Utilization of Programmable Logic Controller (PLC) with System Control Lights on Large Buildings

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Abstract. Enhancement need for energy electricity in buildings or large buildings will increase waste energy and improve the expenditure of funds. For That need given solution How method saves electricity with cheap and efficient equipment. The PLC (*Programmable Logic Controller*) program is A tool operating electronics digitally for replace Suite a row of relays in a conventional process control system. To carry out its function then the PLC has sensor elements, controllers, and output devices so that capable do task control sequential, control sophisticated, and control supervision. Research results This shows that the application of PLC in buildings or big buildings will increase high efficiency by utilizing: a) elements of the system control light involving appropriate sensors, controllers (servers), and actuators; b) put sensor devices with appropriate; c) count wide room with lighting appropriate; and d) combine usage halogen lamp as replacement ray sun and TL lamps as lighting normal.

Keywords : Programmable Logic Controller, System Control Lights , Big Buildings

1. Background

The modern industrial era is encouraging man For How produce products that don't need time Lots For involved in it . Likewise for life daily like method turn off light road . lights at home or at the office can arranged like that so that it runs normally without involve man . Progress technology must can utilized man For help style easy and safe life . One of The method is use tool regulated controls so works in accordance with need humans (Darmawanto & Pambudi , 2019). System control This Certain need series steps form panel settings and relevant switches so that can works in a way automatic . This matter show direction change method Work man fundamentally with utilise technology with create system control in a way automatically (Hamdan, 2018).

There is development technology computers and systems control , then system control sequential in the form of relays can be replaced by a Programmable Logic Controller or PLC device . PLC devices are set control sequential ones are not only own device loud , but also contains device soft (Rusdi , 2012). Existence device soft here has change control sequential become more flexible . Likewise , needs will efficiency energy , comfort , and security in management building become the more important . One of aspect important from management building is arrangement efficient and responsive lighting to need residents and environment .

Proper lighting No only increase comfort and productivity residents building , but also can contribute to efficiency energy and reduction impact environment . Therefore that is , planning system automation lighting building using a PLC (*Programmable Logic Controller*) to be A interesting and relevant innovation . Buildings moment Now built up to on Because land land Already the more narrow . Finally form building to on will accompanied with many

lamp For floor until floor whatever . For That need innovation in build building in need Lots light so that easy controlled .

System control lights on the building graded can integrate tools electronics to cover convenience , efficiency , energy , safety and comfort building and its occupants . Elements in the system control includes a) sensors for temperature , light and motion , automotive , industrial , and so on ; b) controller which is computer network as center controlling system other devices ; c) actuator in the form of switch lights and motorbikes electricity .

Use of PLC is useful in manipulate , execute and monitor speed process state with programmed basic data in based systems microprocessor . PLC accepts input and output output signals electricity For control something system . Massive physics and chemistry will changed become signal electricity Good analog or digital with a PLC program. The character of the PLC controlled process is a gradual process until reach condition desired ending . With a gradual process This known with a sequential process (Prihatmoko , 2015).

PLC program in execution , yes monitor the situation system through signal from input equipment , then based on logic , the program determines Suite action control PLC output equipment can also used for control tasks simple , repetitive or connected with other devices with utilise computer through network communication For integrate complex process control .

From the explanation above show how importance use of PLC in application system control For lamps and lighting, on building or big buildings so that reach high efficiency .

2. The Purpose

Writing purpose This is analyze functions and principles PLC (*Programmable Logic Controller*) program work in support efficiency usage lights on buildings or buildings big .

3. The Method

Research methods in this literature review article is use method qualitative with design descriptive (Creswell, 2016). Qualitative method expected capable dig into the data deep about principle PLC working and concept control system design using PLC. Source of data obtained from the deep internet form books and online journals are good level national nor level published internationally from 2010 to 2024. Search via the internet using the keywords PLC , system work , and function of the PLC. Data analysis using stages data collection , data condensation , data presentation and retrieval conclusion (Mile, Huberman & Saldana, 2014).

