Virtual Ladder Logic using Virtual Instrumentation

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Abstract:- Now a days where world is going to be virtual in next few years with the help from brain of man. It doesn't hamper the real world instead of giving a full scope to enhance the reality with dummy. From last few years Automation is the boom area in every field to reduce the man power from industry to Academic. Internet is the backbone of any knowledge in this Era. The main aim of this paper is to give a virtual research world through internet with a virtual instrumentation software. It will give a concept to implement the LLD through VI where real PLC kit are not available. This paper explain the virtual ladder logic with the help of virtual instrumentation i:e MULTISIM to realize the real world PLC (Programmable Logic Controller) logic with the use of different examples. Three virtual motor (M1,M2,M3) will run alternatively in loop using relay coils from VI.

Keywords: *VI (virtual instrumentation), LLD (ladder logic diagrams), PLC Programmable Logic Controller),Motor control*

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I. INTRODUCTION

PLC is defined as "Digital electronics device that uses a programmable memory to store instruction and to implement specific function such as logic sequencing ,timing counting and arithmetic to control machines and processes". The name PLC itself suggest that it is a programmable controller with different type of logic implementation from brain of man. We can say it is a industrial computer. It w as invented in order to replace the sequential relay circuits which are mainly used for

machine control. Now a days PLC is the master in the automation industry which can replace numbers of man power with a simple logic. A programmable controller is a digitally operated electronics system designed for use in an industrial environment which uses programmable memory for the internal storage of user-oriented for implementing specific function .PLC is an industrial computer in which control device such as limit switches, push buttons, proximity sensors ,float switches and few more provide incoming control signals in to the unit. This is known as input. Input interact with instructions specified in the user LLD which tells the PLC how to interact to the incoming signals. The user program also directs the PLC on how to control field devices like motor starters, pilot lights, and solenoid. A signal going out of the PLC to control a field device is called an output. Application of plc in automation are in the field of sequence control, motion control, process control, data management and communication. Majority of the PLC application are still utilized in machine control material handling, sequence control application.

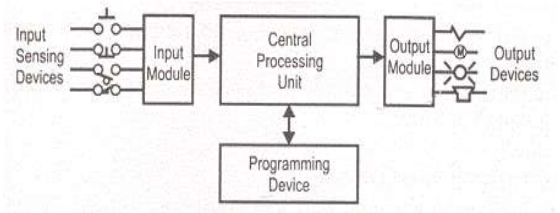

Figure 1: Basic of PLC

For the PLC the heart is LLD.PLC simply follows the instruction stored in memory .To retain user program instruction they are stored in the memory of the PLC for future use and reference. Each instruction that is entered will be placed in memory in ascending order. The list of instruction is called ladder program or ladder logic diagram (LLD).

II. BASICS OF LADDER LOGIC

Conventional hardwired relay ladder diagram represents actual hardwired control circuits. In a hardwired circuit there must be electrical continuity before the load will energize. Even though PLC ladder logic was modelled after the conventional relay ladder. There is no electrical continuity in PLC ladder logic.PLC ladder rungs must have logical continuity before the output will be directed to energize. electrical ladder diagram are used to represent the interconnection of field devices. Ladder diagram became the standard method of providing control information to users and designers of electrical equipment. The difference between PLC ladder program and relay ladder rungs involves continuity. A PLC ladder program closely resembles an electrical schematic.PLC

ladder symbols represents ladder program instruction. A PLC program is a set of instruction that stored in the memory. These instruction will give the PLC a path what to do.PLC ladder logic involve the terms like rungs, NO(Normally open) NC (Normally close).The contact that closes when the coil is energized is called normally open and the vice-versa is true for normally close. There is no physical conductor that carries the input signal through to the output. Each rung is a program statement. A program statement consists of conditions with some action instruction. Input condition will act as the instruction and control and the output is the result of the condition.PLC combines instruction logically using logical operators. Logical operations performed by a PLC are based on the fundamental logic operators like AND, OR ,NOT. Ladder logic diagram is a graphical representation of the instruction that to implement for controlling without man power through a switch. The current implied by ladder diagram does not flow physically.PLC diagram is only symbolic representing the flow of information within the PLC as determined by the software .Figure 2: Steps in LLD Figure 3 depicts an exemplar LLD of a simple safety circuit in a machinery control. As shown in the figure, steps can be configured in a single line or in a combination of lines. The left vertical bar represent a 24V power supply while the right vertical bar represent 0V or ground.

