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Monitoring and Controlling Of Electric Overhead Travelling Crane Using PLC and SCADA

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Abstract: **PLC and SCADA are the two new approaches used to control the motion of Electric Overhead travelling crane. Ladder logic diagram for EOT Cranes are designed for motion using variable frequency drives and contactor logic and performance of various parameters are analyzed and compared and image of E.O.T crane are designed in SCADA software and communication between PLC and Scada is done with the help of Siemens simulator .There is a provision of hydraulic motor for motion in main hoist if power failure of cranes takes place to avoid the unsafe condition and work under extreme condition.**

Keywords: **Electric overhead travelling crane, PLC, SCADA, Ladder logic, Siemens make Simulator.**

1. INTRODUCTION

A crane is the type of machine mainly used for handling heavy loads in different industry branches: metallurgy, paper and cement industry. By the construction, cranes are divided into overhead cranes and gantry cranes. Overhead and gantry cranes are typically used for moving containers, loading trucks or material storage. This crane type usually consists of three separate motions for transporting material. The first motion is the hoist, which raises and lowers the material. The second is the trolley (cross travel), which allows the hoist to be positioned directly above the material for placement. The third is the gantry or bridge motion (long travel), which allows the entire crane to be moved along the working area.

This paper presents the loading zone and unloading zone. Three-motors namely Main hoist, long travel And Cross travel are used for accomplishing movements of electric overhead travelling cranes in desired directions.. PLC are used for controlling the three motors using programs. Drives are used to control the speed of motors proportional to the weights. SCADA techniques are used for monitoring and data acquisition and used as a communicating tool between the client, PLC and other control systems of the crane.

2. BRIEF INTRODUCTION TO PLC AND SCADA

A digitally operating electronic apparatus which uses a programming memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog modules, various types of machines or process. Programmable Logic Controller (PLC) is used to control machines and process . PLCs can be used with a wide range of control systems, which vary widely in their nature and complexity. After programming the PLC, before starting a real process, the operator has to verify if the program is correct, i.e. if the PLC correctly performs the predefined control task. Therefore, the operator monitors the states at input and output port of the PLC. A usual way is to monitor all the states and program variables online, during the operation of PLC, with the same programming environment which was used for programming the PLC. However, it is best to develop a physical

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educational model of the system, where the operator manually enters the inputs of the PLC and monitors its output states. However, this can take a long time depending on the complexity of the system. Also, this solution isn't modular because it is difficult to rebuild the model if some changes are necessary. The most complex system for monitoring and control of industrial processes which is widely used nowadays is Supervisory Control and Data Acquisition (SCADA) system. This system requires use of communication protocols between the client on one side and PLC and other parts of control system on the other side. Although the SCADA is standard monitoring and data acquisition system in industry, it isn't easy to make, so it isn't appropriate in simple control systems, when it is necessary to make a simple cost-effective monitoring system. The operator uses software simulator to activate certain inputs of the PLC, while the application receives the information about output states of the PLC and it shows them graphically, i.e. in animation. This process is realized through interface board which communicates with PC and controls/reads input/output ports of the PLC.

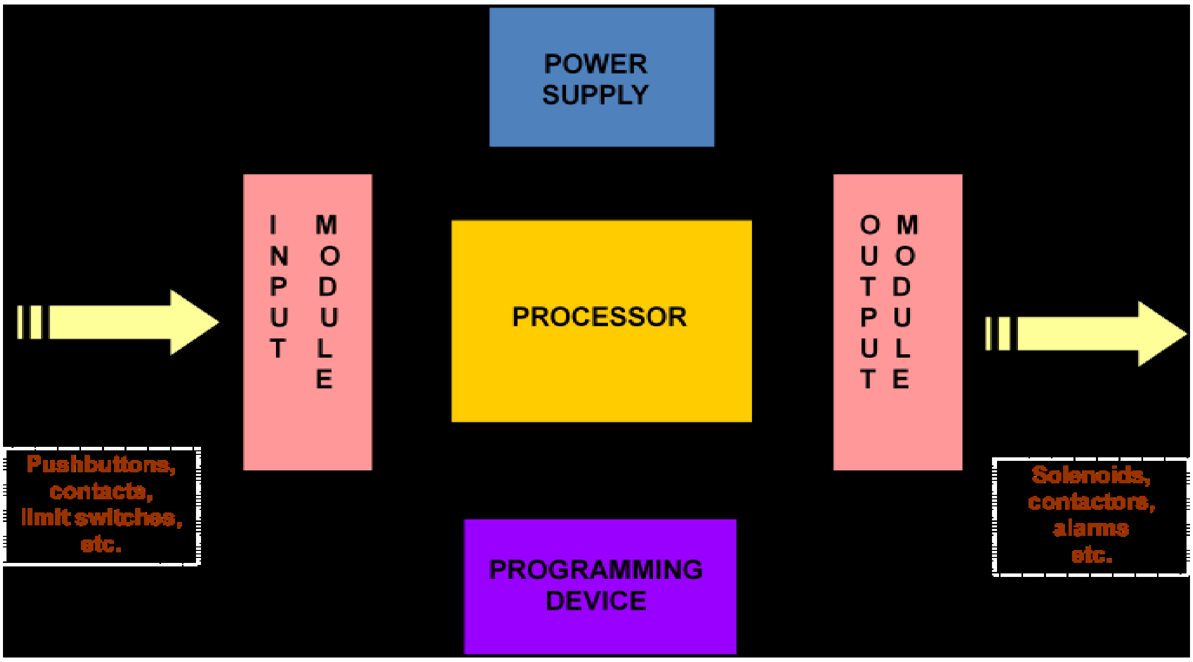

Fig.1: Major Components of a Common PLC

POWER SUPPLY: Provides the voltage needed to run the primary PLC components

I/O MODULES: Provides signal conversion and isolation between the internal logic- level signals inside the PLC and the field's high level signal.

