



# A PLC Based Searching and Data Logging in Warehouse Systems

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## Abstract

Programmable Logic Controllers (PLCs) are commonly used in industrial, and the development of automation technology conduce to more complex and widely used for the PLCs as embedded systems. The usefull of PLCs as data logging implemented in the system of industrial warehouse, where PLCs are used in logging application and data searching by leveraging the output of PLCs as indicator of the stuffs that are stored. Human Machine Interface (HMI) used as interface between PLCs and user. This paper presents the warehouse system, we designed the applications for searching the stuffs by send the inputed data in ASCII forms and stored in each memories that are mapped in array forms, thereby the time anda the data package more orderly in the storage.

*Keywords: PLC, Automation, Searching, Data Logging, Human Machine Interface (HMI)*

## 1. Introduction

Technologies are evolve rapidly, thereby we are required to use it to help people as users in order to be more efficient in terms of time, cost, etc. One of the rapidly evolving technology today is a PLC (Programmable Logic Controller), where the function of PLC today is not only to control the system/process of an industry, but also used in building automation such as storage in data logging and other applications.

Currently, when we want to look for stuffs that are stored neatly on the shelf of cabinets where the number of the cabinet is a lot then we will do the search process by using a computer as data storage of the stuffs. If we use a computer, it only indicate the location of the object that we are looking for, and the user still have to find where the position of cabinets is, then after the cabinets are found, the user will look for columns and rows of shelves cabinets, it would take a long time, in proportion as the number of cabinets.

By using PLC which has a large storage memory and used the memory space as data storage and retrieval of data that has been stored, then search manually as described above can be unavoidable. PLC has input and output that are used as indicators of the stuffs location while touch screen is used as an interface between the user and PLC. Before application of PLC as the data searching and data logging is done, it is necessary to simulate to save the costs and determine the type of the corresponding PLC. There are software that support simulation of PLC LS Series, where the software is support the simulation between the PLC and HMI Touchscreen, those software are XG5000 (PLC programming software LS XGB series) and XP-Builder (Touchscreen HMI programming software).

In this project was made a simulation of design of the application data logging and data searching by using PLC as data storage and HMI touchscreen as user interface. Process of simulation design was created to prevent faults in the manufacture and prevent improper PLC elections, thus saving the time of manufacture.

## 2. PLC (Programmable Logic Controller)

PLC (Programmable Logic Controller) is a tool that is used to replace a series of relays that found in the conventional process control system. PLC works by observe the input (via sensors related), subsequently perform the process and act as needed such as turn on or turn off the output.

The more complex process that must be addressed the more important the use of PLCs to facilitate these processes (and also replace some of tools required). Components of the PLC composed of CPU, Memory, and devices of input or output.

### 2.1. PLC XG Series

PLC has types and the advantages of each, one of them is XGI PLC series manufactured by LS Industrial Systems which has advantages such as speed of execution reaches 0,028 U S / command, and address a large storage, I / O module analog and digital, input / output is relay or transistor. Here are some type of PLC XGI series.

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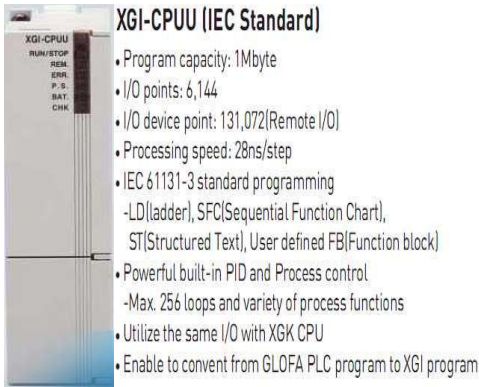


Fig. 1. G PLC XGI-CPUU

2.2. HMI (Human Machine Interface)

Touch Screen is a hardware device such as a computer screen, but has the advantage compared to the usual screen which allows users to interact with the computer by touching areas on the screen that is sensitive to human touch, so that a person can interact with the computer by touching pictures or text displayed on a computer screen. The simplest touch Screen composed of three main components, there are: touch Sensor, controller, software driver

2.3 RS-485 Communications

Standard RS-485 is support half-duplex data communication it means in order to transmit and receive data is using a 2-wire line. Specifications of this standard is able to support data communications from a number of devices and also able to support data communications within up to 1200 meters. The connection of each device connected to the RS-485 performed in parallel, so that the connection and release the device is performed without disrupting the work of the entire network. To adjust the impedance of the cable, which is used, it should be installed resistors and the value of the resistor installed is matched to the characteristic impedance of the cable (~ 120 Ω). Topology of the network data communication using RS-485 can be seen in the Fig. 2.

