Visvesvaraya Technological University

Belgaum, Karnataka-590 018

A Project Report on

"AUTOMATIC TRANSMISSION LINE PROTECTION USING PROGRAMMABLE LOGIC CONTROLLERS"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering

In

Electrical & Electronics Engineering

Submitted by

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2019-2020

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Certificate

Certified that the project work entitled **"Automatic Transmission Line Protection Using Programmable Logic Controllers"** carried out by Ms. Chetana, USN 1CR16EE018; Mr. Guru Pratheek JK, USN 1CR16EE027; Mr. Joseph Silvester Stallone R, USN 1CR16EE032; Ms. Manisha N Phadke, USN 1CR16EE042 are bonafide students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide	*Signature of the HOD*	*Signature of the Principal*
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DECLARATION

We, [Ms. **Chetana (1CR16EE018),** Mr. **Guru Pratheek JK (1CR16EE027),** Mr. **Joseph Silvester Stallone R (1CR16EE032),** Ms. **Manisha N Phadke (1CR16EE042)],** hereby declare that the report entitled **"Automatic Transmission Line Protection Using Programmable Logic Controllers"** has been carried out by us under the guidance of **Dr Viji K,** Assistant Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belagaum during the academic year 2019-20. The work done in this report is original and it has not been submitted for any other degree in any university.

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Abstract

The electric energy produced at generating stations is transported over high voltage transmission lines to utilization points. In the early days, electric systems were operated as isolated systems with only point-to-point transmission at voltages that are considered low by today's standards. In order to increase the reliability of the system and reinstate the power supply in time, it is of immense importance to classify and locate the fault rapidly and to isolate the faulty section precisely.

The aim of the project is to automate the resetting of the electromechanical relays used in power systems by using a combination of hardware and software which controls the functioning of the hardware. This is done by using programmable logic controllers (PLC).

Acknowledgement

(This is an example only; you can acknowledge others also here)

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completion of the project and who made it possible, because success is outcome of hard work and perseverance, but steadfast of all is encouraging guidance. So, with gratitude we acknowledge all those whose guidance and encouragement served us to motivate towards the success of the project work.

We take great pleasure in expressing our sincere thanks to ***Dr. Sanjay Jain****,* ***Principal, CMR Institute of Technology, Bengaluru*** *for providing an excellent academic environment in the college and for his continuous motivation towards a dynamic career.*

We would like to convey our sincere gratitude to ***Dr. K Chitra****,* ***Head of Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru*** *for her invaluable guidance and encouragement and for providing good facilities to carry out this project work.*

We would like to express our deep sense of gratitude to ***Dr Viji K, Assistant Professor, Electrical and Electronics Engineering, CMR Institute of Technology, Bengaluru*** *for her exemplary guidance, valuable suggestions, expert advice and encouragement to pursue this project work.*

We are thankful to all the faculty and laboratory staff of ***Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru*** *for helping us in all possible manners during the entire period.*

Finally, we acknowledge the people who mean a lot to us, our parents, for their inspiration, unconditional love, support, and faith for carrying out this work to the finishing line. We want to give special thanks to all our friends who went through hard times together, cheered us on, helped us a lot, and celebrated each accomplishment.

Lastly, to the ***Almighty****, for showering His Blessings and to many more, whom we didn't mention here.*

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LIST OF ABBREVIATIONS AND SYMBOLS

PLC	Programmable logic controller
AB	Air break
R	Resistance
L	Inductance
C	Capacitance
RMS	Root mean square
DC	Direct current
AC	Alternating current
km	Kilometer
IoT	Internet of Things
V	volt
Amp or A	ampere
LED	Liquid crystal display
RPS	Regulated power supply
MPS	Main power supply
P and N	Phase and Neutral
CS	Current sensor
LL	Ladder logic
FBD	Functional block diagram

CHAPTER 1

INTRODUCTION

1.1 Background of the Research

A transmission line is a specialized cable or other structure designed to conduct alternating current of radio frequency, that is, currents with a frequency high enough that their wave nature must be taken into account. Transmission lines are used for purposes such as connecting radio transmitters and receivers with their antennas, distributing cable television signals, trunk lines routing calls between telephone switching centers, computer network connections and high speed computer buses.

Transmission lines are conductor or conductors designed to carry electricity or an electrical signal over large distances with minimum losses and distortion. Types of transmission line include parallel line (ladder line, twisted pair), coaxial cable, and planar transmission lines such as strip line microstrip.

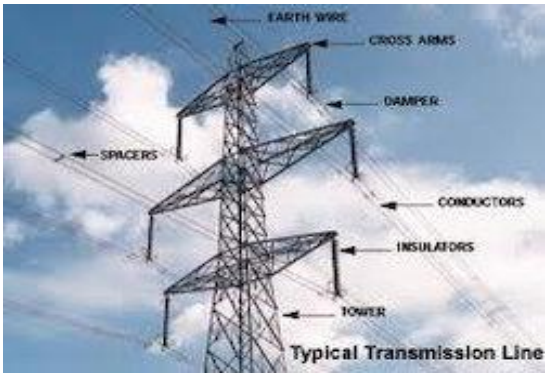


Figure 1: Image of a transmission line

In power distribution system, the transmission lines are the most imperative part, as they play a key role in the transmission of power from generating station to load centers. Transmission lines have a good contribution in the generating unit and consumers to obtain continuity of electric supply. The transmission lines are the major and important part in the power system. Moreover, maintenance of the transmission line is also an important part in transmission line.

The system automatic air (AB) switch is applied on the overhead line network. In our project, this switch will be operated by a PLC automation system. AB switch is installed on transmission line before the main feeder in substation. This switch is very useful to detect and overcome the fault of overloading on transmission line.

A programmable logic controller, PLC, or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLC implementation in distribution reduces the manual labor operation and cost.

PLCs are used in many machines, in many industries. PLCs are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise it will result in unintended operation.

When an overload condition or a fault has occurred, the AB switch is automatically raised and it opens the circuit to protect the line. After some seconds, it again checks the presence of fault in the circuit. If the fault is isolated, then it continues the supply but if the fault is not to be overcome, then it beeps the alarm and we get to know that the occurred fault is severe. This AB switch is very reliable and increases the flexibility of the line. Due to PLC, the system is automatic and hence, it is much easier to access the system and maintain it.

Transmission lines function at distinctive voltage levels from 69kV to 765kV, and firmly interconnected for consistent operation. Various factors akin to de-regulated market environment, right of way, economics, environmental and clearance necessities have forced utilities to operate transmission lines near to operating limits.

1.2 Classification of Transmission Lines

The transmission line can be studied with the three constants: R (Resistance), L (Inductance) and C (Capacitance). These factors are distributed in a line uniformly across the whole length. The inductance and resistance are the two factors that form series impedance. The capacitance that exists between the conductors for a single-phase line or

from the conductor to neutral for the three-phase line forms a shunt path across the length of the line. Therefore, the effects of capacitance introduce complications in the transmission line calculations. Overhead lines are classified on the basis of the presence of capacitance in a line.

