MORFAI JOURNAL
Multidiciplinary Output Research For Actual and International Issue

UTILIZATION OF SMARTPHONES AS HUMAN MACHINE INTERFACE DISPLAYS FOR CONVEYOR CONTROL SYSTEMS LOGO BASED! WEB SERVER

Kartika[1], Asran [2], Bambang Harianto[3]
Prodi Teknik Elektro, Fakultas Teknik, Universitas Malikussaleh, Indonesia
E-mail: kartika@unimal.ac.id

Abstract

This study discusses the use of smartphones as a Human Machine Interface (HMI) display on a conveyor control system with web server technology that has been embedded in the PLC LOGO!.On average, all industrial conveyor control and monitoring systems are HMI-based which are displayed on a large monitor screen. This of course has its own saturation for operators in controlling and monitoring the conveyor because it just sits in one place.The application of smartphones as HMI displays on conveyor control systems can overcome this because the small size of the smartphone can be held, practical and can be carried everywhere. The HMI display application is built using web server technology with the main control being PLC LOGO! Siemens seriesLOGO!0BA8 and a wi-fi network generating device in the form of an outdoor point to point CPE type 01. The input data is taken from the conveyor safety device component which is processed by the PLC and sent to a web server that can be accessed by smartphones via a private IP address.Based on the results of this study, the use of smartphones as HMI displays on conveyor control systems with LOGO! web server technology is able to read input values from conveyor safety devices, and can control to turn on and turn off the conveyor motor at a distance of the outdoor point to point CPE scope.

Keywords: Smartphone, HMI, Web Server, IP Address Private, Outdoor Point to Point CPE

1. INTRODUCTION

Smartphone is a mobile phone that has many capabilities and uses and functions that can resemble the work of a computer. Smartphones can provide advanced features such as email (electronic mail), the internet and the ability to read electronic books (e-books).[1]. The presence of this smartphone is indeed able to provide various benefits and conveniences for its users. With this equipment, it is able to replace part or more of the role of computers and humans, so that industrial processes are easier, cheaper, practical and faster[2]. Smartphones can be used as a data monitoring tool for industrial activities. Monitoring is generally carried out to examine a process, object, and evaluate certain conditions[3]. Monitoring system is an attempt made to find out something about the actual planning or information feedback system. This monitoring provides information on the status of the trend of repeated observations and evaluations from time to time[4].

In general, monitoring is done on a Human Machine Interface (HMI) display. HMI can be used as a monitoring tool as well as a control system for industrial activities in the form of a fairly large computer screen display. The size of the computer is a problem for operators because it cannot be carried to move from one room to another while continuing to control and monitor industrial equipment that is in operation.[5].

In previous studies, smartphones were used as a means of monitoring and controlling the temperature of goat cages based on Internet of Things (IoT) technology. PHMI access via a smartphone can overcome the form of HMI displays which generally only exist in one room and cannot be carried anywhere by the operator.Where, the HMI display can be accessed with a smartphone via a web server using a private IP address. One technology that has been supported and embedded in a web server is PLC LOGO! Siemens with seriesLOGO!0BA8. In addition, this type of PLC has also been embedded in several programming languages, namely:ladder diagrams, and the Function Block Diagram (FBD) language which of course can make it easier for users to

program a project[6]. From a variety of technological sophistication obtained through smartphones and PLC LOGO! Siemens, the author wants to make an HMI display on a conveyor control system that can be accessed via a smartphone.

2. RESEARCH METHOD

Human Machine Interface(HMI) on the conveyor control system is designed to be accessible via a smartphone. So that operators are not bored because they can practically monitor and control the conveyor through a smartphone that can be carried anywhere. Conveyor input datataken from the components of the conveyor safety device. The components consist of MCB, fuse, toggle switch and limit switch. Then the input data is processed by PLC LOGO!Siemens with a program to determine indications and control the conveyor. Then the processed data is sent to the HMI web server via a wi-fi network generated by the outdoor point to point CPE which can be accessed by a smartphone via a private IP address and applied to the conveyor.

All control components on the system are arranged in a box panel to make it more neat and protected. While the safety device input components are arranged directly on the conveyor according to their respective locations and functions. After the components are arranged, a circuit scheme is made for the conveyor control system HMI display. The picture of the circuit of the system made can be seen in Figure 1 below.

