Laboratory Control and Monitor Device Based on Relay With Raspberry

Yunus Tjandi[1]
Zulhajji[2]
Syarifuddin Kasim[3]

University Negeri Makassar[1]
Email: yunus.tjandi@unm.ac.id[1]

Abstract. Observe in the Laboratory for student requires comfortable and safe conditions. Realize this, we need a control and monitor device to secure electrical device inside of laboratory. This research aims to : (1) Build software laboratory control and monitor based on relay with raspberry to bridle electrical devices in the laboratory or office using smartphone, (2) Build laboratory control and monitor device based on relay with created software, (3) Build an interface and application of laboratory control and monitor based on relay with smartphone to bridle electrical devices in the laboratory or office whether in a close or wide range.The result shows that : (1) software of laboratory or office control and monitor based on relay serve properly, this is evidence by all controlled and monitored systems both in Miniatur Circuit Breaker (MCB) as well as various controlled loads, (2) Electrical control and monitor device based on relay serve properly, this is evidence by research trials using smartphone, (3) Applications and interface control systems based on relay with raspberry serve properly, this is evidence by control system trials using smartphone.

Keywords: Control and Monitor Device, Relay, Raspberry, Laboratory's Devices, Smartphone

INTRODUCTION

Abundant hazard occur due to the improper installation of electrical device and the effectiveness use of monitoring and controlling laboratory. When the electrical installation of a house/building has been given an electric voltage by PLN, then the installation is no longer in the private domain, but has become the public domain (Rajeev, 2013). To avoid improper electrical, monitor, and control installation, it is required that everyone who intends to install the device must have an Expertise Competency Certificate of Installing device provided by Government they also should pass the certified examinations both written and practical, whichever in line with 4.0 condition.

Based on initial survey, the utilization of electrical devices are still manual and not in line with modern technology, in addition the use of electrical energy is also fairly wasteful because the system cannot be controlled automatically, both from close or wide range. It can be imagined if in a laboratory/building there are a lot of electrical devices, of course the head of the laboratory will always be alarmed about the equipment he is handling. The electrical devices referred include; electrical power, electric switches, electric safety, electronic devices, water pump machines and monitor devices in the form of CCTV. From the problems above, the researcher willing to create a Laboratory Control and Monitor Device Based on Relay With Raspberry intended for laboratories/buildings by using smartphone as the control media.

A. Electrical Devices in the Lab

The use of electricity in the Lab/office in question is the one that has got an electricity connection, both sourced from PLN and from other sources. The voltage installed is suitable for domestic needs in general 220/380 volts with 50 Hz frequency.

Electrical equipment to be monitored and controlled consists of: webcam, electrical power, electric switches, MCB, and electronic devices inside a Laboratory or Office.

B. Relay

Relay is a simple electronic circuit and has the following components:
1. Switch
2. Medan electromagnet (Coil)
3. Poros iron

This component works when an electric current flows through a coil, then the surrounding magnetic changes the position of the switch so that it produces a greater electric current. Generating greater current is the virtue of this simple component even though it is a simple form.

This simple component in its development has been used as a basic component of various electronic devices, vehicle lights, electronic networks, television and radio. Even in the 1930s it was used as a basic computer device which

is now being replaced by microprocessors such as IntelCorp. and AMD. This is because the use of relays has the following advantages:

1. Control the current and the desired mains voltage.
2. Maximize the amount of electricity to reach the maximum limit.
3. Use a switch or more than one coil, adjusted to the needs.
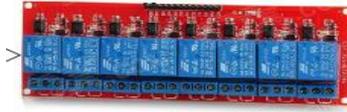
Figure 1. Relay (Putra, 2002)

Before microprocessors were available, relays were also used to control sequential machines . For example in injection molding machines, blow molding, and on the conveyor belt. The contact arrangement of the relay is divided as follows:

1. NO (Normally Open)
   The relay closes when it has electricity
2. NC (Normally Close)
   The relay will open when an electric current flows
3. CO (Change Over)
   This relay has a middle contact that will break away and make other contacts in touch.
   Relay have auxiliary contacts that work in NO and NC according to device requirements. Controlled by the main contact and driven by a coil with AC or DC source. Relays can control both high and low power circuits, according to the functions assigned to them.

C. Router

Router is a computer network hardware which share protocols with other network members. Used as a liaison between two or more networks that forward data. But router is different from Switch, it is only used to form a LAN (Local Area Network) and connect several computers. While the router is used to connect between one LAN with another LAN.

