a PC/laptop. Then on the Blynk platform, the same as Thingspeak, which does not have control limits, because Blynk can use a different network provided that nodemcu 8266 is connected to wifi which has an internet signal and a smartphone that has an internet signal. The auth token is registered with the Arduino IDE program. The difference between Blynk and Thingspeak is that Blynk users can only use one smartphone as the control because if they use a different smartphone, the auth token will be different from that in the Arduino IDE program, while Thingspeak can be accessed via a web browser using any smartphone or PC/laptop. They provided that you log in with the account registered with the Arduino IDE program.

So we can conclude that each of the IoT platforms that the author tested has their respective advantages in terms of making the system controlling, so the author made a comparison table for the IoT Platforms tested as follows:

Table 1. Comparison of test materials with platforms

Testing Material	Platform		
	Web	Thingspeak	Blynk
Minimal Speed Internet	Not Affected By Internet Speed	5mbps	5mbps
Using a Different Network	Cannot Use Different Network	Can Use Different Networks	Can Use Different Networks
Internet Off	Still going well	Control Can't Be Done	Control Can't Be Done
Interface Display	Less attractive	Interesting	Interesting
System build	Easy	Complicated	Easy
Control Distance	Maksimal 30 m	Remote Control	Remote Control
Monitoring Lights	Can't	Can	Can't
Process Control	Enter the Nodemcu IP Address Used	Login First Then Access URL and Enter Digital Logic	Open the Blynk App
Control Media	Smartphone or PC/Laptop	Smartphone or PC/Laptop	Smartphone

Note:

Yellow Color: Enough

Blue color : OK

Green color : Very good

Table 3 above explains that the IoT Platform, namely the Blynk application, is superior in making, controlling, and functioning the tool. Today, everyone must have had a smartphone, and it has become a daily necessity for communication and information, so the Blynk application is highly recommended to be applied to intelligent home programs in everyday life because of the practical and easy way to use it via a smartphone.

VI. Conclusion

Some of the conclusions that the author got during the research are as follows:

1. A Smart Home prototype has been made with IoT-based light control
2. Home light control device with IoT system using Web Platform, Thingspeak, and Blynk works well
3. Light control device using a web platform is recommended for users who have low internet speed and do not need the remote control
4. Light control devices using the Thingspeak platform are recommended for users who have internet speed

REFERENSI

- [1] L. X. Wang, Stable and optimal fuzzy control of linear systems, IEEE Trans. Fuzzy Systems. 6, pp. 137-143, 1998.
- [2] L. A. Zadeh, The concept of a linguistic variable and its application to approximate reasoning, Inform. Sciences. Part I:(8), pp. 199-249 Part II:(8), pp. 301-357, Part III:(9), pp. 43-80, 1975.
- [3] S. L. Campbell, Singular systems of differential equations, Pitman, Marshfield, MA, 1980.
- [4] S. L. Campbell, Singular systems of differential equations II, Pitman, Marshfield, MA, 1982.
- [5] L. Dai, Singular control systems, Lecture Notes in Control and Information Sciences, Springer, New York, 1989.
- [6] F. L. Lewis, A survey of linear singular systems, Circ. Syst. Sig. Proc., 5, pp. 3-36, 1986.
- [7] G. Da Prato and A. Ichikawa, Quadratic control for linear periodic systems, Appl. Math. Optim., 18, pp. 39-66, 1988.
- [8] K. Zhou and P. Khargonekar, An algebraic Riccati equation approach to H optimization, Systems Control Lett., 11, pp. 85-91, 1998.
- [9] Jamshidi, An overview on the solutions of the algebraic matrix Riccati equation and related problems, Large Scale Systems, 1, pp. 167-192, 1980.
- [10] L. Jodar and E. Navarro, Closed analytical solution of Riccati type matrix differential equations, Indian J. Pure and Appl. Math., 23, pp.185-187, 1992.
- [11] D. R. Vaughan, A negative exponential solution for the matrix Riccati equation, IEEE Trans. Automat. Control, 14, pp. 72-75, 1969.
- [12] N. Lovren and M.Tomic, Analytic solution of the Riccati equation for the homing missile linear quadratic control problem, J. Guidance. Cont. Dynamics, 17, 619-621, 1994.
- [13] M. Razzaghi, Solution of the matrix Riccati equation in optimal control, Information Sci., 16, pp. 61—73, 1978.
- [14] M. Razzaghi, A computational solution for a matrix Riccati differential equation, Numerical Math., 32, pp. 271-279, 1979.
- [15] M. Razzaghi, A Schur method for the solution of the matrix Riccati equation, Int. J. Math. and Math. Sci., 20, pp. 335-338, 1997.
- [16] Albagul, Othman O. Khalifa and Wahyudi, Matlab and scilab in Mechatronics, Int. J. engng Ed., 21, pp. 896-905, 2005.
- [17] B. Simeon, Modelling a flexible slider crank mechanism by a mixed system of DAEs and PDEs, Math. Modelling Syst., 2, pp. 1-18, 1996.
- [18] J. Weickert, Navier-Stokes equations as a differential algebraic system, Preprint SFB 393/96-08, Technische Universität Chemnitz-Zwickau, 1996.