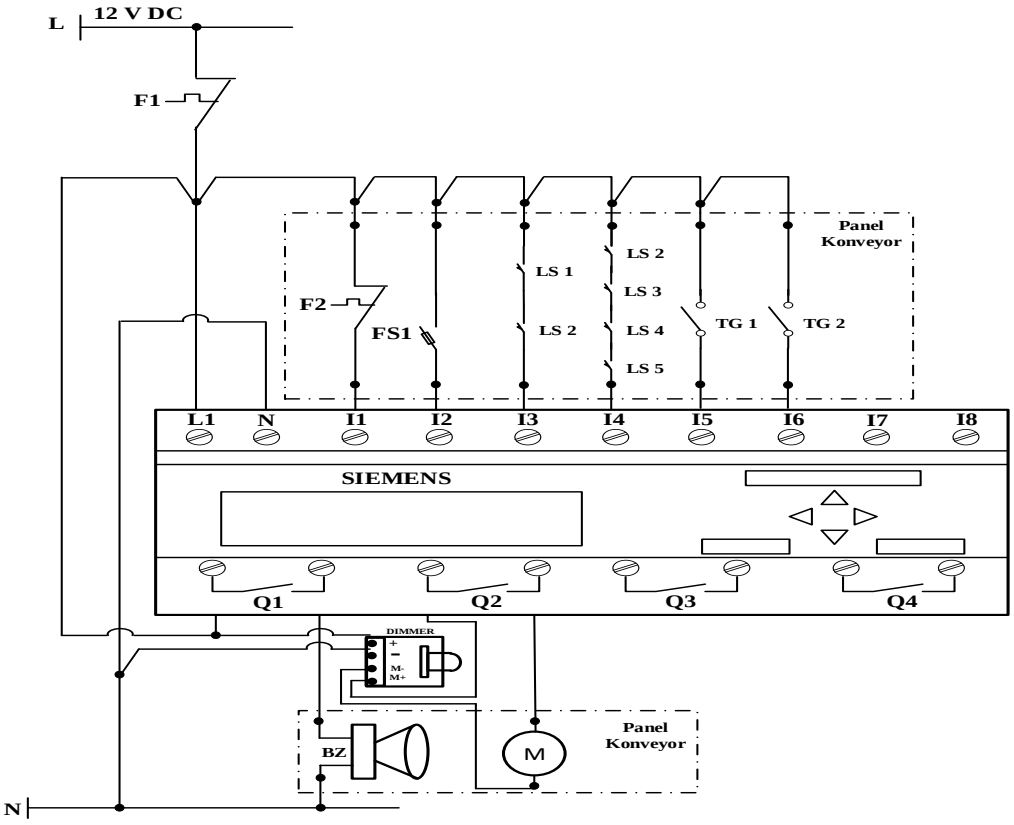

Figure 1. Conveyor Control System Circuit

2.1. Human Machine Interface (HMI)

Human Machine Interface (HMI) is a system that connects humans and machine technology. HMI can be in the form of controlling and visualizing status either manually or through real time computer visualization. HMI systems usually work online and in real time by reading data sent through the I/O port used by the system controller. The purpose of HMI is to improve the

interaction between the machine and the operator through the computer screen display and meet the user's need for system information[7].

HMIin the manufacturing industry in the form of a Graphic User Interface (GUI) display on a computer screen display that will be faced by machine operators and users who need machine work data. HMI has various visualizations for monitoring and connected machine data online and in real time. HMI will provide an overview of the condition of the machine in the form of a production machine map that can be seen which part of the machine is working. In the HMI there is also a visualization of the engine controller in the form of buttons, sliders, and so on that can be used to control the engine properly. In addition, the HMI also displays an alarm if a dangerous condition occurs in the system. In addition, HMI also displays machine work summary data including graphically[5]. For more details on how HMI works, see Figure 2 below.