Figure 2. Router and Modem

D. Access Point

Access points can be found in many places such as home, business and public locations. At home, an access point is a wireless router that is connected to a DSL or a cable modem. However, some modems may include wireless capability to make the modem itself as an access point. Large companies usually provide several

access points so that employees can connect to the central network of various locations.

Access Point is used as a Hub/Switch to connect local networks with wireless networks, in this access point data/internet connections are transmitted through radio waves, signal strength also affects the coverage area to be reached, the greater the signal strength (dBm or mW) the wider the range.

Figure 3. Access Point

E. IP Address

IP Address (Internet Protocol Address) is a sequence of binary numbers between 32-bit to 128-bit as the identification address for each host computer in the Internet network. The length of this number is 32-bit (for IPv4 or IP version 4), and 128-bit (for IPv6 or IP version 6) which shows the address of the computer on Internet network based on TCP/IP.

The Internet Assigned Numbers Authority (IANA) is a global IP address allocation manager. Internet Protocol (IP) addresses are numeric addresses assigned to a computer participating in a computer network that utilizes the Internet Protocol for communication between its nodes. Even though IP addresses are stored as binary numbers, they are usually displayed to make it easier for humans to use notations, such as 208.77. 188,166 (for IPv4), and 2001: db8: 0: 1234: 0: 567: 1: 1 (for IPv6).

Internet Protocol also routing data packets between networks, and determine the location of the source node and destination node in the topology of the routing system. For this purpose, several bits in the IP address are used to designate a subnetwork. The number of these bits is indicated in CIDR notation, which is added to the IP address, for example, 208.77.188.166/24. This IP addressing system is divided into two, namely:

- IP versi 4 (IPv4)
- IP versi 6 (IPv6)

Sending data in a TCP/IP network based on the IP address of the sending and receiving computers. IP address has two parts, namely the network address and the host address. The network address is used by routers to find the network where a local computer is located, while the host address is used to identify a computer on the local network.

F. Smartphone

Smartphone is a sophisticated technology with a combination of Personal Digital Assistant (PDA) and mobile phone. Having various functions and ease of internet access (Phillippi and Wyatt, 2011). The sophistication of a smartphone compared to a cellular phone in its powerful operation system, high processing speed, the latest multimedia devices, the best internet connection and touch screen. According to Brusco (2010), Smartphone is a mobile phone such as a

computerized system, used to sending e-mails, internet access and has an applications of finding information such as health, sports, money and various topics. To concluded, smartphone is like a computer but in a small size. Smartphone are a primary need for both personal and professional. It is suitable for professionals who communicate remotely like sending an email. The advantages of having a smartphone is a sophisticated system to download and install applications in a short amount of time.

This application is like a program on a computer desktop, but it is not complicated and available anywhere. Smartphone are created to provide various applications that can be downloaded from the internet using a specific operating system (OS) such as iOS, Android, Microsoft Windows Mobile, Windows Phone, Nokia Symbian, RIM BlackBerry and others.

G. Raspberry

Raspberry Pi is a computer device like a credit card size, really practical. The operating system is embedded in an SD Flash Card so it is easy to replace and exchange. The potential is extraordinary from those that have or have never been explored. It have been tested as multimedia players with streaming capabilities, as a game machine, internet browsing and as a hardware development mainboard.

This allows the device to be used in educational side for people of all ages and skill levels. The interest in the Raspberry Pi device is extraordinary and has far exceeded expectations. IT professionals, electronics experts and newcomers are all eager to 'put' their hands on this small device, this device will become big and growing.
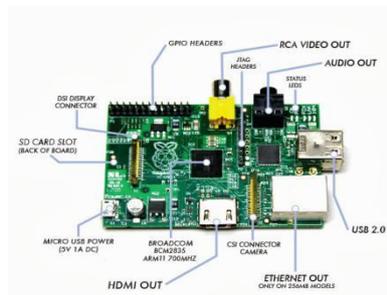
Figure 4 Raspberry

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I. Webcam

Web camera or commonly known as webcam is a camera that can be accessed using the world wide web (www) specially for its pictures, instant messaging programs, or communication applications with video display on a PC. It is described as digital video camera that are designed as low resolution and also used for security systems. Some are equipped with software to detect movement and sound. With this software, it allows PC connected to the camera to observe movements and sounds, then record them when detected. The r recording can be stored on a computer, email or uploaded to the internet. It is very useful in telecommunications, security and industry. e.g for video chat, surveillance camera, and as a video conference by several users.