AC transmission line:

- ***Short Transmission Lines***

  If the line is not more than 80 KV or if the voltage is not over than 66 KV then the line is known as the short transmission line. The capacitance of the line is governed by its length. While studying the performance of the short transmission line only resistance and the inductance of the line is calculated.

- ***Medium Transmission Line***

  The line which is ranging from 80 to 240 km is termed as a medium transmission line. The capacitance of the medium transmission line cannot be ignored. The capacitance of the medium transmission line is considered to be lumped at one or more point of the lines. The medium transmission line is sub-divided into Pi – model and T – model.

- ***Long Transmission Line***

  The line having a length more than 240 km is considered a long transmission line. All the four parameters (resistance, inductance, capacitance, and leakage conductance) are found to be equally distributed along the entire length of the line.

Dc transmission line:

The DC transmission is mainly used for bulk power transmission. For long distance transmission, DC is less expensive and has low electrical losses. The cost of the DC transmission systems is higher for short distance transmission lines because it requires more convertible equipment as compared to an AC system. The converter station converts the AC to DC at the sending end and DC to AC at the load end of the line. One of the major advantages of the DC system is that it allows the power transmission between two unsynchronized AC systems.

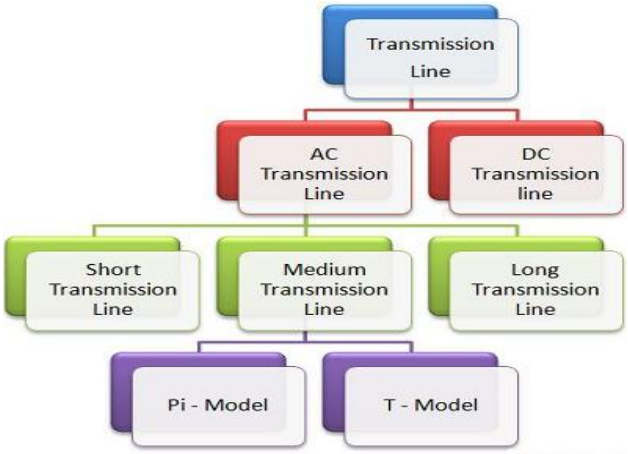


Figure 2: Classification of transmission lines

1.3 Some of the Common Faults Affecting Transmission Lines

Electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in a safer operation of the system. But when fault occurs, it causes excessively high currents to flow which causes the damage to equipment and devices. Fault detection and analysis is necessary to select or design suitable switchgear equipment, electromechanical relays, circuit breakers and other protection devices.

Types of faults:

There are mainly two types of faults in the electrical power system. Those are as following:

I. Symmetrical

II. Unsymmetrical faults.

a) Symmetrical faults:

These are very severe faults and occur infrequently in the power systems. These are also called as balanced faults. There are mainly two types namely

1) Line to line to line to ground (L-L-L-G) and

2) Line to line to line (L-L-L)

Analysis of this fault is easy and usually carried by per phase basis. Three phase fault analysis or information is required for selecting set-phase relays, rupturing capacity of the circuit breakers and rating of the protective switchgear.

b) Unsymmetrical Faults:

These are very common and less severe than symmetrical faults. There are mainly three types namely

1) Line to ground (L-G),

2) Line to line (L-L) and

3) double line to ground (L-L-G) faults

1.4 Objective

- The main objective of our project is to design an automatic protection scheme for transmission lines using Programmable Logic Controller (PLC).
- To prevent overloading of the transmission line using current sensor.

There are combinations of a circuit breaker and a relay protection system in a typical fault cleaning system. The main parts in protection system are wiring, auxiliary power supply, AB switches, circuit breakers, relays and the operating coil of the circuit breaker. All this are controlled via PLC. In normal operating conditions, power system equipment or lines carry nominal voltages and currents which results in an accurate and good operation of the system.

1.5 Problem Definition

- The most common problem is overload condition which creates fault in operation and it may damage system.
- As fault analysis became important requirements of the electric power system to became more accurate.
- So as to avoid such cases we designed a simple and economical equipment which will give a solution to the above-mentioned problems.

- Types of fault may be depending on atmospheric parameter and component property.

CHAPTER 2

Literature Review

Below is the literature review on fault detection or overhead in transmission line using different technique by some authors and their main observations:

2.1 Overhead Line Protection with Automatic Switch by Using PLC Automation

---Ajit B. bachhav, Nikhil S. Sarode, Rajashree

- It is very important to know the effect of series compensation on transmission voltages. If the effect of series compensation on voltages is not known, it will cause various operational problems such as high voltages and low voltages.

  Series compensate on can cause low and high voltages due to different line loading conditions and the method by which the voltage control is adjusted. The protection scheme of double circuit transmission line based on artificial neural network (ANN) has been proposed in the future.

- Three stages are involved in this scheme to detect and classify different types of faults.
- Data from one end of the double circuit transmission line has been utilized to calculate the wavelet coefficients.
- The primary protection is provided to entire transmission line by using one end data only.
- For forward and backward adjacent transmission line, back up protection is provided.

  This technique improves the first zone reach setting up to 99% of the length of line for protection of transmission line. Optimal Coordination of Automatic Line Switches for Distribution Systems.

- Author mainly focuses on distribution feeder automation system; protection coordination; underground 4-way automatic line switch. This study investigates the coordination time intervals (CTIs) among the protection devices of the duty point of high voltage customers, automatic line switches lateral protection relays, feeder overcurrent protection relays, bus interconnection overcurrent protection relays, and distribution transformer overcurrent protection relays, so that the entire protection scheme of the distribution systems can be formulated, particularly for the two-level protection scheme below the feeder circuit breaker (FCB). Multi-Agents for Fault

Detection and Reconfiguration of Power Distribution Systems.

2.2 Fault Detection in Switch Yard and Transmission Lines Using PLC and SCADA

---Praveen Reddy, Samreen Kausar, Uppalpati Ramyashree Laxmi, Varadi Sahana.

SCADA - a Supervisory Control and Data Acquisition System is a high-tech computer. the main purpose of SCADA is the high voltage transmission and its also applicable for wide range of distribution system. Supervisory control of equipment's like e.g. closing and tripping of switchgear and tap changing of transformer in power plants, controlling process parameter in process plant. Data acquisition i.e. ability to get various information from the field by some mean.

The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control, distributed control systems and networking. The data handling, storage, processing power and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. The main difference from other computers is that PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output (I/O) arrangements.

Using PLC and SCADA together have a lot of application like follows:

- The PLC & SCADA allows detecting the exact location of fault.
- Reduces the time.
- Quality output.
- Increased accuracy and speed.
- Profit maximization.
- Improved productivity.

CHAPTER 3

Proposed Model with Theoretical Background

3.1 Principle of Working with Flowchart

Power management is an important constraint in the design of various loads in industries for automation. So, if power consumption increases then the substation monitoring is very important for the purpose of controlling the hardware and software optimization with the help of PLC ladder logic system.