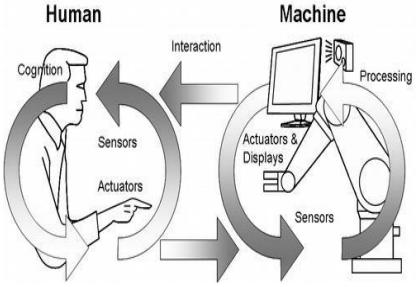

Figure 2. HMI Working System

2.2. Programmable Logic Controller (PLC)

According to the National Electrical Manufacturing Association (NEMA), PLC is defined as a digital electronic device with a programmable memory to store instructions that perform specific functions such as logic, sequencing, timing, counting, and arithmetic to control an industrial machine or machine. industrial process as desired[6]. The appearance of the PLC module can be seen in Figure 3 below.

Figure 3. PLC Module

2.3. LOGO!Soft Comfort

LOGO!Soft Comfort is a means to test or simulate programs as well asprovide information about LOGO!.LOGO!Soft Comforthave real similarities with PLC hardware. This software is useful in minimizing and even avoiding mistakes when working with PLC hardware which is quite sensitive to damage. The existence of these errors, it is possible to delete and write repeatedly. This of course will reduce the life of the PLC[6].The display of the LOGO!Soft Comfort interface can be seen in Figure 4 below:

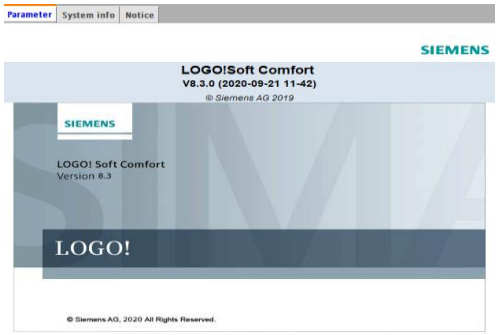

Figure 4. LOGO Background! Soft Comfort

In some PLCs, in addition to having software for downloading programs, the software also functions for controlling via a computer (interface), providing professional documentation with all necessary project information such as program switching, comments, and parameter settings. LOGO display! 8 offers 6 characters for every 16 lines per message text. In External Text Display (TDE), 6 characters for every 20 lines can be displayed[6].

2.4.LOGO! Web Editor

LOGO! Web Editor (LWE) serves to create a web site that is adapted to the contents of the program on the PLC. Where, the web can be used to control and monitor LOGO! automatically[6]. The background display of the LOGO!Web Editor can be seen in Figure 5 below.

Figure 5. LOGO Display Background! Web Editor

2.5.Web Server

Server can be interpreted as a center, both data center, data base center, system center. So the server is a computer in charge of serving all requests made by the client computer, then the results of the request will be sent back to the client computer[8]. Web server is a software that provides data services that function to receive HTTP or HTTPS requests from clients known as web browsers and send back the results in the form of web pages which are generally in the form of HTML documents.[9]. Web Server serves to transfer all aspects of the file in a web page including those in the form of text, video, images and more[6]. For more details on the work of the web server can be seen in Figure 6 below.

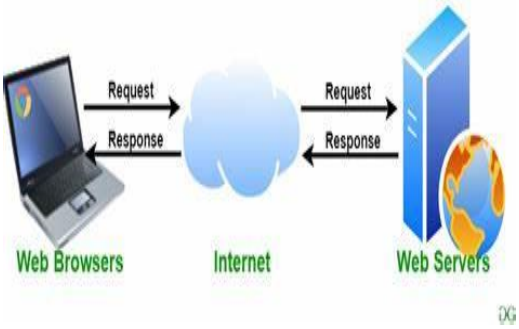

Figure 6. Web server Flow

2.6.IP Address

IP address is a standard identifier address for all devices on a network that uses the TCP/IP network protocol so that all computers connected to it can communicate with each other. The IP address consists of a 32-bit binary number which is divided into 4 segments. Each segment consists of 8 bits which means it has a decimal value from 0-255. There are as many as 232 address combinations that can be used worldwide. So, a TCP / IP network with 32 bit addresses is able to accommodate as many as 232 or more than 4 billion hosts. To facilitate reading and writing, IP addresses are usually represented in decimal numbers. So, the address range above can be changed to address 0.0.0.0 to address 255.255.255.255. The decimal value of the IP address is what is known in everyday use.[6][10].