Figure 5. Webcam Utilization

RESEARCH METHOD

A. Research Type

This study use an experimental method in accordance with the objectives to be achieved which is produce a product and the feasibility test for the product, then there are certain steps that must be followed to do it.

B. Research Locations

The limitations of the equipment in this study were overcome by using several laboratories at the Faculty of Engineering, Makassar State University, including: Electrical Engineering Control and Computer Engineering Laboratory of Makassar State University was carried out by making an electric control device to control and downloading them in the Lab/office based on Relay With Raspberry and

smartphone assist into the Microcontroller. In this case into the Relay and Raspberry devices, as well as several trials with improvements.

C.   Materials and tools used

To carry out this research several tools and materials are used as follows:

1. Material

1). Board House set	10). Raspberry, set
2). Saklar push ON set	11). Smartphone
3). Electrical Installation Cable set	12). Multimeter Digital
4). Ligts 4 set	13). Amperemeter Digital
5). Relay Board, set	14). MCB
6). Modem Router, set	15). jack konektor, set
7). USB Cable	16). Adaptor
8). Jumper wire, set	17). Screw Shield, set
9). Webcam 2 set	18). KKB 3 set

2. Tools

1). Access Point TP-Link MR-3020

D.   Data Collection Techniques

Data collection techniques are:
1.   Direct interview techniques with several experts in the field of electrical installation and control systems.
2.   Literature techniques to support this research, we need some literature for conceptual comparison of theories and application.
3.   Direct measurement techniques in order to attained more clearly result, then a direct measurement toward the controller needs to be done.
4.   Documentation techniques. After successful testing documentation is needed for some of the symptoms that occur. This reinforces the process of making an application.

E.   Data Analysis Method

The method of analysis is an approach to modeling and formulating the system so that it can be solved by applying appropriate techniques. The analytical method directly influences the level of accuracy of this study. The expected analysis results are the success of the monitor and control device which is controlled automatically via smartphone or manually through the switch buttons attached in the Lab/Office (Board House).

1.   Application Design

This system is a control and monitor electrical device such as webcam, electrical power, electric switches, MCB, and electronic devices inside a Laboratory or Office. It consists of three main elements input, process and output. Output is what is produced by the control system, while input is what influences control, as

we can say it regulates output. In this case the electrical device is inside the lab/office.

The minimum control requirements for electrical devices generally activate and extinguish electrical equipment, therefore in this study an electrical device control system was built and simulated as shown in Figure 6 below.
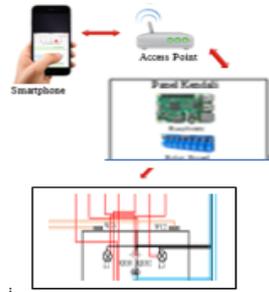
Figure 6. Laboratory Control and Monitor Device Based on Relay With Raspberry

F.   Trial of Control and Monitor Device Using IP Internet Network
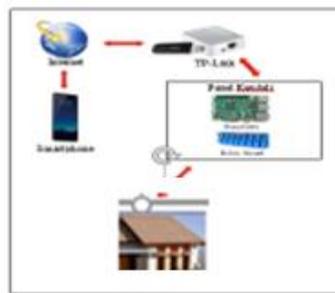
Figure 7. Internet Network Architecture

The picture above is a development of local connection, so user can control electrical devices (electrical power, electric switches, MCB, electronic devices, water pump machines and monitor devices in the form of CCTV) through an internet connection. In Figure 5 there is a modem/router as a medium to connect to the internet. Before this device used, it must be connected to the internet first then access "http: //www.kamamedyedyus@gmail.com control" on the user's smart phone. Then the website page appears on the user's smart phone as a remote to send instructions to the Raspberry whose function is to monitor and control the safety and electrical equipment in the Lab./Office.

RESULT AND DISCUSSION

Research Team first made an electrical installation then proceeded to application design as shown in figures 1,2,3, 4, 5, 6, and figure 7. Software that has been verified by the Validation Team is then downloaded into Raspberry which is then connected to other devices such as Relay Board, and Microcontroller (Raspberry set, Modem Router, Smartphone and other small devices). Download to the Raspberry set after all device perfectly connected. When Relay is successfully used, all electrical devices are tested then. The results of the test can be seen in the following tables.