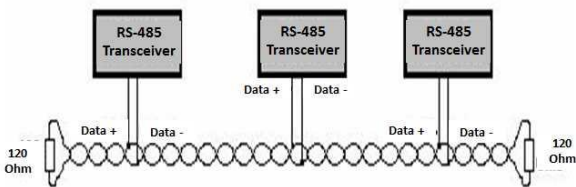


Fig. 2. Cabling Topology RS-485

RS485 or EIA (Electronic Industries Association) RS485 is a balanced line network, the data transmission

system is half-duplex. RS485 can be used as a network data transfer with maximum distance is 1.2 miles

3. DESIGN

The design of searching and data logging system on the storage warehouse in general can be seen in Fig. 3.

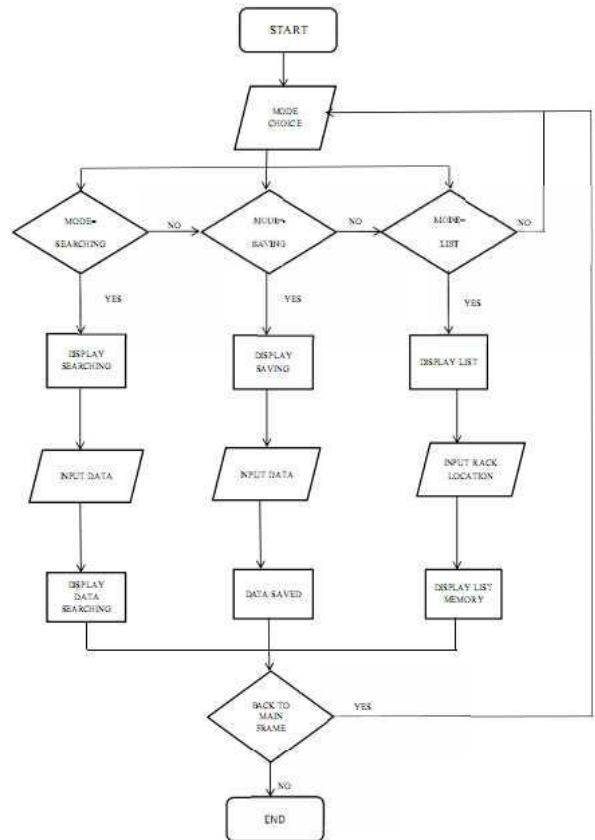


Fig.. 3. Flowchart of Logging and Data Searching

In Fig. 3. it can be seen that there are three modes of use: Searching mode (search data that has been entered previously), Saving mode (storage data to be entered), Listing mode (where to see the goods that have been entered previously).

In the state of list mode, will appear the selection of the cabinet names on the screen, columns and rows must be filled to bring out 15 data's, because on this equipment one box (column, row) able to load/available storage space as many as 15 different type stuff. Suppose the user want to see the stuff in the cabinet AC in column 1 and row 2, then the user will insert the data AC-1.2, it will display the name-size-type and quantity of stuff inside of the box.

In saving mode state there is a box for filled by name of the stuffs according to the format name of the stuff (4 digits) - the size of the stuff (9 digits measure items) -type of the stuff (4-digit combination of numbers and letters) the number of the stuffs to be stored in a box cabinet, then there is an alarm message if the selected space is full, the

message is "this area is unavailable" and will be appears the display name of the stuffs that are contained in the selected location. In the state of saving mode, there is a button choice whether to save or to replaces, the save button will work if in addressee there is no name of stuffs while the replace button will still save (overwrite) the new data at selected locations, although there is the old data at the site.

**4. RESULT**

Testing of software simulation is conduct by XG5000 (PLC programming software LS XGB series) and XP-Builder (Touchscreen HMI programming software) at the same time. Testing the data is using software XG5000 and XP-Builder by entering the data-DA1C ABCD-180 180 180 AA-1-1-1 in cabinets, which means the name of the stuff is ABCD, dimensions LxWxH (180X180X180) and type of stuff is DA1C, in cabinets AA, column 1, line 1, and storage area is 1

Tabel 1  
HMI Data dan PLC Data

HMI Input	PLC
ABCD	1145258561
180180180	180180180
DA1C	843268673

Based on data obtained in Table 1 it can be seen that the data sent by the HMI is based on the setting data at 32 bits for each of the data, for ABCD data's the results of the data obtained is 45258561 in unsign decimal, if converted into binary the form of data is 1000100010000110100001001000001. Based on the binary data, the conversion can be done by taking each data into 4 bits, so the hexadecimal numbers as in table 2:

Tabel 2  
Conversion of data bits to hex and to ASCII

Biner	Hexadecimal	ASCII
0001	1	A
0100	4	
0010	2	B
0100	4	
0011	3	C
0100	4	
0100	4	D
0100	4	

Data in Table 2 can be translated in ASCII code by converting the numerical values into ASCII codes as in Table 3:

Tabel 3  
Table ASCII

	0	1	2	3	4	5	6	7
0	NUL	DLE	space	0	@	P	`	p
1	SOH	DC1 XON	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3 XOFF	#	3	C	S	c	s
4	EOT	DC4	\$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	del

Based on the conversion data in Table 3, and the ASCII table, then the data of ABCD is gained thus it can be concluded that data in letters form will sent by HMI in character ASCII data.

*4.1. Number's Data in PLC*

Tabel 4  
Table of Number's Data

HMI	PLC
180180180	180180180
250250250	250250250

In monitoring of PLC, Number's data sent by the HMI to the PLC is unchanged in the form of numbers, the data is 180180180, it can happen because, the data sent to the PLC has been in the form of 32-bit unsign decimal number, it means that the data sent maximum is 4294967295. So if the number's data sent a number that exceeds the data then the data will be 0, because if the data sent is 4294967296 (bigger one than the maximum data) then the bit 33 has a value of 1, thus bits 0 - 32 becomes 0 and this situation will result in data that does not match. This situation would not occurs in searching and data logging system, because the system has been protected by the maximum number of digits that are sent (9 digits), so by sending data to the system maximum numbers 999999999, if converted into bits, then the data obtained is 0011-1011-1001-1010-1100-1001-1111-1111, so by sending maximum data into the

system in the form of numbers 999999999, if these numbers converted into bits then the data obtained is 0011-1011-1001-1010-1100-1001-1111-1111. Based on the previous explanations it is known that the maximum bits that might be used is 30 bits so the system will be secure from error allocation of memory bits from HMI to PLC. For data 250250250 the data that is sent to the PLC is in the form of numeric data 250250250, this is due to occur efficient of memory bits used as we know if the data that is sent in the form of ASCII then the bits required is greater, seeing that one numbers will use 8-bit data.

4.2. Combined number's data and letter's data in PLC

Table 5  
Table Number's Data

Display HMI	Data PLC	Data biner	ASCII
DA1C	8432	11001001000011010000	DA1
	6867	1001000001	C
	3		

Result data in numbers and letters as follows: DA1C, where the data was sent by the HMI to the PLC, then in the PLC system the data obtained was the conversion of letters and numbers into the numeric data only. In the table 4.5 there is 843268673 as a result of conversion from numbers and letters data to numeric data only. For letter's data would be the same thing because the packet data (numbers and letters) will be sent in ASCII data code

Table 6  
The Whole Testing Table System

Data	Status			
	Memory Retain	Saving Status	Searching Status	List Status
ABCD-180180180-DA1C	OK	OK	OK	OK
AFGH-250250250-WS12	OK	OK	OK	OK

After overall testing to the application of searching and data logging using PLC XGI and the interface is XGT-TTA 50 concluded that the system works overall, where data can be stored, search system run properly, the data can be viewed on screen list and retain the memory was work well. When the overall system is turned off (shut down) and the system was turned back on, then the data that has been stored in memory was retained and concluded that retain memory was working properly.

4.3. Comparison between manual input system and automatic input system with barcode input system

In the application of data logging, there are two kinds inputting methods, by using a barcode or user manual

input. in the system where the number of stuffs taken was not determined (in accordance with the wishes of the user), thus a more efficient system is the system manually inputted. If using a barcode it will take longer time because the stuffs should be scanned one by one, if the number of stuffs stored is greater than 1000, then the time required to input the stuffs will be longer. When the process of taking stuff in which quantity of stuff is appropriate with the wishes of the user, thus the chaos of the data in the database is getting higher due to barcodes will scan the data that are taken one by one or taken in a package, if the data that is retrieved by the system package and the amount taken is less than the packet, then the remaining stuff of the package will be the stuff that is not identified in this storage system, but if a storage system is in a package, then use the barcode is more efficient.

5. CONCLUSION

The application of PLC technology in automated warehouse designed provides automated operation in industrial and manufacturing. Accuracy of the selecting and reduce the time of the selecting optimized the

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