Public IP

Public IP is the IP address used in the global internet network. Where, its use and allocation is governed by InterNIC to ensure the unique use of this IP address. Because this IP address is used in the internet network, this IP can be accessed directly through the internet network. Devices that use public IPs, such as web servers, mail servers, DNS servers, game servers or other devices can be accessed from any network in the world that is connected to the internet. To be able to use a public IP, an organization can usually register with an Internet Service Provider (ISP).[6].

Private IP

It is called a private IP because this IP is only recognized and can be accessed from the local network and cannot be accessed via the internet directly without the help of a router that has a NAT feature. Private IP is used for local networks so that fellow computers can communicate with each other. Devices that are connected to a local network such as printers, computers, laptops, and smart devices will usually get a private IP address. In order for private IPs to be able to connect to the internet, a router that has the ability to perform Network Address Translation (NAT) is needed so that all devices with private IPs can connect to the internet using a public IP that is connected directly to the Internet.[6].

Block diagrams are made to make it easier for writers to make hardware. This block diagram depicts the input data to the output section. The input section contains MCB components, fuses, limit switches, and toggle switches that function as input for conveyor safety devices. In the process section there is a PLC which functions as a data processor or command from input to output. At the output there is data access and control on the web server that can be done via a smartphone using an outdoor point to point CPE as the sender of the Wi-Fi connection. In addition, there is a DC motor as a conveyor belt drive and a buzzer that functions as an alarm signal when the conveyor will operate. Figure 7 is a block diagram of the system carried out in this study:

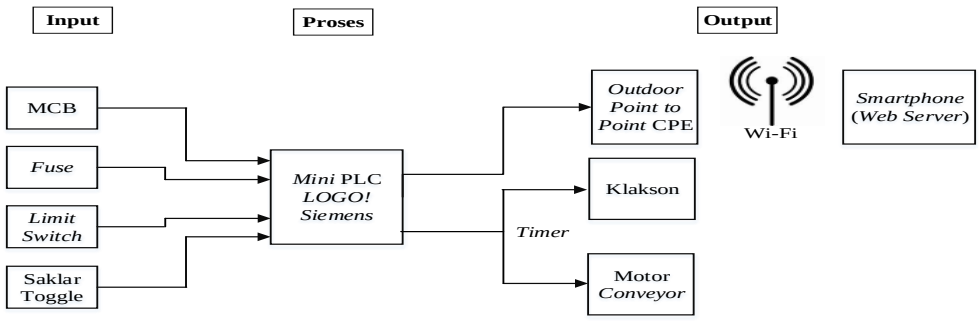

Figure 7. System Block Diagram

When the tool is working, the PLC will read the input data parameters from each component of the conveyor safety device. Then the data is managed through the PLC program and sent to the web server. The web server will display the received data in the form of an HMI display then wait for a response to the movement of input from the web server user to be returned to the PLC and applied to the conveyor. Before the program is created, a flow chart is needed. Flowcharts are used to describe the flow of the program to be created. The program flow is preceded by the initialization of program input and output. The outline of this flowchart is based on software programming. The overall program flow chart can be seen in Figure 8 below:

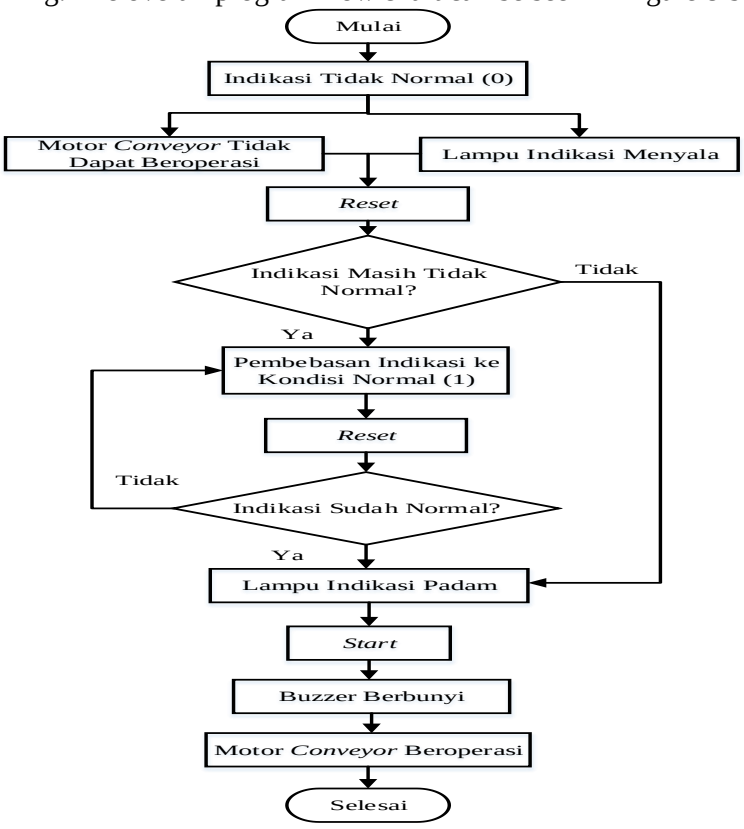

Figure 8. System Block Diagram

The program works to manage input data from each component of the conveyor safety device. When the component provides an input of 0 or an abnormal condition, the conveyor motor cannot be operated and the indication light on the HMI will light up. Then the operator can provide reset input through the HMI to determine whether the indication is still worth 0. If it is still worth 0, the operator can release or return the safety device to a value of 1 or normal conditions and return to provide reset input to re-check whether the data input has a value of 1 If so, the indication light will go out and the conveyor motor can be operated by starting with a buzzer sound signal when the motor is started via the HMI.

3.RESULTS AND DISCUSSION

3.1.Result

This research has produced a prototype conveyor control system and then made a web server as HMI access. So that the conveyor can be controlled and monitored via a smartphone. The prototype of the conveyor control system tool can be seen in Figure 9 which consists of a power supply, MCB, fuse, limit switch, toggle switch, PLC LOGO! Siemens, dimmers, buzzers and DC motors. All components are assembled on a panel box made of iron plate with a size of 1 mm and a

MORFAI JOURNAL
Multidiciplinary Output Research For Actual and International Issue

conveyor made of plywood with a thickness of 15 mm and 8 mm. Furthermore, the form of HMI display on the web server can be seen in Figure 10 below.

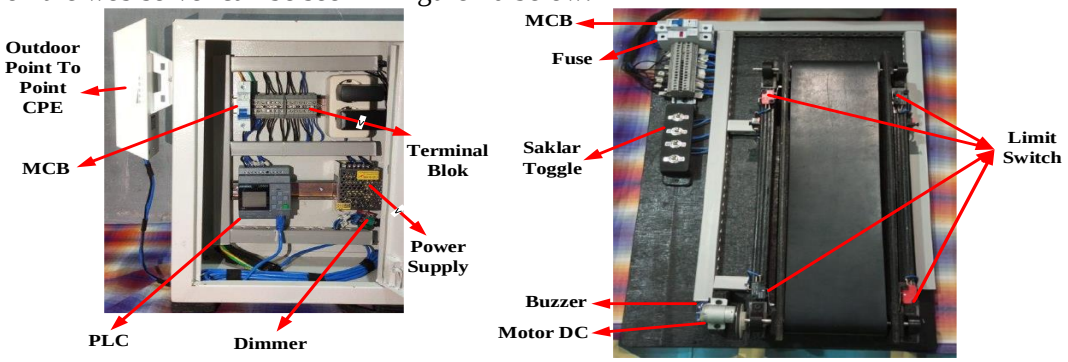

Figure 9. Control System Prototype

Figure 10. Display HMI

After the prototype conveyor control system has been assembled, then testing is carried out to determine the level of accuracy of the work of each control system input to the web server and to find out the limits of network access coverage that can be achieved by smartphones in both open and closed spaces. The web server testing topology can be seen in Figure 11 and Figure 12 below.