PROCESSOR: Provides intelligence to command and govern the activities of the entire PLC systems.

PROGRAMMING DEVICE: Used to enter the desired program that will determine the sequence of operation and control of process equipment or driven machine.

Advantages of PLCs :

1. Less wiring
2. Wiring between devices and relay contacts are done in the PLC program.
3. Easier and faster to make changes.
4. Trouble shooting aids make programming easier and reduce downtime.
5. Reliable components make these likely to operate for years before failure.

METHODOLOGY OF THE PROPOSED WORK:

The methodology which has been proposed for the solution of the problems identified in the project is as shown in the Figure 2.

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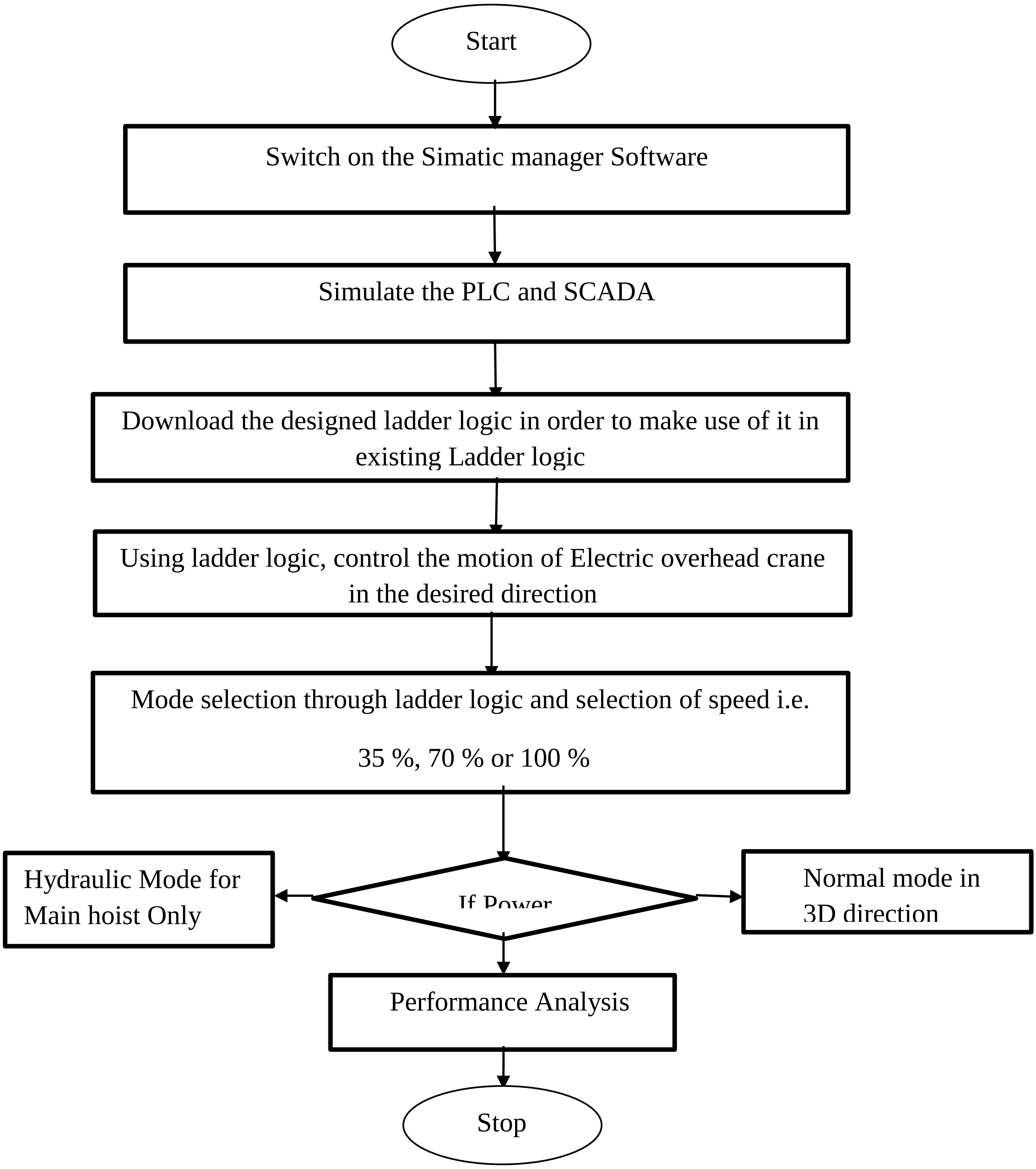

Fig.2: Methodology of the proposed work

To perform the experiment, we will need the Simatic software to simulate for the same.

