

“INTEGRATION OF LABVIEW AND MAT LAB FOR TESTING SYSTEM OF CONTROL PANEL OF SWITCHGEAR”

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ABSTRACT

This paper describes the integration of MATLAB and LabVIEW for the implementation of testing system for control panel of medium voltage switchgear. This system tests two types of sockets of control panel i.e. nonstandard socket and standard socket. The standard socket is the one who has universal wiring diagram (64 pins socket) and nonstandard socket (generally 8, 16, 24 or even 32 pins socket) is the one who's wiring diagram changes from panel to panel. For testing of nonstandard type of socket system needs its wiring diagram, which is to be decoded by Image processing algorithm implemented in MATLAB. The LabVIEW is central controlling element and it is also used to test nonstandard socket along with DAQ hardware. The system checks 'Normally closed' and 'Normally open' status of pin pairs of control panel mentioned in the wiring diagram in case of non standard socket while in case of standard socket there is no such need of scanning the wiring diagram as it has universal wiring diagram, so those pin pairs are already mentioned in LabVIEW those need to be checked. Also use of other made hardware than national instruments with LabVIEW is described in nonstandard type socket testing.

KEYWORDS

Socket checking, NO NC status, control panel, MATLAB, LabVIEW

1. INTRODUCTION

A substation is a part of an electrical generation, transmission, and distribution system. Each and every electrical sub-station has got switchgear. One of the basic functions of switchgear is protection. The controlling system of this switchgear is nothing but control panel. Control panel (control cabinet) is actually low voltage system and takes different supply voltages from another feeder or Battery.

Testing of this control cabinet is the one of the important task in the manufacturing of any switchgear system. Testing of this control panel includes checking of potential free contacts as per

wiring diagram, which checks manufacturing defects at early stages and assures us proper functioning of the

system. For manual testing, proper observation of wiring diagram is to be done. The wiring diagram includes pin numbers contact status whether it is 'Normally open' or 'Normally closed' of potential free contacts, along with it has other components. Then continuity test is performed to check its status.

The manual checking of this control box increases human efforts and takes longer time to connect continuity tester to pair of pins. Human also takes time to decode the wiring diagram. This ultimately increases delivery time and also reduces overall efficiency of the manufacturing plant. Additionally it is not feasible to employ people to act as full time checker for the electrical system.

Thus we need time efficient, more accurate automatic testing system for control panel. The solution has use of two software's LabVIEW and MATLAB. Here the central controlling element is LabVIEW because it has very good user interface (good graphical display) and it can also able to call MATLAB active server by MATLAB script which is necessary to scan wiring diagram in case of nonstandard socket testing. MATLAB is used because it provides good technical language for scanning digital images.

The system mainly divided into two parts first part is testing of nonstandard socket which includes use of both software's i.e. LabVIEW and MATLAB along with hardware like PIC and LCD. Starting point is LabVIEW's front panel now depending upon the input got from the user for type of socket, LabVIEW does the further process. The non standard socket varies in number of terms like its pin number, its component placement, control voltage and coil voltages. Pin number can be 8, 16, 24 or even 32. This variation in the control panel generates the need of decoding of the wiring diagram, which is to be done by the use of image processing tool box of MATLAB. So LabVIEW calls MATLAB active server for scanning the mentioned wiring diagram. The path of the input image file is also given to

MATLAB active server by LabVIEW which is obtained from user.

Now MATLAB detects the various pin numbers as well as it also detects the various components connected between this pin pairs by their equivalent symbols from the wiring diagram. Later necessary information like pin numbers is transferred to PIC via serial communication by MATLAB. The PIC then checks actual status of control panel depending upon data received from MATLAB and displays the output on LCD display, this observation obtained from MATLAB again displayed on LabVIEW's front panel. The nonstandard socket testing describes the novel method that is use of other made hardware than national instruments with LabVIEW with the help of MATLAB scripts in this work. The use of PIC is done only to show that others made hardware can be used with LabVIEW. [1]

The second part is testing of standard socket. The standard socket is 64 pins socket. This standard socket has universal wiring diagram irrespective of its manufacturer. Even the control voltage and voltages for other components remains same. Testing is done by LabVIEW and DAQ hardware. The 5 V DC signal is written on the group of the channels, this channels are connected to pin's of standard socket, then signals are obtained from other predefined channels. In case of normally closed contact testing, if there is well connected normally

closed contact, system will get 5 V DC signal and in faulty case no such signal will be available. Exactly opposite will be the case for normally open contact testing.