4. Results and Discussion
a. PLC Programs

According to Jatmiko (2015) understanding The PLC (*Programmable Logic Controller*) program is something programmable control device for control the process or operation machine . According to Rusli (2012), the meaning of PLC is equipment containing electronics microprocessor For monitor circumstances from input equipment , then analyzed in accordance with need planner For control output state . In other words, PLC program control for analyze last input signal arrange the output state is appropriate with desire user .

The PLC (*Programmable Logic Controller*) program is A tool operating electronics digitally for replace Suite a row of relays in a conventional process control system . PLC has : a) memory as place For keep useful instructions relate with function control certain ; b) series logic ; c) sequence execution ; d) calculation ; e) hose time ; and f) function arithmetic .
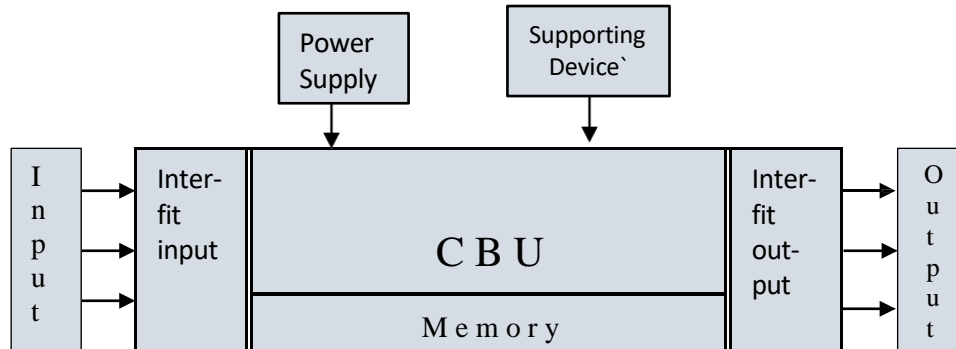
Figure 1. PLC Block Diagram
Source : Rusli (2012

PLC is also a type system control that has input equipment or sensors, controllers and output devices. Tasks that can be done carried out by the PLC is control sequential , control sophisticated , and control supervision . Draft PLC work according to Jatmiko (2015) includes :

1) Programmable, that is ability in memory For save the program that has been made that will easy For changed function and use .

2) Logic that is ability in processing input sequentially arithmetic and logic (ALU) through operation compare , subtract , add , switch , divide , negate , AND, OR, etc .

3) Controller ie ability in control and organize the process so produce the desired output .

PLC works with method observe input through the related sensors , then process and carry out action required (can turn on or turn off output (logic = 0 or 1 = on or dead). The PLC programming language uses a ladder containing input-process-output (Syahputra ddk , 2022). PLC 15 has 3 components main namely input, central processing unit (CPU) and output. The input component contains buttons , sensors and switches . Component output containing controlled system like actuator , motorm contactors and lights , CPU for control device connected outside with output module .

b. PLC device

According to Syah Putra et al (2021), in general There is four part The devices that make up the PLC are: module supply power , CPU module , module device software , and I/O modules . The explanation fourth device that is :

1) Supply module Power

Supply module Power or power supply (PS) provides DC voltage to all existing PLC module . With own ability total current is about 20 A to 50 A or The same with Integral lithium battery used for memory back up. If this PS fail or the voltage back and forth come back input down from mark especially , then fill memory still awake . Should using a power supply that has a built-in PLC triconex USA, Trisen TS3000 even has a double power supply. This matter addressed Because if the first PS failed , then will replaced second automatic will replace it function supply film power .
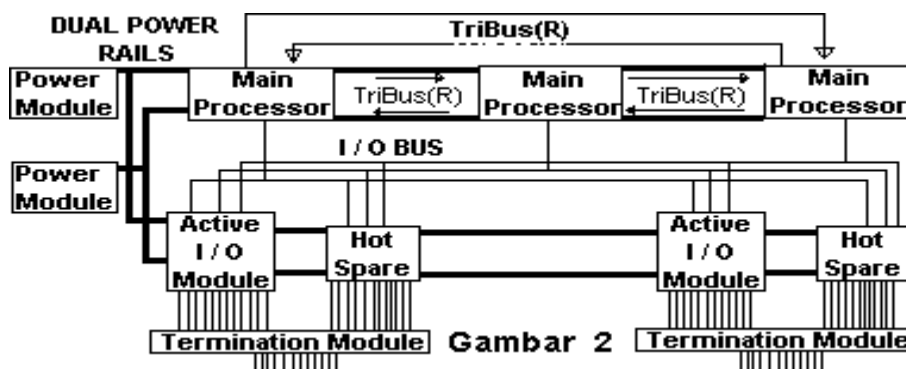
Figure 2. Interaction between module in a Trisen TS3000 PLC .
Source : Rusli (2012