Methodology in Detail:

Step 1:- Switch on the Simatic manager Software

- Siemens Automation is a company to run PLC (Programmable Logic Controller). This software is used with the help of ladder logic, statement logic etc.
- The Ladder logic is chosen and with the help of the software, methodology is performed.
- It Consists of a switch 'ON' and 'OFF' and it is used to regulate the programmable approach.

Step 2:- Simulate the PLC (Programmable Logic Controller) and SCADA **(**Supervisory Control and Data Acquisition).

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- Programmable Logic Controller (PLC) is used to control machine and processes. PLCs can be used with a wide range of control systems, which vary broadly in their nature and complexity.
- The most difficult system for monitoring and control of industrial processes which is widely used nowadays is Supervisory Control and Data Acquisition (SCADA) system. This system needs use of communication protocols between the client on one side and PLC and other part of control system on the other side.
- The Crane normally used to run 24 hours without stoppage, which results in frequent electric failure. It was a major issue regarding the operation of crane.
- Using variable frequency drive (VFD) simulation fed in Ladder logic programming, the crane has been designed to run at a variable speed and variable voltage to avoid the above software.
- Designing of E.O.T Crane model by using Siemens make WINCC SCADA software and communicating it with SIEMENS PLC and communicating with programmes is the main operation.
- This VFD was successful to overcome this problem and hence PLC and SCADA has been designed to control the motion of the electric overhead crane.
- PLC is a Digital Electronic Device that uses a Programmable memory to store instruction and to implement function such as Timing, Counting, Logic, Sequencing and Arithmetic in order to control the machines and their processes. Input Devices such as switches, different types of sensors are used to control the input switching and output devices such as motors solenoids are used to control the output circuitry. Input devices e.g. switches, and output e.g Motors.
- **Ladder Language:**

LADDER LOGIC:

• The Ladder logic is widely used in programming PLC where sequential control of a process or manufacturing operation is required. It is a graphic Language and can be used to transcribe relay diagrams, and is suited to combinational processing. It provides basic graphic symbols, contacts, coils, and blocks. Specific calculations can be executed within the operation blocks. Any control task modifications are done by changing the program.