The project's main purpose is to disconnect the faulty section using a current sensor, which is connected in series with the air break (AB) switch which detects the current value as the current value increases.

The proposed model uses a conventional air break switch for automation by using programmable logic controller (PLC) system and the AB switch is normally used for the disconnection or de-energization of the supply from the line. The main working of the AB switch is to disconnect the faulty section without interrupting the whole section or feeder line.

PLC gives instruction to open or disconnect the AB switch by using a mechanism which is directed through DC motor and instructed by PLC from the substation.

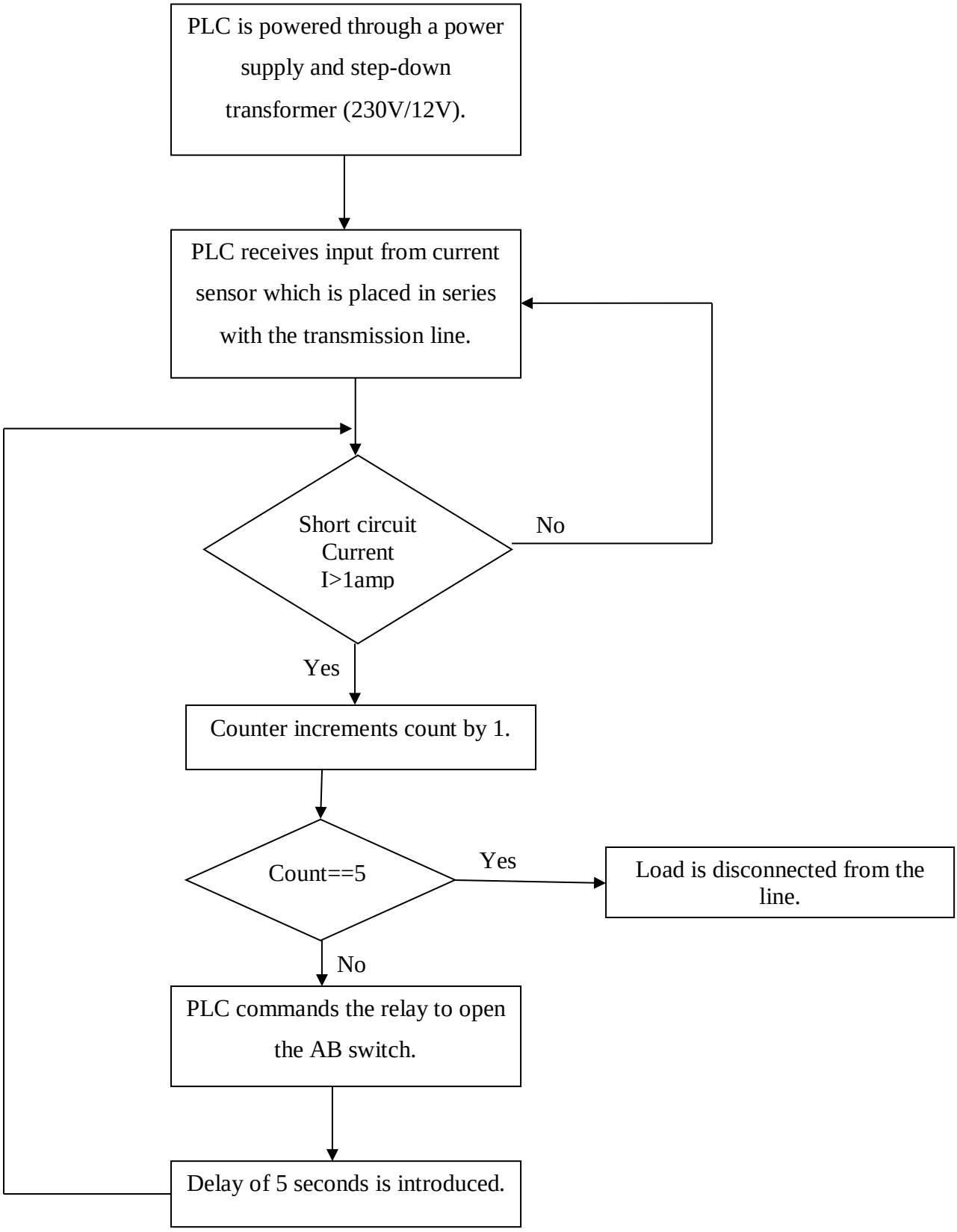
The faulty section is easily disconnected and after a delay period of 5 seconds, the PLC gives instruction to the circuit to close the open contact for trial of the faulty section. The faulty section is tested for any faults. If once again a fault is detected on the line, it is declared as a faulty section.

If a fault is detected on the line five times, the load is disconnected from the circuit.

An IoT cloud is interfaced with the system to indicate the state of the system in real-time to the utility and if needed, the consumers. The IoT cloud updates the information displayed depending on the functioning of relays and connection/disconnection of loads, which are fed to the cloud through the PLC via Bluetooth.

The design of transmission protection systems is in such a way so as to locate the fault location and segregate only the faulted part. It is a very challenging task to identify and isolate the faults in order to have a very reliable transmission line protection. Most of the power distribution or utility companies rely on manual labour to perform the distribution tasks like interrupting the power to loads & all parameter hourly checking.

The process can be represented in the form of a flowchart, as shown below.



PROGRAMMABLE LOGIC CONTROLLER FEATURES:

1) Compact PLC

2) Configurable LED display

3) Window based software

4) Program for configuration

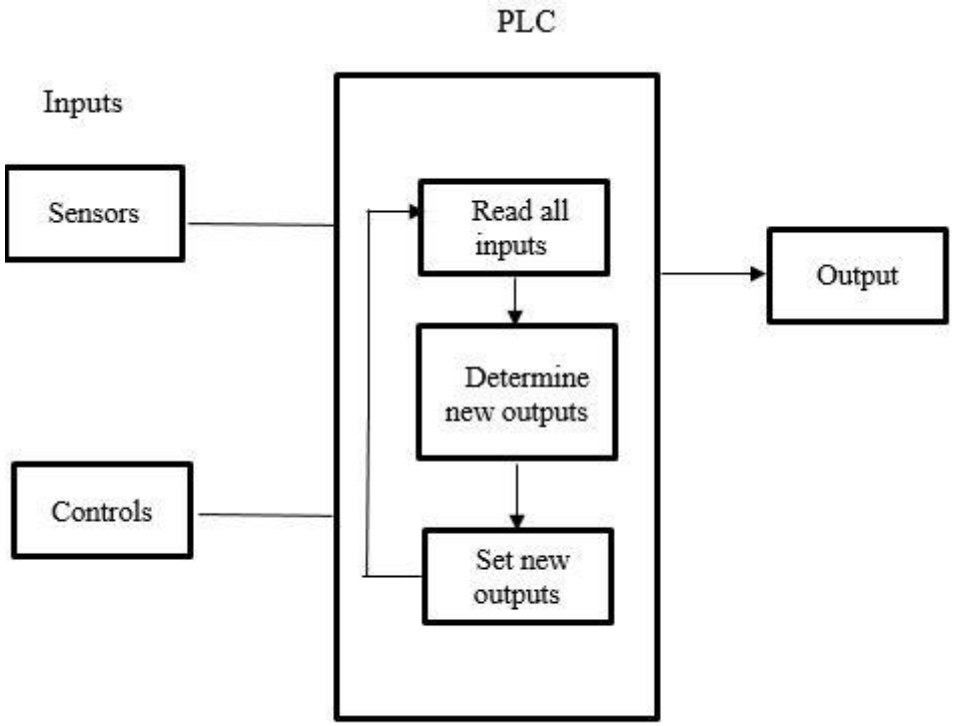


Figure 3: Block diagram of PLC

This model is implemented with fault detection system, location of the fault on the line and rectifying the same by isolating the faulty part of the circuit. It also provides information on peak load demands, value of the allowable current and the fault current in the system. All these functions are performed automatically using Programmable Logic Controller (PLC).