2)   CPU module

CPU module (Central Processing Unit) or model controller or processor has two parts namely : a) Functioning processor For operate and communicate PLC modules via serial or parallel buses , and execute control programs; b) working memory keep digital information that can be is changed and takes the form of a data table, register, image , or RLL (Relay Ladder Logic) which is process controller .

There are PLCs that have a number of processor in One indicated module For support reliability system and upgrade performance control . Examples of PLC types Trisen TS3000 which has 3 pieces processor with so -called system Triple Redundancy Modular. PLC memory capacities vary , as the TS3000 has 384 Kbyte memory (SRAM) for user and 256 Kbyte (EPROM) for system the operation . The Simatic S5 made by Siemens has 16 Kbyte EFROM memory and 8 Kbyte RAM. Memory capacity depends use it and how much Lots required location For control certain plants .

3)   Device Module soft

Device module known software are state language, SFC and RLL. The famous is RLL (Relay Lader language). All programming language created based on sequential processes that occur in the plant. All program instructions will executed by the CPU module , and program writing can be done carried out online or offline . PLC can written control program at the time He control the process without disturbing moderate control done . Execution device soft No will influence ongoing I/O operations walk .

4)   **I/O module**

The I/O module is module input and module output is module input and module output on duty arrange PLC connection with device external or peripherals that can form something host computers , switches , motor drive units , and various type source existing signal in the plant. Input module accept signal from the peripheral sensing unit and delivers arrangement signal , termination , isolation , and signal indicator input . Signals from Peripheral devices will be scanned and their condition will communicated through module interface in PLC.

Voltage model type input (DC (110,220,14, 24, 48, 15-30 V) or C(4-2MA); AC voltage (110, 240; 24; 48V Aor AC (4-20A); latching input (24VDC/110VAC) ; input isolated (24VDC/85-132VAC); input intelligent (contains microprocessor); input positioning (positioning); PID input (proportional , derivative , and integral); Credit speed tall .

Output module activate various type device like actuator hydraulic , neumatic , solenoid, motor starter, and dotted status displays connected peripherals in system . Function module output other includes conditioning, termination and isolation existing signals . Activation process That Of course

just done with delivery signals relevant discrete and analogous , based the character of the PLC itself is digital devices . A number of module normal output moment These include : DC voltage (24, 48, 110V) or DC current (4-20mA), AC voltage (110, 240V) or AC current (4-20mA), output analog (12-bit), word output (16-bit/ parallel); output intelligent , ASCII output and Communication port double .

c. How PLC Works and Functions

Principle PLC work according to Yulianto (2006) is accept signal input (input device) controlled process Then carry out series instructions logic to signal input the in accordance with stored programs in memory , then produce signal capable output controlling actuators, motors, and equipment others installed . Equipment The external input device can form switches , sensors, and equipment other . Data from equipment This will become signal analog , then by the input module , signals analog This will changed become digital signal . Then by the processing unit center (CPU), the digital signals will processed in accordance with programs in memory . Then the CPU will take decision will move to the output module is still in form digital signal . Signal analog this will be it move output equipment that can in the form of actuators, motors, relays and so on . This output device will operationalize the system or process that will be carried out controlled . Method that can done For protect existing LAN network built is carry out control facing every user activity on the LAN.

Writing paper This designing a control system to every user activity on the LAN with emphasize technical principles sequential (sequential). For that , PLC must set to be capable know and control in a way sequentially . A number of method Work from the PLC include :

1)   Equipment outside the PLC such as equipment discrete can in the form of limit switches, push buttons , starter motors, transducers and the like will connected direct with module input or module output .