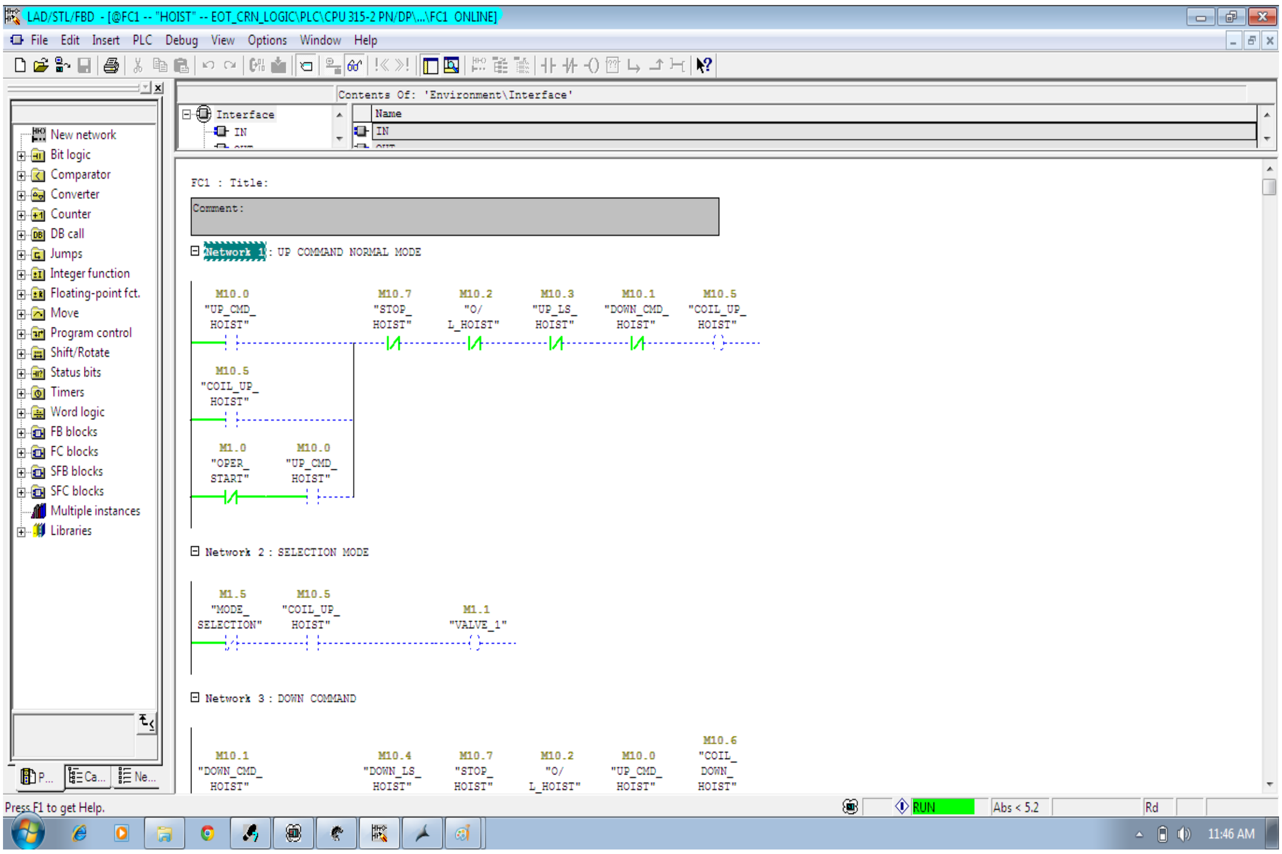

Fig.3: LADDER LOGIC FOR MAIN HOIST

International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)
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In the above logic diagram, the ladder logic for motion of electric hoist for up motion is described. In the same manner ladder logic for main hoist, cross travel is described for both variable frequency drive simulation and contactor logic is Described.