All this information is monitored by a mobile application which will send the user, as well as to the substation, the alerts via texts. One of the main components that we use for sensing the current value is current sensor. A current sensor is a device that detects electric current in a wire and generates

a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control.

The sensed current and the output signal can be:

- Alternating Current Input

o analog output, which duplicates the wave shape of the sensed current.

o bipolar output, which duplicates the wave shape of the sensed current.

o unipolar output, which is proportional to the average RMS value of the sensed current.

- Direct current input

o unipolar, with a unipolar output, which duplicates the wave shape of the sensed current

o digital output, which switches when the sensed current exceeds a certain threshold.

3.2 Block Diagram

The block diagram given below represents the proposed model in the industry.

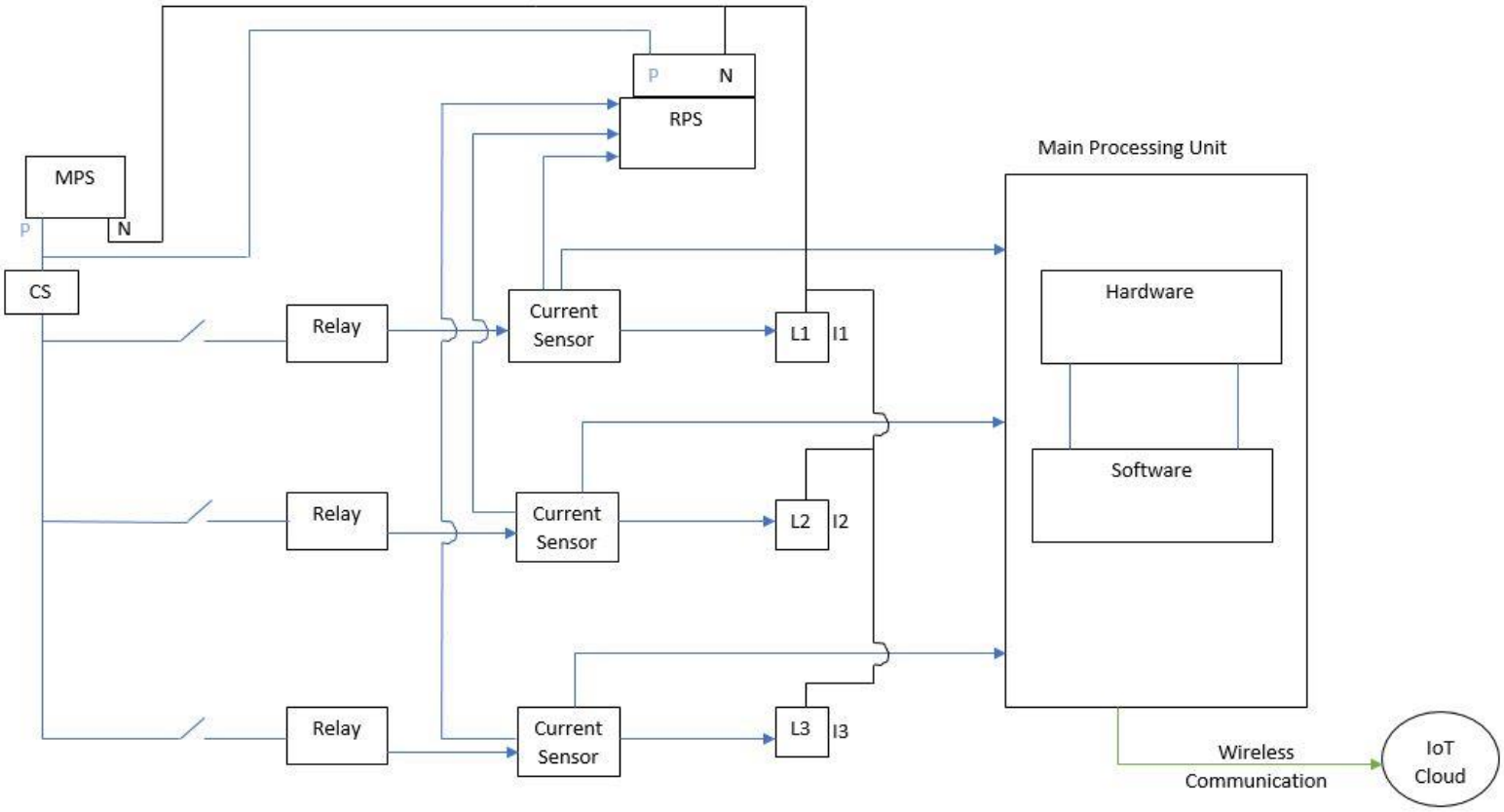


Figure 4: Block diagram of proposed model

The main power supply (MPS) is used to power the current sensors (CS), the PLC kit through the regulated power supply (RPS) and the overcurrent relays when tripped. The regulated power supply incorporates a switching regulator to convert AC to DC since the PLC requires a DC supply. The switching regulator ensures a constant voltage supply to the PLC kit is maintained.

Since it is a three-phase system, three relays, current sensors and loads are depicted. In our implementation, the loads used were DC motor and AC motor.

As it is a closed loop system, the output has an effect on the input quantity in such a manner that the input quantity will adjust itself based on the output generated. This feedback automatically corrects the changes in the output due to external disturbance, thereby increasing accuracy and reducing sensitivity to noise.

The current sensor continuously senses the current in the transmission line it is connected to. The output of each current sensor (represented by I1, I2 and I3) is given to the main processing unit, the PLC, consisting of hardware whose functions are controlled by the software. Depending upon the current signal received, the processing unit commands the relays to trip and disconnect the load from the system. The buzzer is used to indicate the detection of fault.

The main processing unit is interfaced through wireless communication (Bluetooth) to an IoT (Internet of Things) cloud which is updated according to the output of the current sensor. The utility can monitor the state of the system and magnitude of current in each branch through the cloud. In addition, the consumers can also be given access to viewing the information on the IoT cloud, provided the system is resistant to online security breach.