Figure 1 shows wiring diagram, this wiring diagram shows motor connected between pin numbers 3 - 9. Tripping coil is connected between pin numbers 5 and 16, while Tripping coil is connected between pin numbers 7 and 13. It also has different contacts like pin numbers 4-15 and 6 -11 have normally closed contact, while 9-12, 2-14 and 1-10 has normally open contacts. It also shows that contacts between pin pairs 4-15, 9-12,6-11 and 1-10 depends upon switch S1. While contact between pin pair 2-14 depend upon switch S2. This all information is extracted from wiring diagram by MATLAB, further this results are shown on LabVIEW's front panel.

The second section algorithm gives system's detailed algorithm (fig 2), it also explains image processing algorithm implemented in MATLAB. The third section implementation shows block diagram of the system, it also gives reasons for use of two software's i.e. MATLAB and LabVIEW. The forth section shows some results obtained in MATLAB, it also gives a snap for system's user panel i.e. front panel of LabVIEW.

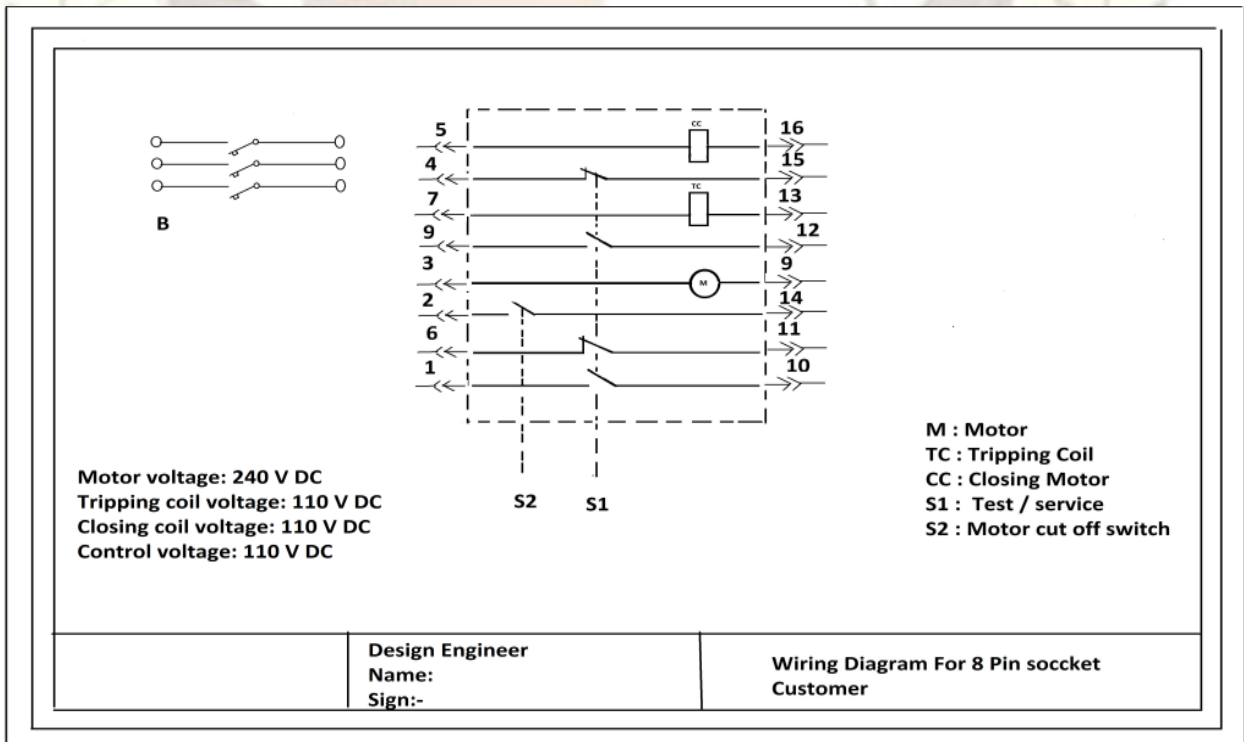


Fig 1: Wiring diagram of 16 pins nonstandard socket

2. ALGORITHM

The following diagram shows testing algorithm in detailed, which is self explanatory. The algorithm shows

mix use of both the software's i.e. MATLAB and LabVIEW.