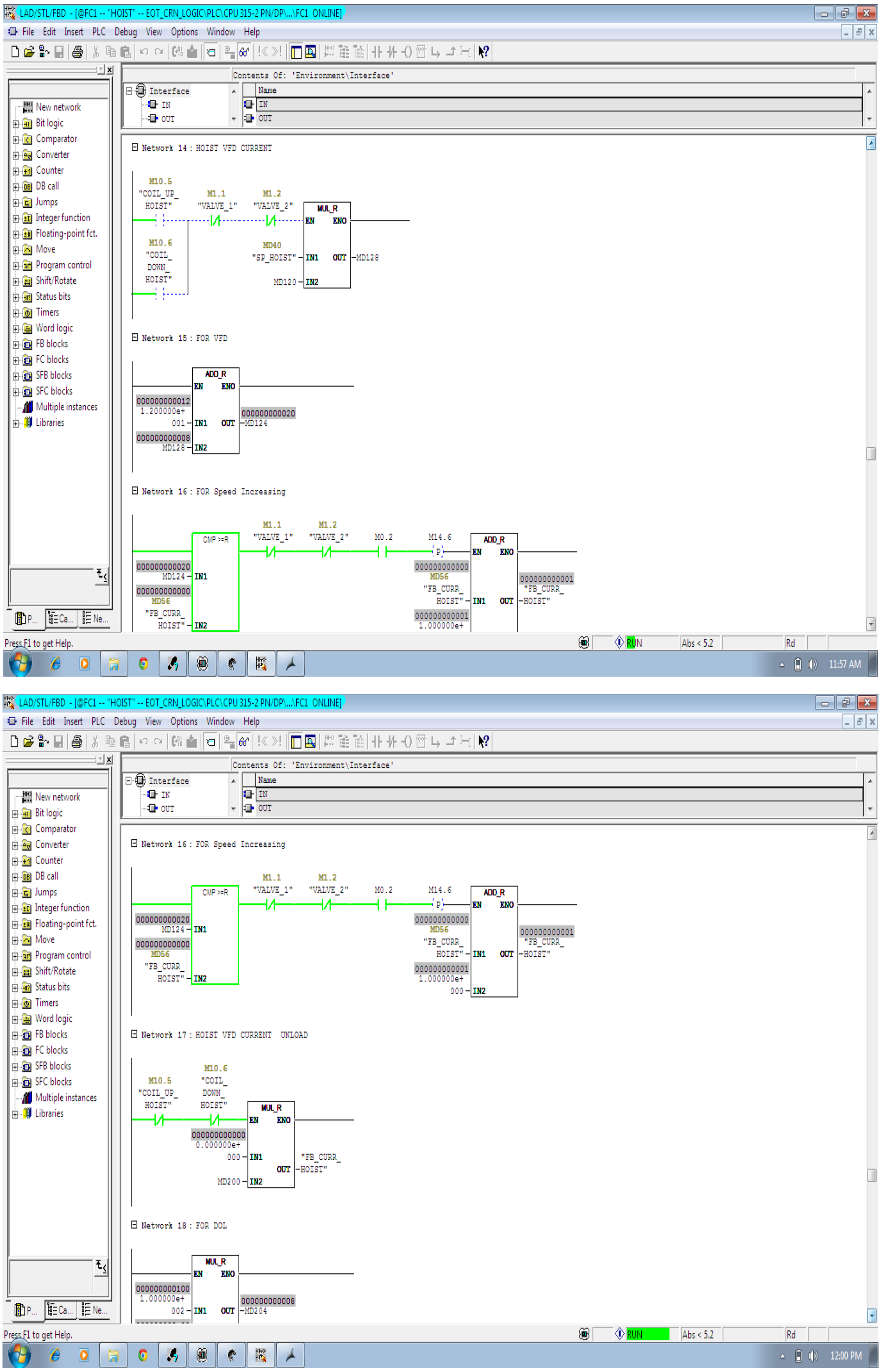

Fig.4: FOR MAIN HOIST VFD

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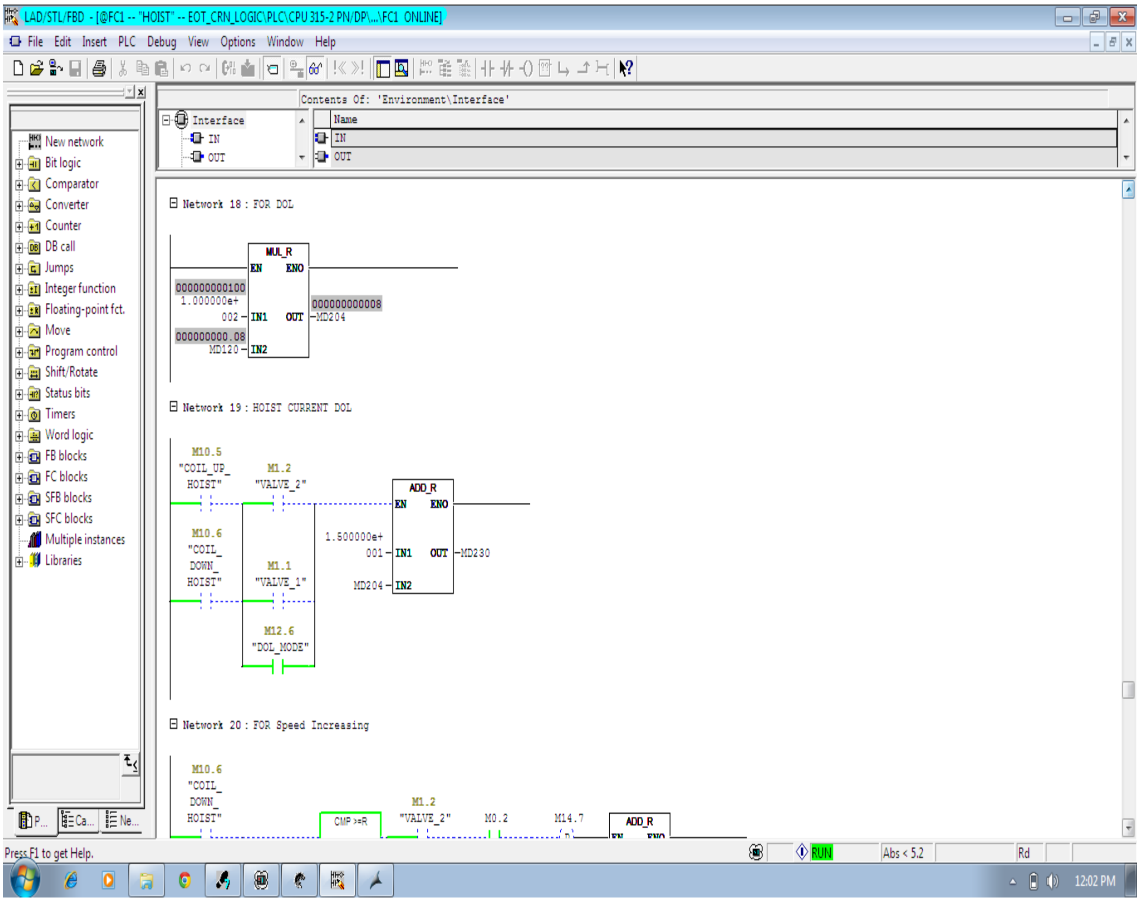