CHAPTER 4

Design Process

4.1 Components Used

The main components used are PLC model, DC motor, current sensor and Bluetooth module. These components must be chosen such that the input and output peripherals are compatible with each other. This can be done by analyzing the datasheet of each component. The components chosen were based upon the specifications of the PLC kit, which was PLC 81/P50/PR1 using a PIC16F886 microcontroller. Their respective specifications are as follows:

1) PLC

- Model: PLC 81/P50/PR1
- Input: 12 V DC
- Microcontroller: PIC16F886

The PIC16F886 is a 28/40/44-pin flash-based, 8-bit CMOS microcontroller.

The PIC16F886 features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 11 channels of 10-bit Analog-to-Digital (A/D) converter, 1 capture/compare/PWM and 1 Enhanced capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and an Enhanced Universal Asynchronous Receiver Transmitter (EUSART).

The controller has 16KBytes flash memory which is enough for many applications. Along with 24 programmable Input/output pins which are developed to handle 20mA current (direct LED driving capability) the system can interface many peripherals easily. With Watchdog timer to reset under error automatically the controller can be used to develop applications

of permanent installation.

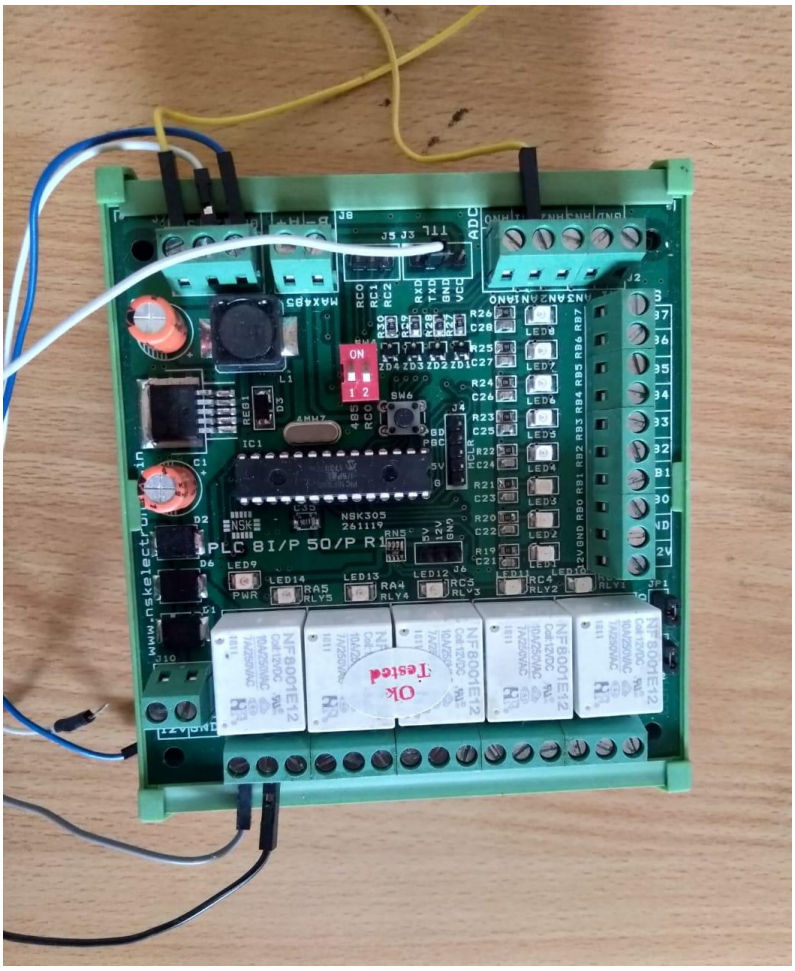


Figure 5: Photograph of PLC model used

2) DC motor

- Brushed DC motor of speed 100-500 rpm
- Voltage rating: 12 V DC

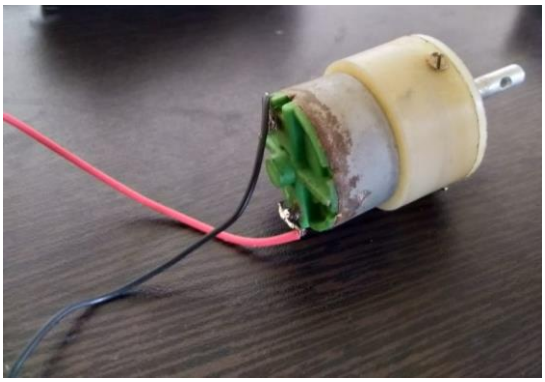


Figure 6: Photograph of DC motor used

3) Current sensor

- Model number ACS7121
- 1.2 mΩ internal conductor resistance
- 2.1 kV (RMS) minimum isolation voltage from pins 1-4 to pins 5-8
- 5.0 V, single supply operation

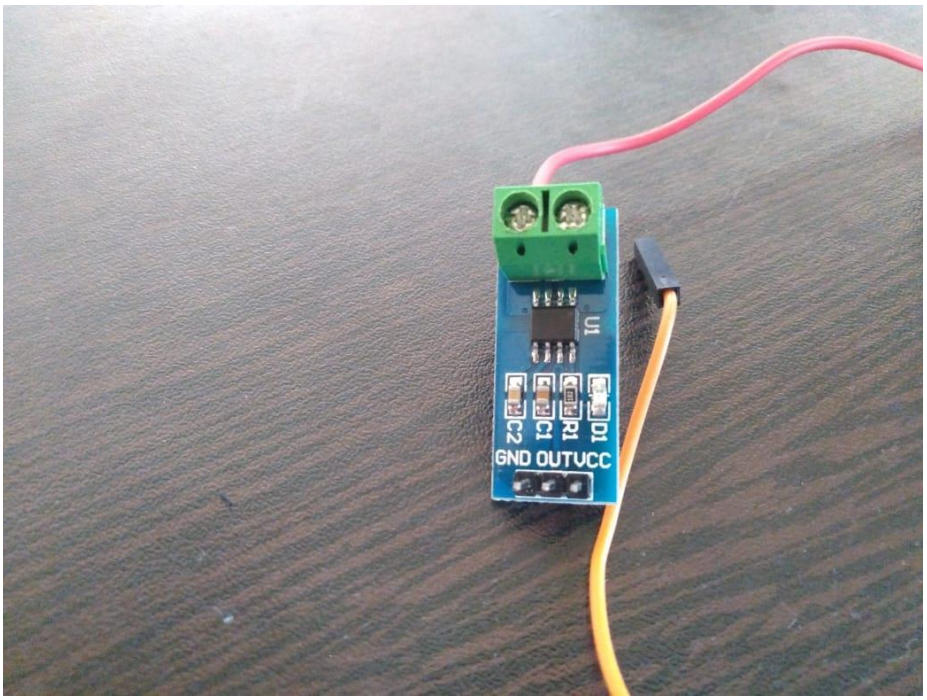


Figure 7: Current sensor ACS7121

4) Bluetooth module

- Model number: HC05
- Voltage rating: 3.6 to 6 V
- Serial communication device

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration,

making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices.