Fig 2: System algorithm

MATLAB Processing

The system processing on wiring diagram is explained shortly, which done by MATLAB is explained here.

Image conversion

The first step is transfer of image to MATLAB root directory. If image is RGB image it is converted first to gray scale image, which is further converted to binary image based on threshold calculated from gray scale image. [1]

Crop image

The wiring diagram which is in jpeg (RGB) format contains fixed outer box which contains customer name, designer name and other design number which is to be separated from main image. [1][5][7]

Segmentation

The binary image is now segmented into different regions. This segmentation is done on the basis of histogram calculated. [1][5][8]

Character localization

Characters and number are then separated from

segmented regions which are then transferred to OCR (optical character recognition) one by one. [1][5][8]

Optical character recognition (OCR)

Here OCR by template matching using correlation is used. [1]

Symbol Detection

The symbol detection is important step in this, it detects pin pair in which special components like motor, tripping and closing coil are connected. [1]

Serial Communication

The serial communication is used to pass string containing pin numbers and their status to the PIC by MATLAB. [1]

Checking by PIC

The PIC then reads all characters from the EPROM memory. Later PIC does continuity test. This results i.e. 'NO' and 'NC' is displayed on LCD. These results are also transferred to MATLAB by same serial communication.[1]

3. IMPLEMENTATION

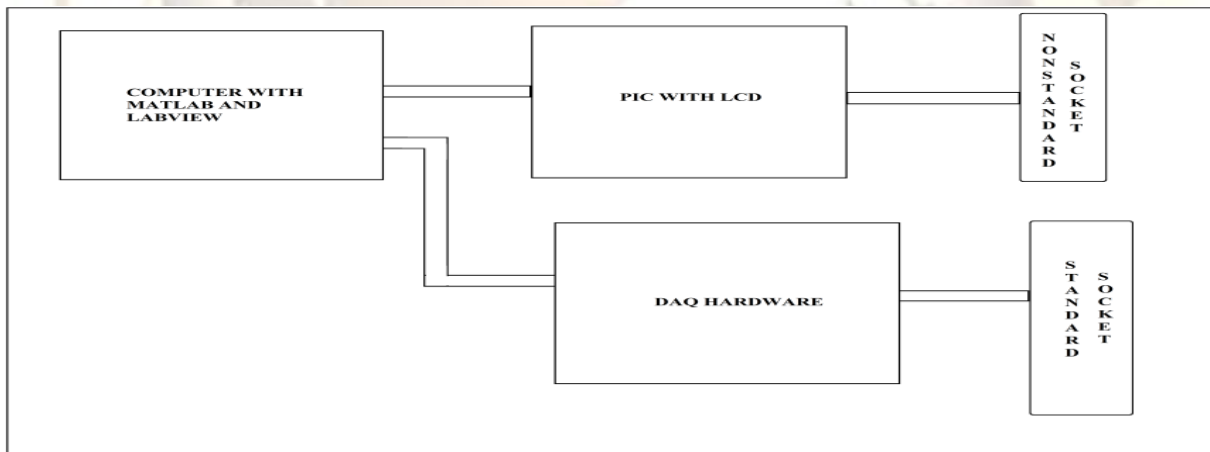


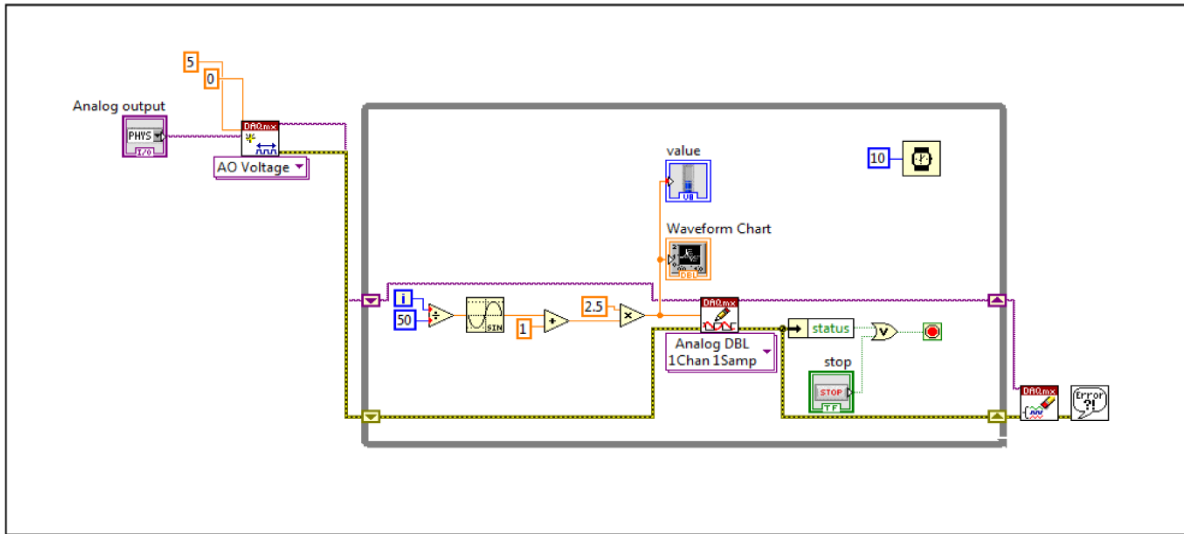
Fig 3: Implementation

Block Diagram –

The fig 3 shows block diagram of the Testing system for control panel (TSCP), it has a personal computer with Two software's installed i.e. LabVIEW and MATLAB. The hardware is PIC along with LCD for testing of non standard socket. The others blocks shown in the second row are for standard socket testing hardware.

Use of LabVIEW, MATLAB -

LabVIEW software is used in this project because it has very good user interface (good graphical display) and it can also able to call MATLAB software by MATLAB script which is necessary to scan wiring diagram in case of nonstandard socket testing. MATLAB is used because it provides good technical language for scanning digital images.

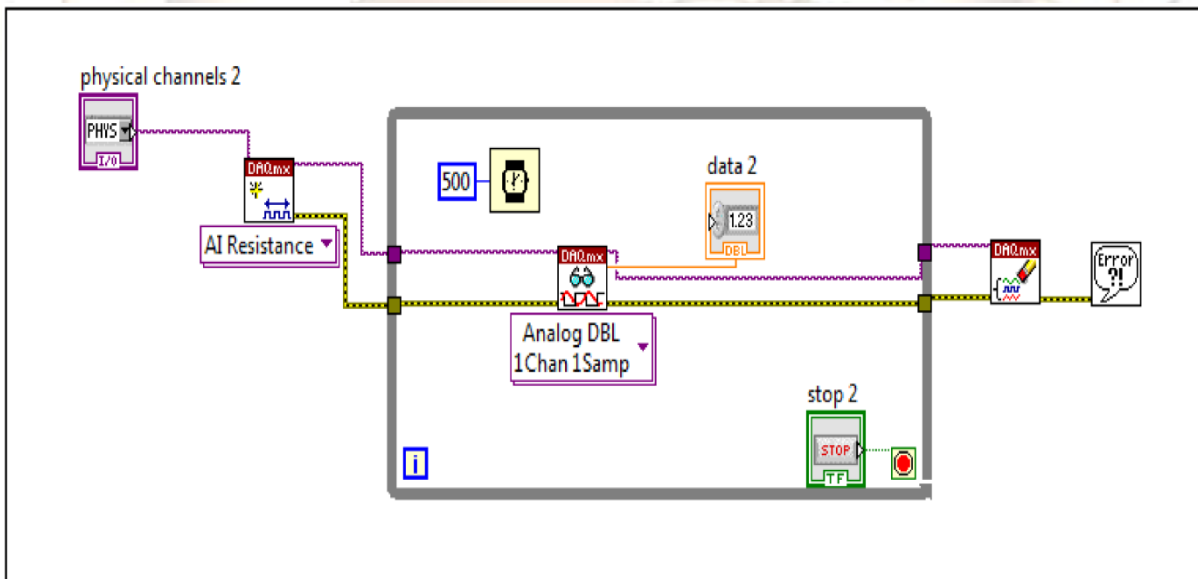


4. A. To write physical channels

Fig 4: Block diagram's in labVIEW

The fig 4.A shows the block diagram of LabVIEW implemented to write analog voltage on peculiar channels to test standard socket, those analog voltages are used to test motor, tripping and closing coil. The same block diagram is used for contact

testing with some smaller modification like change of physical channel, and in this case system are writing digital signal on those physical channels.