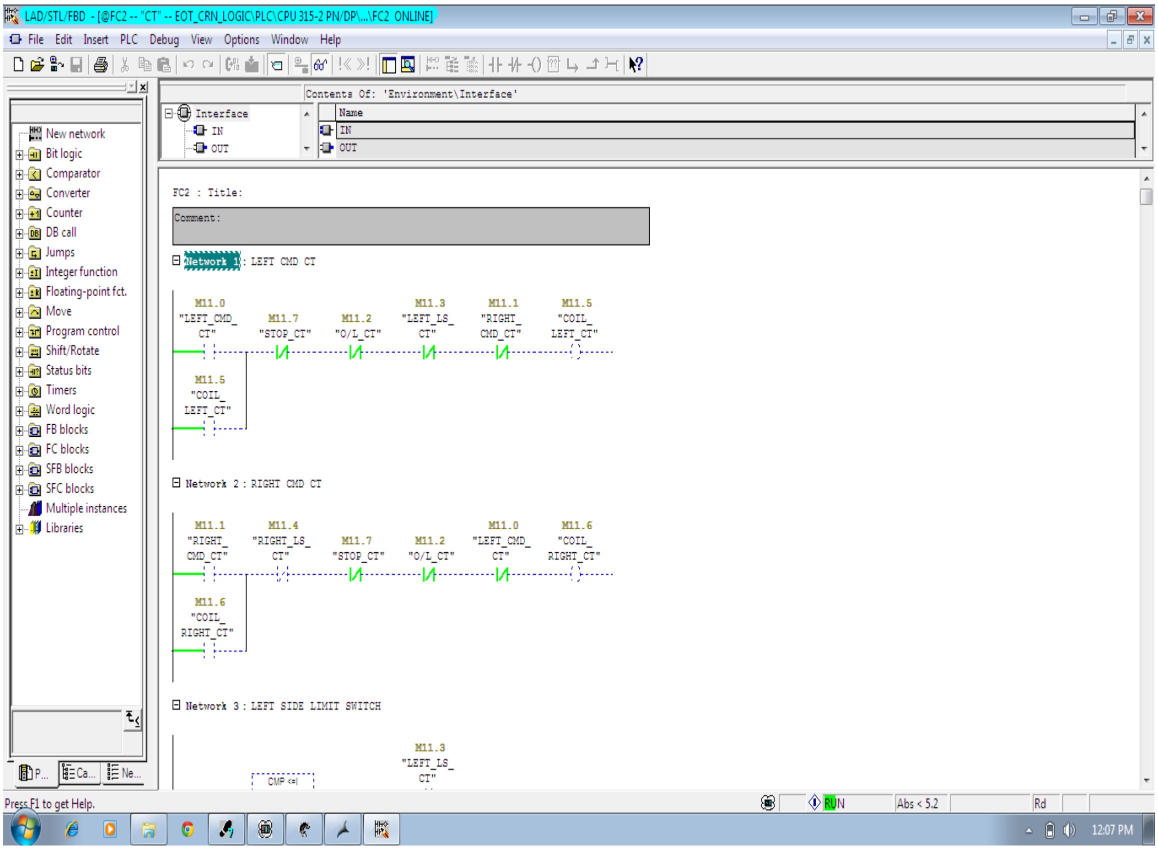

Fig.5: LADDER LOGIC FOR CROSS TRAVEL MOTION

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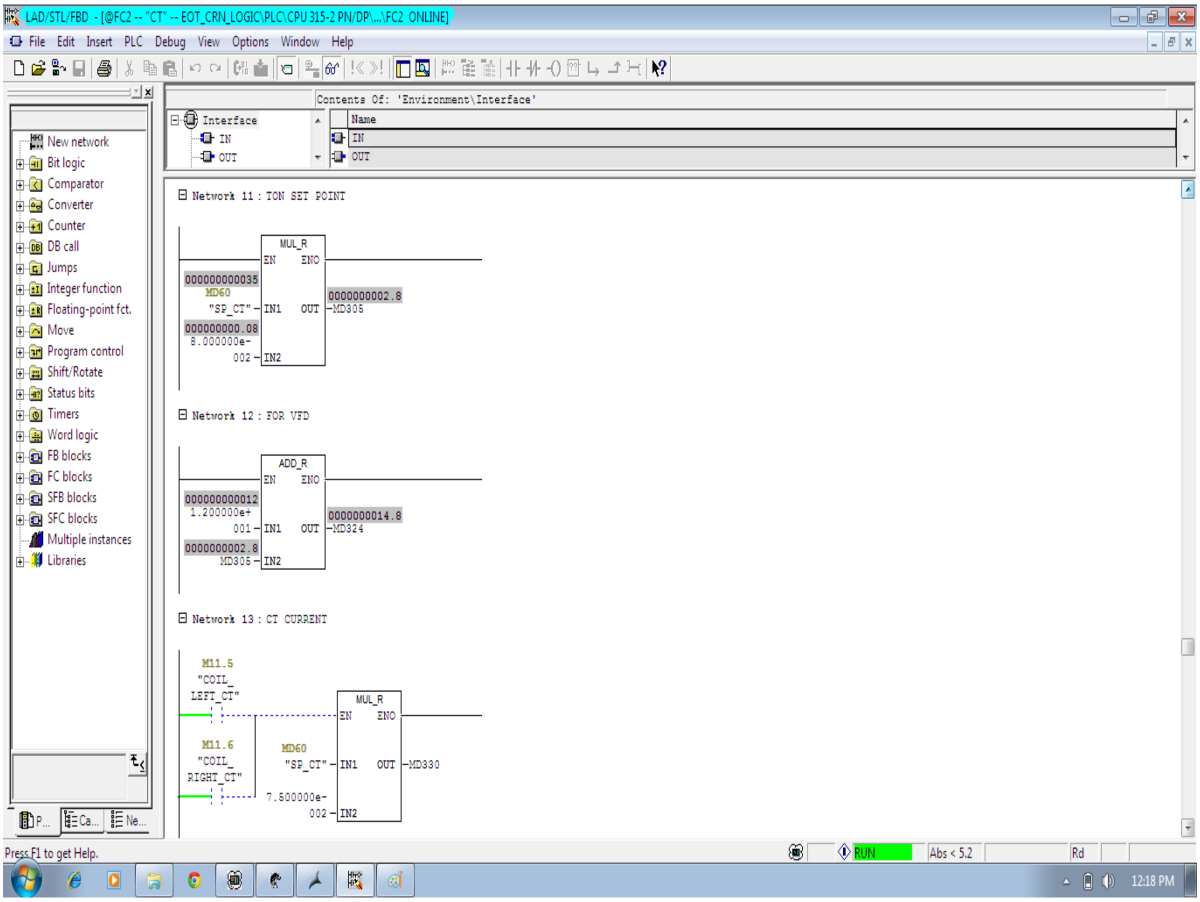
Vol. 3, Issue 2, pp: (1-10), Month: April 2016 - June 2016, Available at: www.paperpublications.org