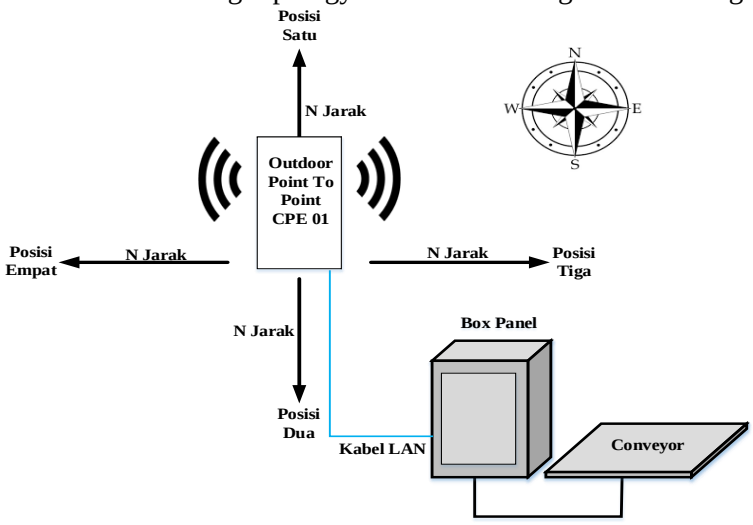

Figure 11. Testing Topology in Open Space

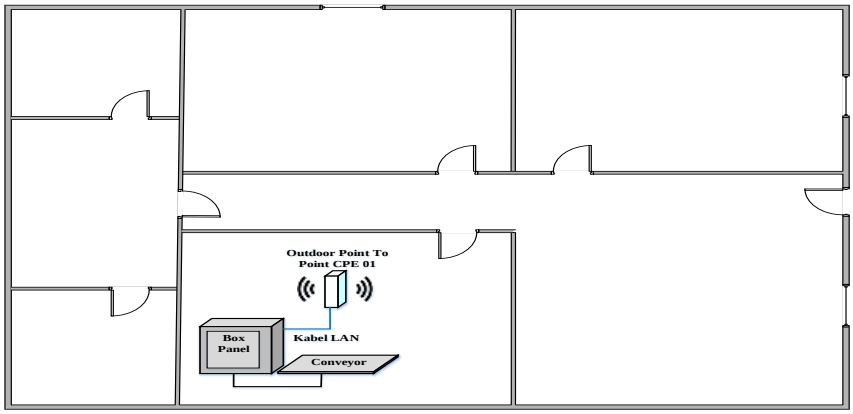

Figure 12. Testing Topology in Closed Space

Tests in open space are carried out in four positions, namely facing North, South, East and West towards the outdoor point to point CPE. The results of the test in the four directions are in the north direction the limit of network coverage that can be accessed by smartphones as far as 200 m, south as far as 55 m, east as far as 69 m and west as far as 69 m. Furthermore, the test is carried out to find the value of the web server response delay at a certain distance. The results of the measurement of the web server's delay value can be seen in Table 1 and Table 2 below.

Table 1. Results of Testing the Delay Value in the North and South Directions

No	Control System Input	Response Time Speed (Second)	
		Smartphone Measurement Direction and Distance	
		North 100 m	South 20 m
1	Reset	0.34	0.22
2	Motor Start	0.25	0.19
3	Stop Motor	0.15	0.16
4	BSS Not Interlocked	0.16	0.12
5	Ripcord Switch Conveyor	0.12	0.19
6	Main Circuit Breaker Off	0.12	0.15
7	Conveyor Motor Overload	0.20	0.15
8	Inclined Conveyor Belt	0.12	0.15
9	Fuse Electrical Malfunction	0.12	0.19
Average		0.17	0.17

Table 2. Results of Testing the Delay Value in the East and West Directions

No	Control System Input	Response Time Speed (Second)	
		Smartphone Measurement Direction and Distance	
		East 40 m	West 30 m
1	Reset	0.15	0.30
2	Motor Start	0.31	0.44
3	Stop Motor	0.12	0.19
4	BSS Not Interlocked	0.16	0.22
5	Ripcord Switch Conveyor	0.09	0.13
6	Main Circuit Breaker Off	0.12	0.12

7	Conveyor Motor Overload	0.12	0.16
8	Inclined Conveyor Belt	0.09	0.12
9	Fuse Electrical Malfunction	0.19	0.28
Average		0.15	0.22

FromTables 1 and 2 can be seen that the web server test was carried out by measuring the delay value on 9 conveyor control system inputs and carried out at different distances and directions. In the North direction, measurements are taken at a distance of 100 m, the South direction is carried out at a distance of 20 m, the East direction is carried out at a distance of 40 m and the West is carried out at a distance of 30 m.