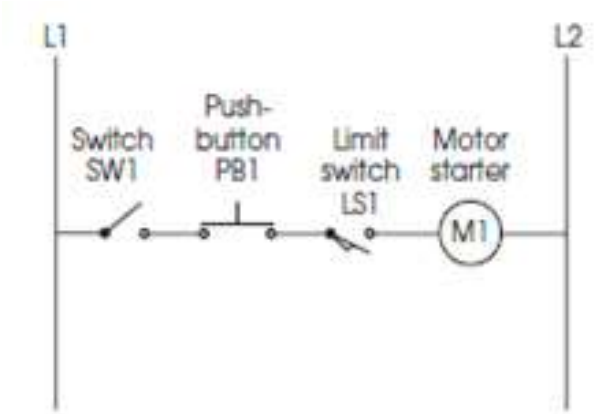

Figure 2: Steps in LLD

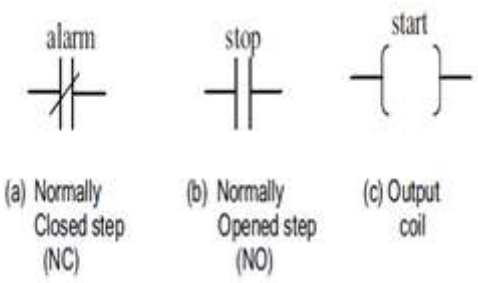

Figure 3: A simple relay logic diagram

Current flows from the left rail of the ladder, i.e. a combination of relay contacts or steps, to the right rail, i.e. the output coil (represented by the symbol in diagram (c) in Figure 2). The output coil models the logical state or output variables of the ladder. A combination of steps and an output will construct a complete ladder logic network or also called a rung. For instance, the first rung in Figure 3 consists of a single line of steps, which defines an AND logic[4]. The second rung consists of three lines of steps, which defines an OR logic. The third rung is made up of two lines, modelling a combination of AND- OR logic. There are two main techniques used to solve the rungs: horizontal or vertical scans. In horizontal scan, the steps of a rung are scan from left to right (or from right to left) and the rung is solved one at a time. In vertical scan, all the steps

in a column are solved from the top-most rung to the bottom-most rung or from the bottom-most rung to the top-most rung. Once the column steps are solved, the procedure moves to the next column of steps. Once the process has reached the end of rung or column, the scan process is repeated again from the first rung or column, indefinitely. This process is referred to as the cyclic scan. In the example in Figure 3 horizontal scan is applied. In practical PLCs [7] besides the combinations of bit logic, timers and counters, and sometimes also sequencers are also used in the LLD models.

III. VIRTUAL INSTRUMENTATION

Virtual instrument is a combination of commercial technologies with flexible software and a wide variety of measurement and control hardware. The virtual instrument is used widely because of the flexibility with software and user friendly atmosphere in every field. You can design your own user defined system which can meet your exact application needs. Automation industries are using VI for better productivity, reliability, safety and stability.VI is a computer based software that the user can implement ,test, measure and control from desktop. Innovations mandates use of software to accelerate a new concept and product development It also require instrumentation to rapidly adapt to new functionality. Because VI uses software modular input output and commercial platform, it delivers instrumentation capabilities uniquely qualified to keep pace with today's concept and product development. The main difference between hardware instruments and VI are the software interference. Every hardware instrument like oscilloscope, multimeter , ADC, DAC, logic gates, LED and many more has been replaced by a virtual instrument with a simple schematic representation with all the facility from a physical laboratory. VI is defined as an industry standard computer equipped with user friendly application software, cost effective hardware and driver software that together

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platform the functions of traditional instruments. Simulated physical instrument are called virtual instrument. software tool, engineers and scientists can efficiently create their own applications, by designing and integrating the- routines that a particular process requires. They can also create an appropriate user interface that best suits the purpose of the application and those who will interact with it. They can define how and when the application acquires data from the device, how it processes, manipulates and stores the data, and how the results are presented to the user.

IV. VIRTUAL INSTRUMENTS VS TRADITIONAL INSTRUMENTS

Stand-alone traditional instruments such as oscilloscopes and waveform generators are very powerful, expensive, and designed to perform one or more specific tasks defined by the vendor. However, the user generally cannot extend or customize them. The knobs and buttons on the instrument, the built-in circuitry, and the functions available to the user, are all specific to the nature of the instrument. In addition, special technology and costly components must be developed to build these instruments, making them very expensive and slow to adapt.