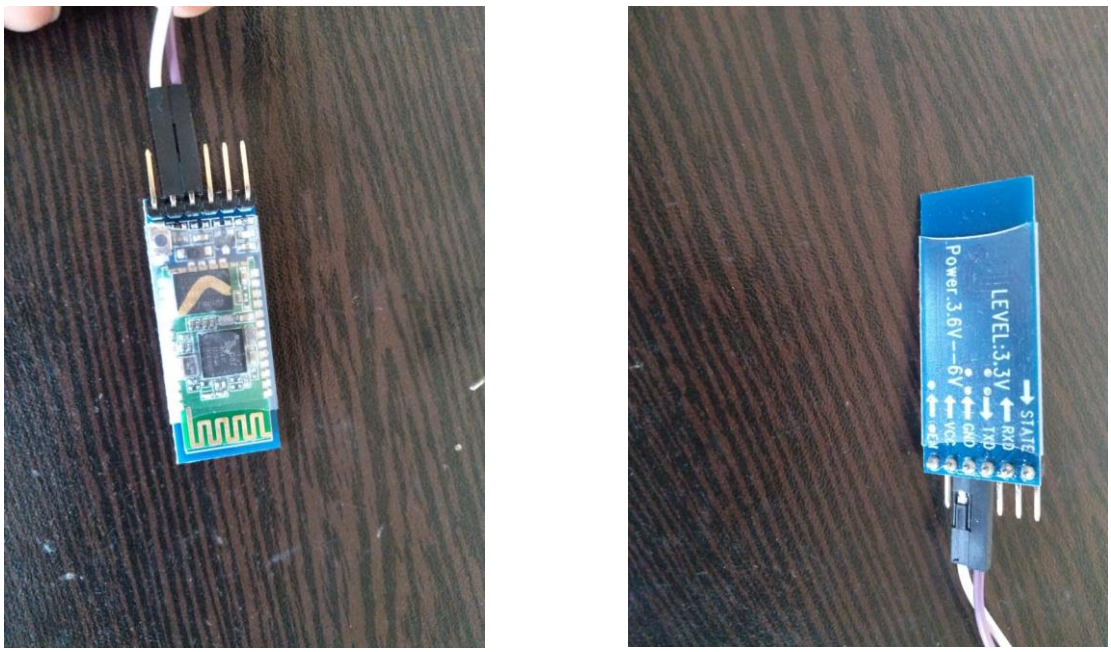


Figure 8: Bluetooth module used

4.2 Software Used

There are two types of programming in PLC. These are:

1) Textual Language

This type of programming consists of Instruction List and Structured List but it is difficult to understand when compared to graphical language.

2) Graphical Form

The graphical form includes ladder logic (LL), Functional block diagram (FBD) and sequential functional chart. The ladder logic is the simplest form of PLC programming. It is also known as “relay logic”. The relay contacts used in relay-controlled systems are represented using ladder logic.

The horizontal lines are called rungs and two vertical lines are called rails. Every rung forms the electrical connectivity between Positive rail (P) and Negative rail (N). This allows the current to flow between input and output devices.

For our project, we used Ladder Logic due to its simplicity in programming and ease of understanding.

The two software that we used for programming are:

1) **LDmicro**

LDmicro generates native code for certain Microchip PIC16 and Atmel AVR microcontrollers. Usually software for these microcontrollers is written in a programming language like assembler, C, or BASIC.
A program in one of these languages comprises a list of statements. These languages are powerful and well-suited to the architecture of the processor, which internally executes a list of instructions.

LDmicro compiles ladder logic to PIC16 or AVR code. The following processors are supported:

* PIC16F877
* PIC16F628
* PIC16F876 (untested)
* PIC16F88 (untested)
* PIC16F819 (untested)
* PIC16F887 (untested)
* PIC16F886 (untested)
* ATmega128
* ATmega64

* ATmega162 (untested)
* ATmega32 (untested)
* ATmega16 (untested)
* ATmega8 (untested)

Using LDmicro, ladder diagram was drawn for our program. The logic was simulated in real time on a laptop. Pins on the microcontroller were assigned to the program inputs and outputs. After assigning the pins, the PIC code was compiled for our program. The compiler output was a .hex file that was programmed into our microcontroller using a PIC programmer.

LDmicro is designed to be somewhat similar to most commercial PLC programming systems. It was essential that we carefully read the description of each instruction, even if it looked familiar.

2) **PICkit2 Development Programmer/Debugger**

The PICkit 2 Development Programmer/Debugger is a low-cost development programmer. It is capable of programming most of Microchips Flash microcontrollers and serial EEPROM devices.

The PICkit 2 Programmer application allows us to program all supported devices. Program code can be loaded into the PICkit 2 Programmer application by selecting File>Import HEX to import a hex file or by clicking Read to read the device memory. The origin of the code is displayed in the Source block. The Program Memory window displays the program code in hexadecimal. The code may be edited in the window.

EEPROM code can be loaded into the PICkit 2 Programmer application by selecting File>Import HEX to import a hex file or by clicking Read to read the device memory. The origin of the code is displayed in the Source block. The Data EEPROM Memory window displays the program code in hexadecimal. The code may be edited in the window. An image of the application is shown below.