Closed space testing is carried out in a room whose walls are made of half stone and plywood. The results of the closed space test are the limit of network coverage that can be accessed by smartphones as far as 15 m. The results of the measurement of the web server's delay value can be seen in Table 3 below.

Table 3. Results of Testing the Delay Value in Closed Space

No	Control System Input	Enclosed Space Testing at a Distance of 7 m
		Response Time Speed (Second)
1	Reset	0.22
2	Motor Start	0.28
3	Stop Motor	0.22
4	BSS Not Interlocked	0.12
5	Ripcord Switch Conveyor	0.15
6	Main Circuit Breaker Off	0.14
7	Conveyor Motor Overload	0.15
8	Inclined Conveyor Belt	0.12
9	Fuse Electrical Malfunction	0.12
Average		0.17

FromTable 3 tests are carried out to find the value of the web server response delay at a distance of 7 m. The test was carried out once by comparing 9 inputs of the conveyor control system. The delay value obtained from the closed room test is 0.17 S.

3.2.Discussion

Fromweb server testing carried out in open and closed spaces, the results showed that all conveyor control system inputs were running normally. NetworkThe resultant outdoor point to point CPE in open space is emitted further in the north direction so that it has the same delay value as the south direction even though the measuring distance in the south direction is much shorter. For the East and West directions, the maximum network coverage distance has the same point, but in testing the delay value there is a difference in value of 0.07 seconds. This is due to environmental factors that can interfere with network connections, such as the number of passing vehicles, thus blocking the outdoor point to point CPE. From the data of the average value of the results of testing the speed of the response time of the web server in a closed room, it was found that at a measuring distance of 7 m, the web server delay value was 0,

4. CONCLUSIONS AND SUGGESTIONS

Based on the results of this study, the use of smartphones as HMI displays for conveyor control systems with LOGO! web server technology is able to read input values from conveyor safety devices, and can control to turn on and turn off conveyor motors at a distance of the outdoor

point to point CPE scope. As for further research, use an antenna with a higher type or use an antenna with an omni type so that the network area coverage can be wider and further.

REFERENCES

TM Daeng, NN Mewengkang, and ER Kalesaran, "Use of Smartphones to Support Lecture Activities by Fispol Unsrat Manado Students," Acta Diurna Komun., vol. 6, no. 1, 2017.

H. Rudiansyah, "Low Cost Remote Terminal Unit (RTU) Android-Based SCADA System," Gadjah Mada University, 2014.

A. Herliana and PM Rasyid, "Information System Monitoring Software Development at the Web-Based Development Stage," J. Inform., vol. 3, no. 1, 2016.

A. Hasibuan, Kartika, A. Qodri, and M. Isa, "Temperature Monitoring System using Arduino Uno and Smartphone Application," Bull. Comput. science. electr. Eng., vol. 2, no. 2, pp. 46–55, 2021, doi:10.25008/bcsee.v2i2.1139.

H. Haryanto and S. Hidayat, "Design of a Human Machine Interface (HMI) for DC Motor Speed Control," Stun Sist. Full-Power-electronics-telecommunication-computers, vol. 1, no. 2, pp. 58–65, 2016.

MR Ali, MA Falahuddin, and S. Susilawati, "Making Remote Accessable PLC LOGO! Siemens with Web Server Programming on Refrigeration System Training Unit," in Proceedings of Industrial Research Workshop and National Seminar, 2021, vol. 12, pp. 75–80.

B. STEVEEN, "Application of Monitoring System in Design of Red and Green Colored Goods Sorter With HMI Based on Schneider PLC," Undip, 2018.

I. Susilo and GK Nugroho, "Development of a Web Server Using Debian Server for Learning Media in State 1 Vocational High School (SMK) Sragen," Indonesia. J. Netw. Secur., vol. 2, no. 1, 2013.

A. Azikin, "Debian Informatics." Bandung, 2011.

R. Muzawi, "Bandwidth and QoS Management on PC Routers Using Gnu/Linux and FreeBSD Kernels," J. Edik Inform. researcher. bids. computer. Science and Educators. Inform., vol. 2, no. 1, pp. 78–94, 2017.