2)   Input module or output from the PLC will observe changes in machine variables automatic and capable move device machine in a way automatic .

3)   Input module or output will connect between CPU and information input and results of CPU processes to equipment drive at the output .

The PLC function according to Jatmiko (2015) has similarity with equipment controller others , namely :

1)   Emit signal results program calculation to equipment mover signal controller .

2)   Accept input from sensors as trajectory bait come back .

3)   Carry out the calculation process from appropriate sensor signal with a written program .

d. Application of PLC in Building or Big Buildings

System control lights on buildings or buildings big need system that integrates and controls tools electronic . The benefits of using a PLC are: makes it easier efficiency energy , safety and comfort in buildings big . Elements on the system control light involving sensors, controllers (servers) and actuators. Inayati et al (2011) did analysis system control illumination in each room building with own size length 3.5 m, width 3.46 m and height 2.76 m. Each room have character coated walls curtain or colored background black on three the side and one of the his side colored white . Source light from light as replacement ray sun use halogen lamps of 50 watts placed on two sides wall . Connected light sensor with connected to the system control placed on the side walls and roof. Installed 4 sensors on each side walls , 4 sensors on the roof, and 4 pcs controlled TL lamps with system controls placed on the roof.

Usage halogen lamps are used replacement ray the sun can enter to room . For That halogen lamps provided Genre strong electricity in AC form . Arrangement strength ray halogen lamps can classified as in table 1 below This .

Table 1. Condition Space Lighting by Halogen Lamps

Number	Variable Voltage (x) Volt Condition
x < 100	Dark
100 < x < 150	Dim
150 < x < 190	It 's dim
190 < x < 210	Rather bright
x > 210	Bright

Source : Inayati et al (2011)

Then done analysis how much strong lighting on the system control to halogen lamp by each sensor. With exists difference sensor location from source halogen light causes difference results in readings on each sensor. Difference This caused by factors geometry at the moment measurements that follow the inverse square law method , namely the more Far distance point measuring to source light , then strength information received the more small . Beside that's the cause is curtain or a colored background black on third side wall . This matter caused exists factor reflection wall Where color black will absorb light whereas color white reflect light .

Benefits of use curtain color black is For reduce effect lighting in room . Usage curtain black is also expected more sensor readings maximum so that can set points are obtained for each condition explanation . System control at the moment active will makes it easier for sensors to detect illumination room, from halogen lamps , but also the consequences from TL lamp . When system control No turned on with condition dark room , then system control No capable running the actuator which is represented by 4 lights , so condition room still will dark . On the contrary at the time condition dark and control system is activated , then the sensor will detect the set point of halogen lamps on condition dark so that running 4 TL lights . In other words, when the 4 TL lights are on , then will give mark illumination room TL lamp against condition dark .

System control must designed to be capable detect circumstances lighting room in a number of conditions (Muhainin , 2012). Actually system control No designed For detect less room the lighting , however will detect level lighting room with One condition just . This matter cause system control difficult For placed a set point on each sensor location room or areas that have level illumination low . When with use halogen lamps should be system control designed capable produce stable condition . Inayah et al (2011) prove this that when use halogen lamps and TL lamps , then designed so that when There is decline intensity light in room still strong . When lighting halogen lamps decrease , then in a way automatic the TL lights will direct light up . On the contrary when intensity light in room increases , then in a way automatic light inside TL lamp room will off .

5. Conclusion

The PLC (*Programmable Logic Controller*) program is A tool operating electronics digitally for replace Suite a row of relays in a conventional process control system . For carry out its function then the PLC has sensor elements , controllers, and output devices so that capable do task control sequential , control sophisticated , and control supervision . Research

result This show that application of PLC in buildings or big buildings will increase high efficiency with utilize : a) elements of the system control light involving appropriate sensors, controllers (servers) and actuators ; b) put sensor device with appropriate ; c) count wide room with lighting appropriate ; and d) combine usage halogen lamp as replacement ray sun and TL lamps as lighting normal .

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