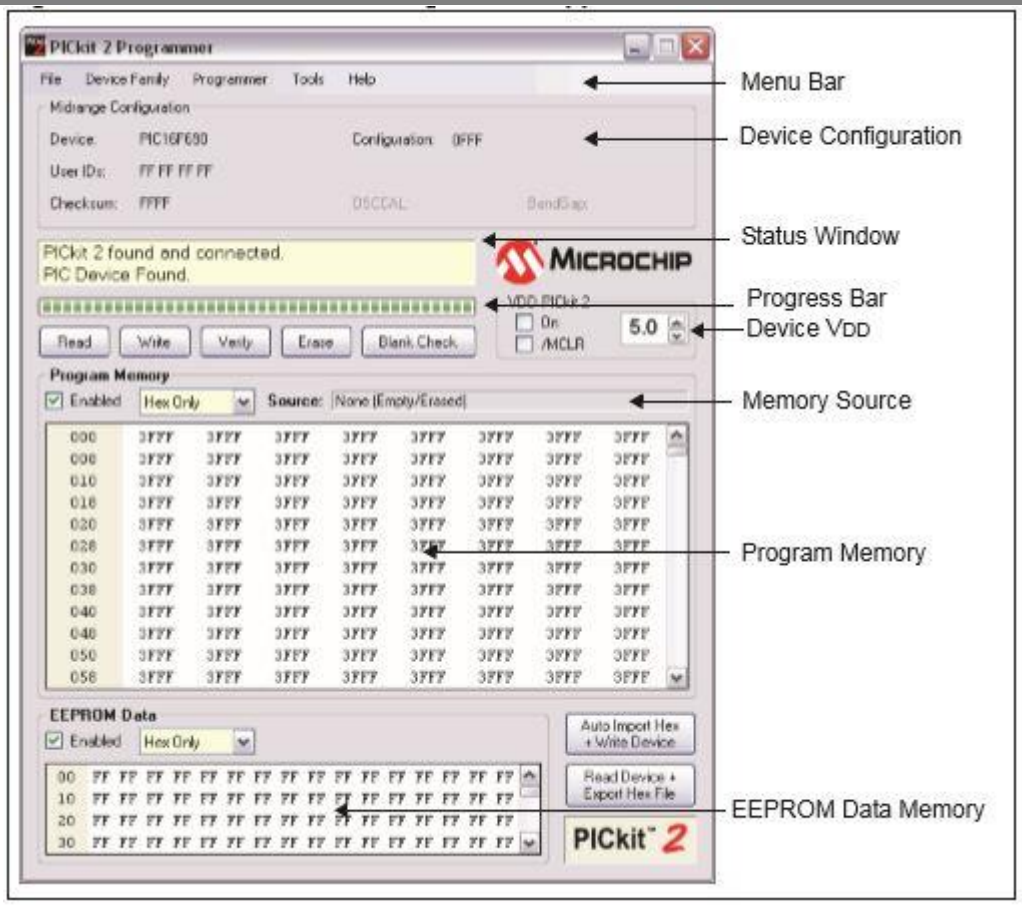


Figure 9: PICkit 2 Application

After a device family has been selected and a hex file has been imported, the target device can be programmed by clicking Write. The device will be erased and programmed with the hex code previously imported. The status of the Write operation is displayed in the status bar located under the Device Configuration window. If the write is successful, the status bar turns green and displays Programming Successful, as shown.

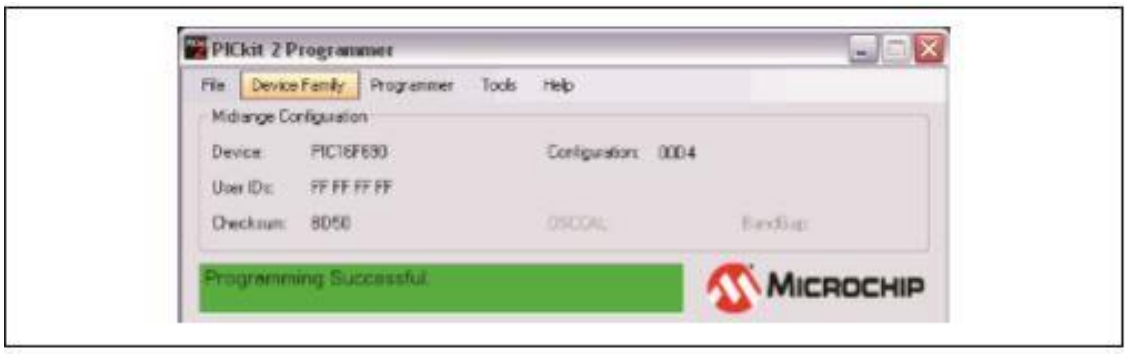


Figure 10: Successful write operation

4.3 Connection of the components

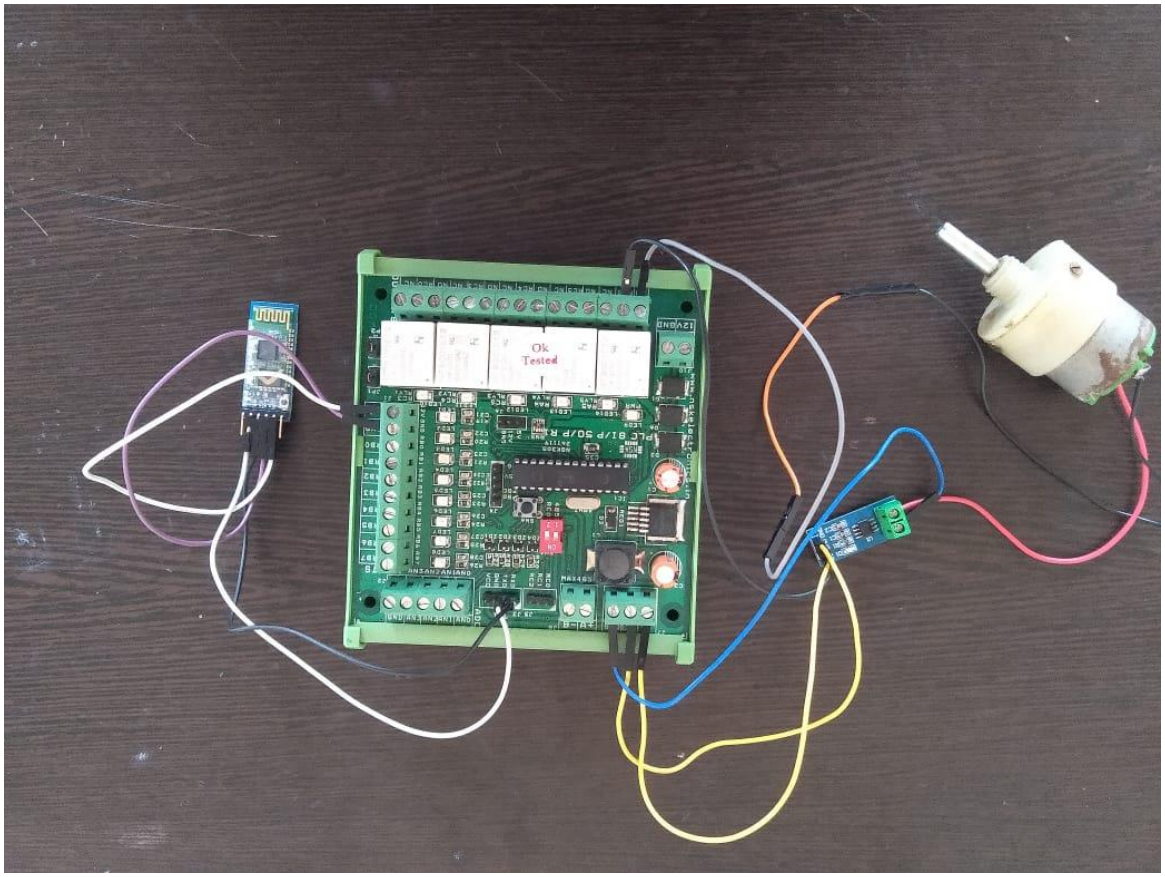


Figure 11: Connections made without connecting power supply

The components are first connected to one another according to the block diagram, and then connected to the power supply. The PLC is also connected to a laptop, where we could observe the current reading as a number based on the resolution of the PLC. In addition, the program to the PLC was done on the laptop and was transferred to the PLC by the interfacing software.