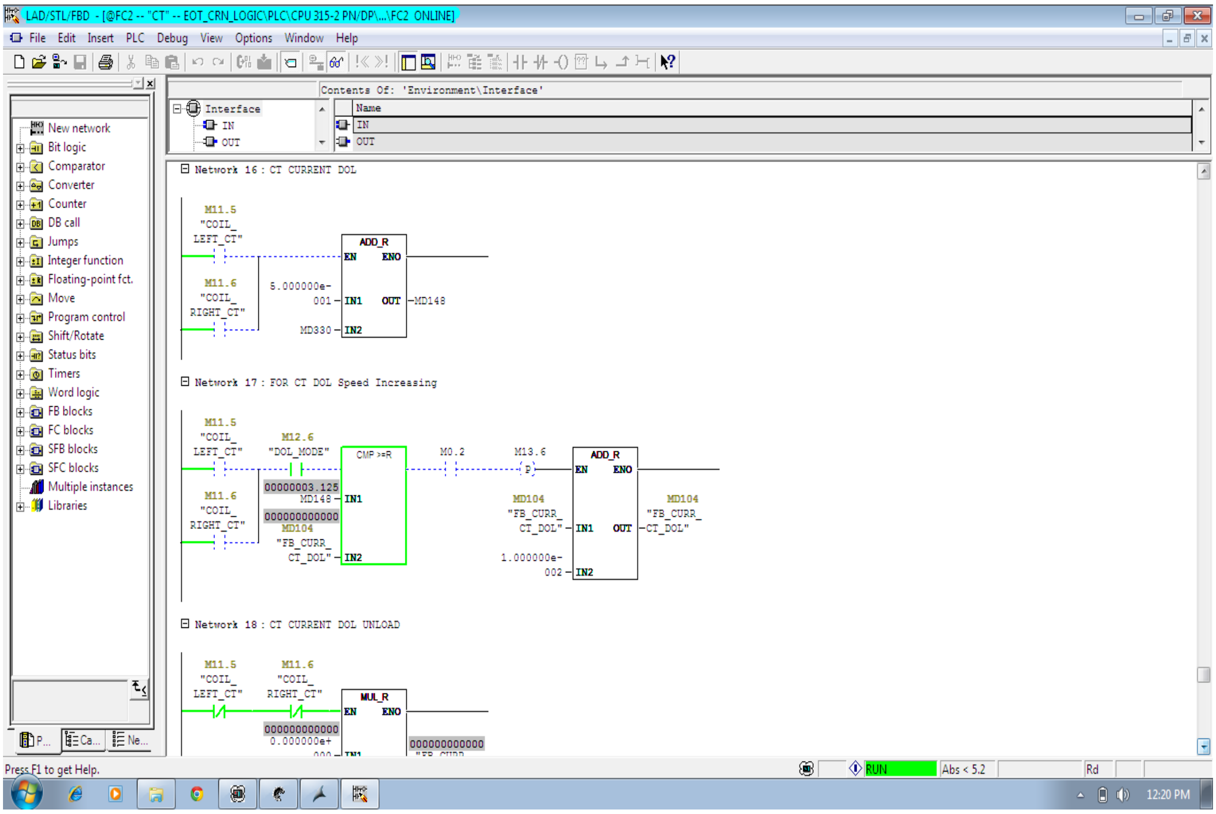


Fig.6: LADDER LOGIC FOR CROSS TRAVEL USING VFD LOGIC FOR CROSS TRAVEL BY USING CONTACTOR LOGIC

ISSN 2350-1049

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Specification Of 5 Ton Electric Overhead Travelling Crane:

List OF Equipment	Specification
Main hoist	35 h.p,1480 r.p.m,, Squirrel cage Induction motor
Cross Travel	5 H.P, 1480 r.p.m, ,, Squirrel cage Induction motor
LONG Travel	15 h.p, 1480 r.p.m,, Squirrel cage Induction motor
Hydraulic Motor	35 h.p, 1480 r.pm, Hydraulic Motor