4. B. To read physical channels

Fig 4: Block diagram's in labVIEW

The fig 4.B shows the block diagram of LabVIEW implemented to read analog voltage on peculiar channels, this analog voltages are used to test motor, tripping and closing coil performance, and this signals are coming from the channels which are

write in first part. The same block diagram is used for contact testing with some smaller modification like change of physical channel, and in this case system are reading digital signal on those physical channel.

5. RESULTS

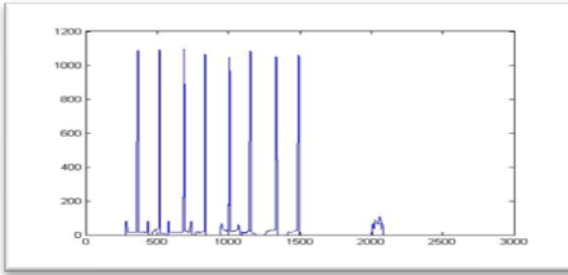


Fig 5.A Horizontal histogram

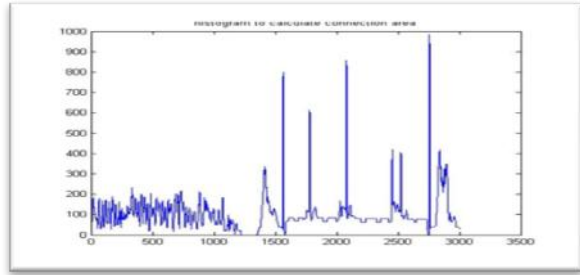


Fig 5.B Vertical histogram

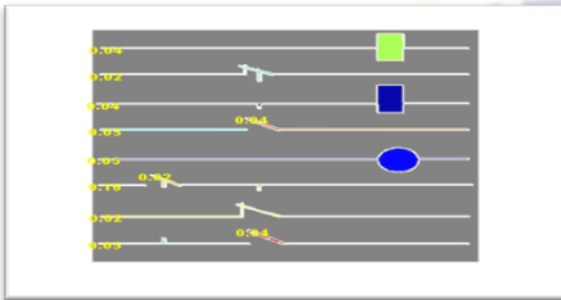


Fig 5. C Contacts



Fig 5. D Segmented contacts

TESTING SYSTEM FOR CONTROL PANEL OF SWITCHGEAR

Non Standard Socket Testing | Standard Socket Testing

Select Wiring Diagram Here

D:\desktop2 2012\matlab\Project1\image1.jpg

NON STANDARD

Selection of socket

Non Standard Socket Testing

Display for Non Standard socket testing | Display for Standard socket testing

Pin Numbers	Contacts	S1 Contacts	S2 Contacts
05X16	Coil	Does not depends on S1	Does not depends on S2
04X15	Normally Closed (NC)	Depends on S1	Does not depends on S2
07X13	Coil	Does not depends on S1	Does not depends on S2
09X12	Normally Open (NO)	Depends on S1	Does not depends on S2
03X09	Motor	Does not depends on S1	Does not depends on S2
02X14	Normally Open (NO)	Does not depends on S1	Depends on S2
06X11	Normally Closed (NC)	Depends on S1	Does not depends on S2
01X10	Normally Open (NO)	Depends on S1	Does not depends on S2

Display for Non Standard socket testing

Fig 5.E Labview's front panel

The fig 5.A and 5.B shows histogram, which are calculated by amplitude projection method. This are used to segment the input wiring diagram. Fig 5.C and 5.D shows segmented contacts. Those contacts are taken from the connection area.

Fig 5.E shows results obtained for nonstandard socket, which is nothing but the LabVIEW's front panel, which shows different pin pair combination, component connected to them and S1 S2 contact section shows switch dependent contacts.

5. Conclusions

In this paper, the checking system for control panel using MATLAB and LabVIEW programs is

presented. The MATLAB program uses series of image processing techniques for identifying pin number, NO NC status and other necessary details from the wiring diagram. The controlling of system is done by LabVIEW and its performance is tested on images of wiring diagram consisting of different pin numbers. The results show that both standard and nonstandard sockets and systems can be implemented in the manufacturing plant to automate the tedious work and increase the efficiency of the plant.

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