V. RESULT ANALYSIS USING MULTISIM SOFTWARE

Multisim is an industry-standard, best-in-class SPICE simulation environment. It is the cornerstone of the NI circuits teaching solution to build expertise through practical application in designing, prototyping, and testing electrical circuits.

The Multisim design approach helps you save prototype iterations and optimizeprinted circuit board (PCB) designs earlier in the process.

CASE 1

STEP 1 Define the problem for LLD.

There are three motor using relay coil named as M1,M2,M3.We want to run those virtual motor in a condition that when the one motor will on two motor will be in off condition.

Step 2:

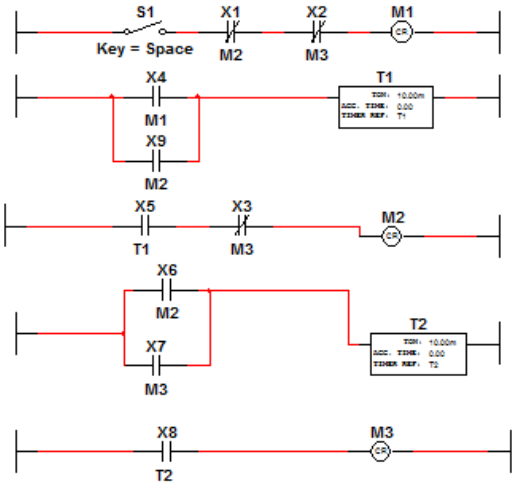

Figure 4: RLL with switch off condition

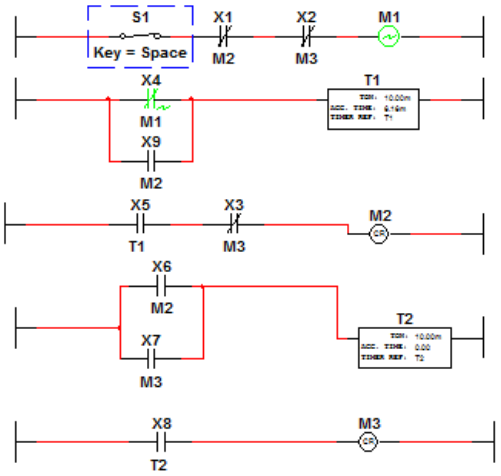

Figure 5: M1 on M2 M3 off

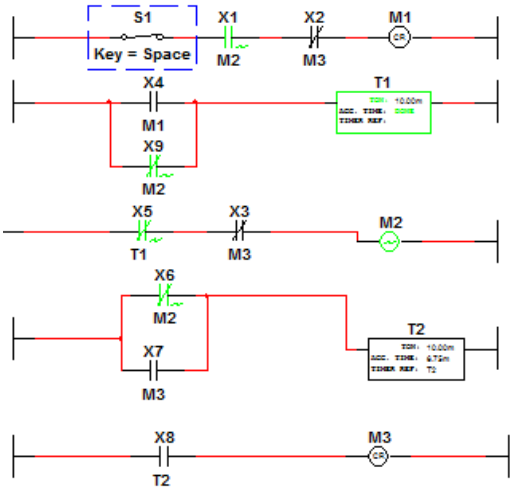

Figure 6: M2 on M1 M3 off

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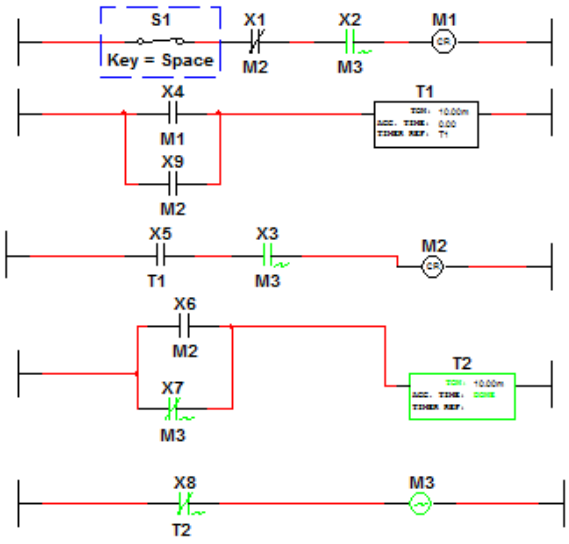

Figure 7: M3 on M1 M2 off

CASE 2

Step 1: Define the problem for LLD.

There are three motor using relay coil named as M1,M2,M3.We want to run those virtual motor in a condition that when the two motor will on one motor will be in off condition.