3. RESULTS AND DISCUSSIONS

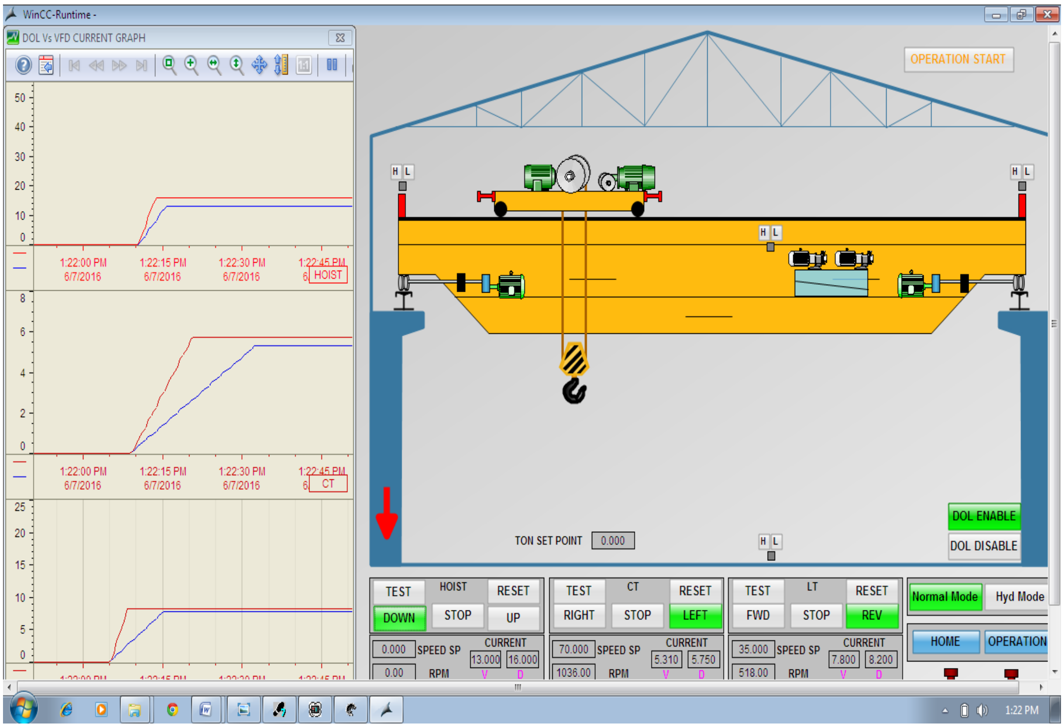

FIG.7: COMPARISION OF VFD SIMULATION AND CONTACTOR LOGIC SIMULATION AT NO LOAD

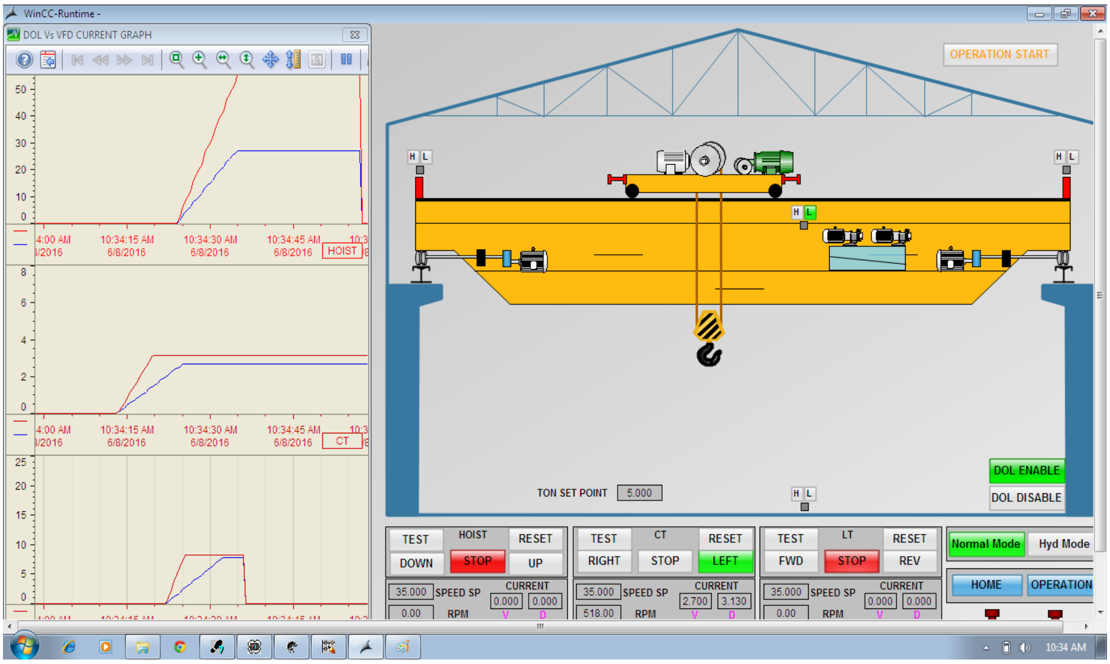

Fig.8: COMPARISION OF VFD SIMULATION AND CONTACTOR LOGIC SIMULATION AT 5TON LOAD

Based upon the steps discussed in the Methodology, the graphical user interface is designed in Simatic Software with the help of WinCC, which makes the task easier. It has been cleared from SCADA picture that starting as well as running performance of electric overhead travelling crane is improved and variable frequency drive simulation shows better performance when compared with contactor logic and these will help us in reducing electrical failures and helps us in improving the performance of electric overhead travelling crane.

4. CONCLUSION

PLC and SCADA today are advancing in terms of applicability and capability. The System works during normal operation and greatly improved the automation processes with the use of the PLC ladder diagram. The ladder logic for contactor logic and variable frequency simulation has been designed and comparison shows that variable frequency drives based simulation shows better performance in starting as well running current for motions in desired directions at different values of speed and troubleshooting and monitoring is easy.

5. FUTURE ENHANCEMENT

The system performance can be improved with simulation of electric overhead travelling crane of higher capacity rating and these system can be implemented in any existing contactor logic system. In the further research, detailed ladder logic has been explained for electric overhead crane.

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