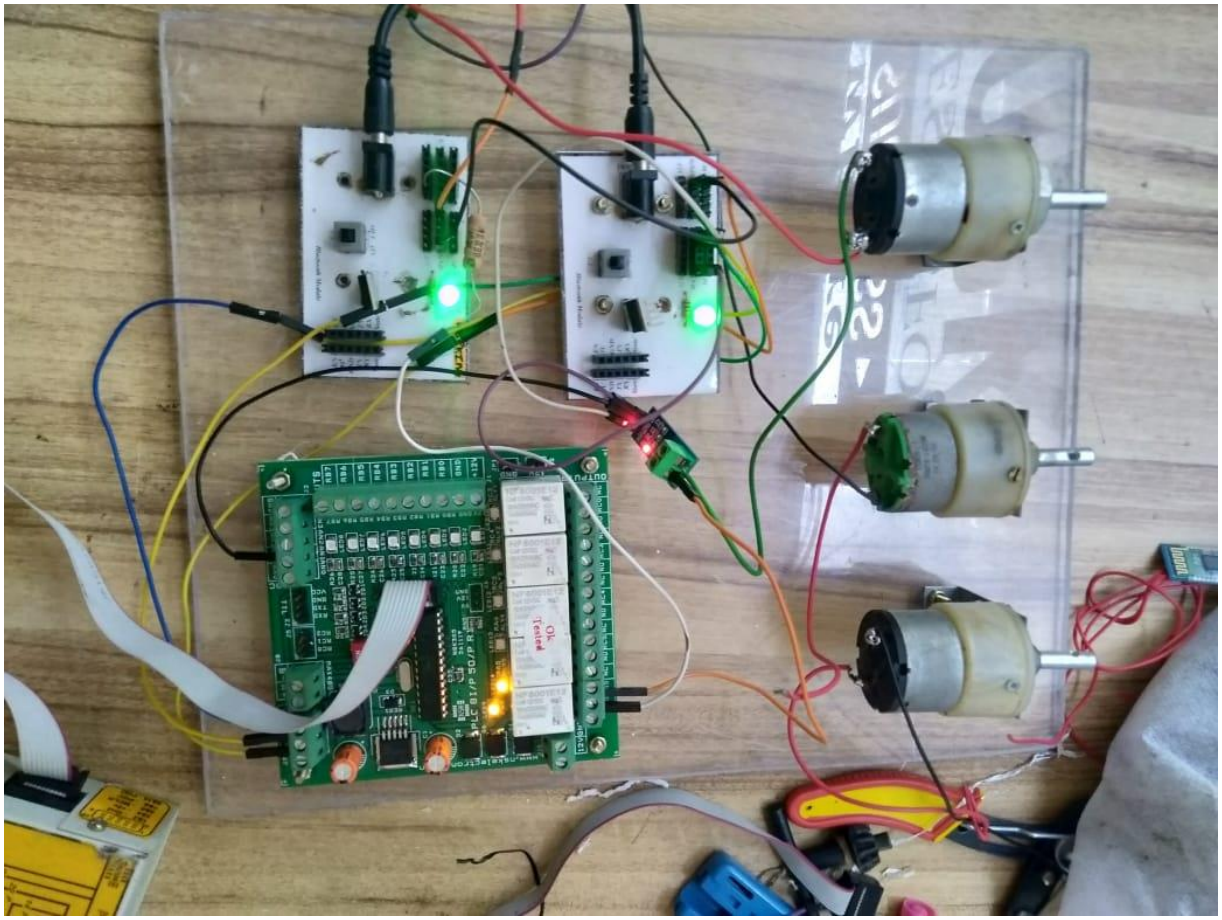


Figure 12: Complete connection of hardware on fiber-glass board

CHAPTER 5

Results and Discussion

5.1 Results Obtained

- The module worked satisfactorily when the load was shorted to simulate the short circuit.
- The amount of time between making and breaking the circuits was accurate according to our settings.
- The load was disconnected after sustained short circuit after 5 cycles of checking.
- The disconnection is followed by sending a message to the nearest control section using IoT.
- Current sensor calibration should be done accurately as the amount of rise in current can be for a shorter duration due to a power surge, lightning or due high MVA transformers on the line.
- The minimum and maximum value of the line current should be updated in the program accurately after many trials.

5.2 Table of Observations

Parameters	**Voltage(V)**	**Current(mA)**
No load condition	6.84	1.6
Loaded condition	i. 7.3 ii. 8.8 iii. 10.2 iv. 12.32	1.9 2.3 2.88 3.3
Short circuit condition	0.5	85.6

5.3 Discussion

- The value of current sensor's analog output has to be monitored for different values of load current.
- After finding the corresponding analog output values registered based on different load currents the maximum and minimum values of the line current should be chosen.
- If the rise in current is for a very short duration the PLC should not initiate the program, because it can be due to a momentary power surge.
- If the overcurrent situation is persistent after a minimum time, then the PLC program should be initiated.
- The process should be initiated for an AC load for future work.
- The design process for AC load will be different as the alternating current varies periodically, so we have to monitor the current differently than the DC.

CHAPTER 6

Conclusion & future work

6.1 Conclusion

With the help of switchyard and transmission system automation we can improve reliability, power quality & power handling and distribution capacity/management. The implementation of automation is a very costly & complex procedure with increasing use of power electronics & electronics equipment, for implementation in the practical existing field. After investing more equity for automation, we can achieve a lot from the system.

Total 60% to 65% of existing substation's age is more than 25 years. According to its age, the government has started renovating and improving towards system automation. This improvement should be IEC 61850 instead of distinctive Substation Automation. At present in INDIA knowledge of IEC 61850 & implementation. technology is only with private sectors. This standard is accepted worldwide. So, government should try to train engineers to achieve an enhanced output. A considerable amount of effort is necessary to maintain an electric power supply within the requirements of various types of consumers without failure of system.

One important requirement of a transmission system is that voltage variations at consumer's terminals should be as low as possible. The changes in voltage are generally caused due to the variation of load on the system. Low voltage causes loss of revenue. Power must be available to the consumers in any amount that they may require from time to time. For example, motors may be started or shut down, lights may be turned on or off, without advance warning to the electric supply company.

As electrical energy cannot be stored, therefore, the transmission system must be capable of supplying load demands of the consumers. This necessitates that operating staff must continuously study load patterns to predict in advance those major loads.

The electric energy produced at generating stations is transported over HV transmission lines to utilization points. In the early days, electric systems were operated as isolated

systems with only point-to-point transmission at voltages that are considered low by today's standards. The proposed PLC based controlled protective relay used deals with the failures, which are the over/under current, over/under voltage, unbalance of supply voltages, overload, unbalance of phase currents and the ground fault. Switch is closed until fault isolates, once the faults isolated the switch is closed and makes the circuit a closed loop. To increase the reliability of the system and reinstate the power supply in time, it is of immense important to classify and locate the fault rapidly and to isolate the faulty section precisely.

6.2 Future Work

Improvising the model in terms of mobility, durability, timing and data recording using IOT as IOT has an excellent data management, better security, required scalability.

- The addition of voltage sensor or voltage comparator to detect voltage fault or fluctuation in transmission line.
- This system can be used in DC parameter fault analysis.

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