Table 1. Testing of Electrical Safety Device (MCB/ELCB /NFB/MCCB)

Electricity Safety Status (MCB/ELCB/ NFB/MCCB) on the Board House	Electricity Safety Status (MCB/ELCB/ NFB/MCCB) on the Smart Phone	Explanation
ON	ON	All electrical devices in the Board house can be operated with a 220 volt working voltage. (MCB, webcam, electronic devices, electrical power, electric switches)
OFF	OFF	There is no supply voltage from the electricity source (PLN), means that all electrical devices cannot be operated, because the working voltage from PLN = 0 volts.

Table 2 Testing of a burdened Auxiliary Contact Box (KKB)

KKB	Smart Phone Status	Explanation
1	ON	KKB1, functioning by a variety of electrical devices with 220 Volt electrical working voltage
1	OFF	KKB1, not functioning because the supply voltage from the source / PLN does not exist or the mains voltage = 0 Volts
2	ON	KKB2, functioning by a variety of electrical devices with 220 Volt electrical working voltage
2	OFF	KKB2, not functioning because the supply voltage from the source / PLN does not exist or the mains voltage = 0 Volts
3	ON	KKB3, functioning by a variety of electrical devices with 220 Volt electrical working voltage
3	OFF	KKB3, not functioning because the supply voltage from the source / PLN does not exist or the mains voltage = 0 Volts

Table 3. Testing of Switches With Electric Light Loads Installed in the Board house

Saklar	Manual Switch Position on Board House	Switch Position on Smartphone	State of Lights	Explanation
1	ON	ON	No.1 Lamp is On	220 Volt working voltage on the lamp. According to setting
1	OFF	OFF	No.1 Lamp is Off	There is no power supply voltage on the lamp. According to setting
2	ON	ON	No.2 Lamp is On	220 Volt working voltage on the lamp. According to setting
2	OFF	OFF	No.2 Lamp is Off	There is no power supply voltage on the lamp. According to setting
3	ON	ON	No.3 Lamp is On	220 Volt working voltage on the lamp. According to setting

	OFF	OFF	No.3 Lamp is Off	There is no power supply voltage on the lamp. According to setting
	ON	ON	No.4 Lamp is On	220 Volt working voltage on the lamp. According to setting
4	OFF	OFF	No.4 Lamp is Off	There is no power supply voltage on the lamp. According to setting

Table 4. Testing of Electric Heaters with Voltage Source from Auxiliary Contact Box1/KKB1

Heaters Status on Board House	KKB1status on Board House	KKB1status on Smartphone	Explanation
ON	ON (There is supply voltage from the electricity source (PLN) (V = 220 volt))	ON	Heaters working normally with 220 Volt electrical working voltage
OFF	OFF (There is no supply voltage from the electricity source (PLN) (V = 0 volt))	OFF	Heaters not functioning because the supply voltage from the source/PLN does not exist or the mains voltage = 0 Volts (V = 0 Volt)

Table 5 Testing of CCTV1's Monitor (Webcam 1)

	Webcam 1 Status on the SmartPhone	Explanation
Webcam 1	ON	Webcam 1 Functioning, so it can capture the satate inside Lab/office
	OFF	Webcam 1 not functioning, because there is no signal from Raspberry and web's network.

Table 6 Testing of CCTV2's Monitor (Webcam 2)

	Smartphone Status	Explanation
Webcam 2	ON	Webcam 2 Functioning, so it can capture the satate inside Lab/office
	OFF	Webcam 2 not functioning, because there is no signal from Raspberry and web's network.

Table 7 Testing of CCTV3's Monitor (Webcam 3)

	Smartphone Status	Explanation
Webcam 3	ON	Webcam 3 Functioning, so it can capture the satate inside Lab/office
	OFF	Webcam 3 not functioning, because there is no signal from Raspberry and web's network.

CONCLUSION

1. Laboratory control and monitor software based on relay with raspberry works properly, this is evidenced by the functioning of all monitoring and control systems in the Lab/office with smartphone's support, both to the safety system and to the electrical loads.
2. Laboratory control and monitor hardware based on relay with raspberry has been work properly to control electrical devices (electrical power, electric switches, MCB, electronic devices, water pump machines and monitor devices in the form of CCTV) in the lab/office (Board House) this has been proven in research trials using smartphone.
3. Application and Interface of control and monitor devices based on relay with raspberry that have been made, function properly. This has been proven based on trials in the Lab/office (Board House) both from a short range using Local IP or widely using smartphone with Internet connection

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