Step 2:

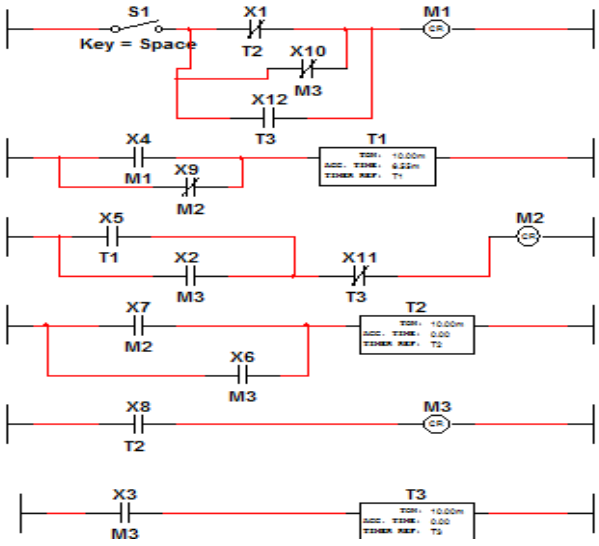

Figure 8: RLL with switch off condition

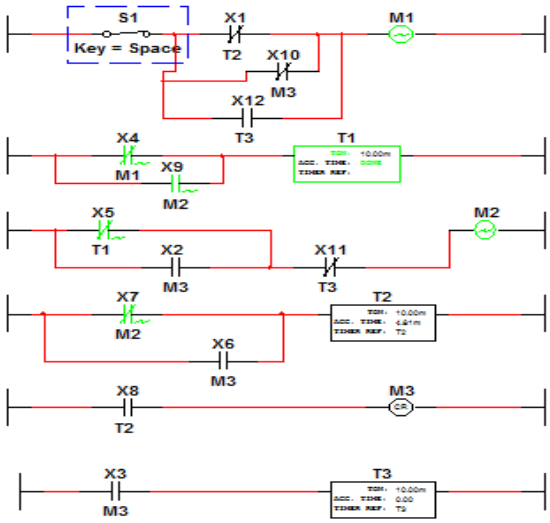

Figure 9: M1 and M2 on M3 off

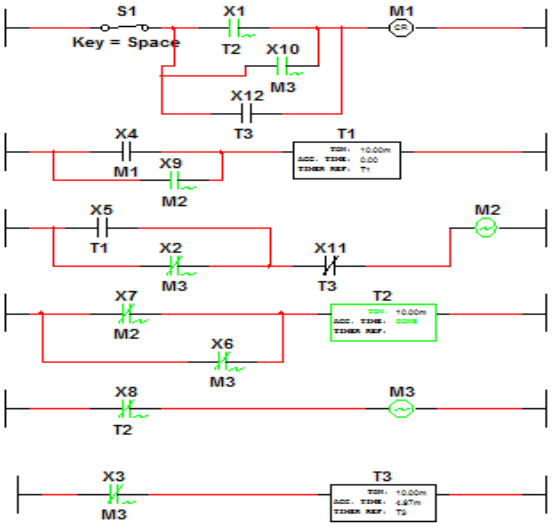

Figure 10:M2 and M3 on M1 off

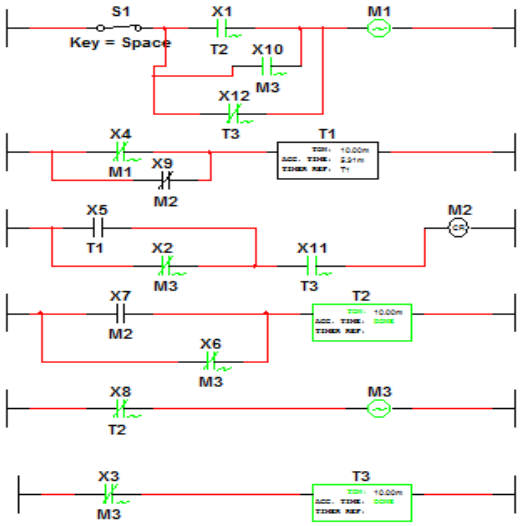

Figure 11:M1 and M3 on M2 off

VI. CONCLUSION

Virtual instrumentation was devloped from scientists in mind, for providing powerful tools and a familiar development environment for the academicin, researchers and industry to implement their opinion through a computer window with logical diagrams to visualize the real world instruments. Every where PLC kits are not available, this virtual instrument can give a excellent platform to enhance the logic i:e LDD which can implement in practical PLC kits in the future. we can simply create virtual LLD through virtual instrumentation.

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