

Testing system for control panel of switchgear Using MATLAB and PIC

¹Yogesh Gorane, ²Dr. Nisha Sarwade, ³Vishal Vaswani

^{1,2}Department of Electrical Engineering, VJTI, Mumbai, India

³ PPMV – R & S ABB Limited, Nashik, India.

Email:yogesh_gorane@yahoo.co.in¹,nisha.sarwade@vjti.org.in²,vishal.s.vaswani@in.abb.com³

ABSTRACT

This paper describes the implementation of testing system for control panel of medium voltage switchgear using MATLAB and PIC. The system checks 'Normally closed' and 'Normally open' status of pin pairs of control panel mentioned in the wiring diagram. The input to MATLAB is wiring diagram which is in the jpeg format, this jpeg image is used for getting the information, like which pin pairs are 'NO' which are 'NC' and the components connected between those pins. After finding such information from the jpeg image, it is save in text file for further reference. The external hardware is needed for actual connection to socket of control panel and it is also used to sense the status of pins. The necessary information is transferred to external hardware by serial communication which is controlled by MATLAB. This external hardware can be any microcontroller. Here PIC18f877a is used as external hardware. The PIC shows the result on LCD display connected to it. The results are also transferred to MATLAB by PIC so that MATLAB can print tested ok certificate for the control panel.

KEYWORDS

Socket, checking, NO NC status, control panel, MATLAB, PIC microcontroller

1. INTRODUCTION

A substation is a part of an electrical generation, transmission, and distribution system. Each and every electrical sub-station has got switchgear and One of the basic functions of switchgear is protection, which is interruption of short-circuit and overload fault currents while maintaining service to unaffected circuits. Switchgear also provides isolation of circuits from power supplies. The controlling system of switchgear is nothing

but control panel. Thus switchgear and its control panel are very important part of the electricity transfer and distribution system, and the control cabinet is actually low voltage system and takes different supply voltage from another feeder or Battery. This supply voltage is called as auxiliary supply voltages while the connector which gives this supply is called as auxiliary connector. The control panel has mechanism which supports opening of breaker when any faults occurred like short circuit current, overvoltage or overcurrent. It includes different limit switches, different relay coils, tripping coil, closing coil, motor also different contacts which are interrelated to support proper functioning. The internal functions and additional facility (which includes different safety indicator and additional safety mechanism) changes from switchgear to switchgear. So we have control panel whose internal structural component varies along with different pin socket, different supply voltage along with separate wiring diagram.

Testing of the system is the one of the important task in the manufacturing of any electronics and electrical system. Testing checks manufacturing defects at early stages and assures us proper functioning of the system and which also gives more reliable and safe product to end user. The each and every electrical system made by us should be properly check and test before giving to the user. The whole functional test should perform in order to give maximum accuracy, which also assures safety and proper functioning. Manual checking has number of drawbacks like increase in time for delivery of product, decrease in efficiency; also it results in higher cost of the system. At the same time, the manual checking of any electrical system is quite difficult task if checking is to be done number of times, then it also increases the chances of wrong checking, which can be hazardous. Additionally it is not

feasible to employ people to act as full time checker for the electrical system.

At last when person has to check control cabinet, in first step he has to observe wiring diagram, it includes pin number and also has to check contact details like whether it is 'NO' or 'NC'. And then he will perform continuity test to check its NO & NC contacts. Along with this he has to check whether motor is short or not, in the control cabinet. The manual checking of this control box increases human efforts and takes more than enough time to connect continuity tester to pair of pin as shown in the wiring diagram (e.g. fig 1). Human also takes time to decode the wiring diagram. This ultimately increases delivery time and also reduces overall efficiency of the manufacturing plant.

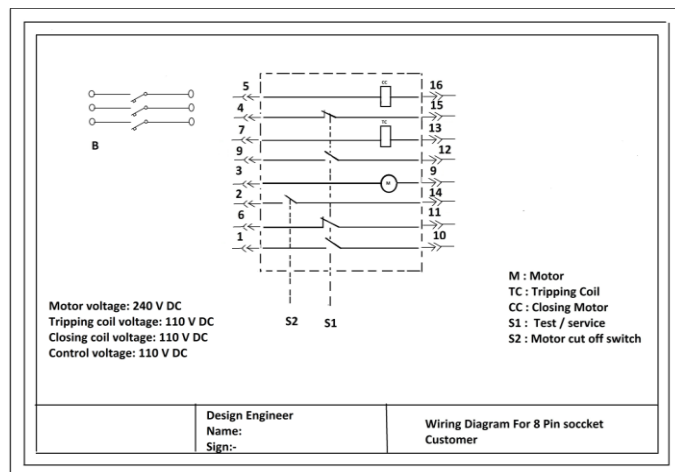


Figure 1: Wiring diagram

2. ALGORITHM

The system algorithm is divided in to nine steps as follows and which is implemented in MATLAB2010a.

2.1. 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. Then image is resize to fixed dimension.

2.2. 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. The rectangular outer image part is extracted in this step, and its dimension find out by image histogram. The higher three lines in histogram gives area of outer box. [4][6]

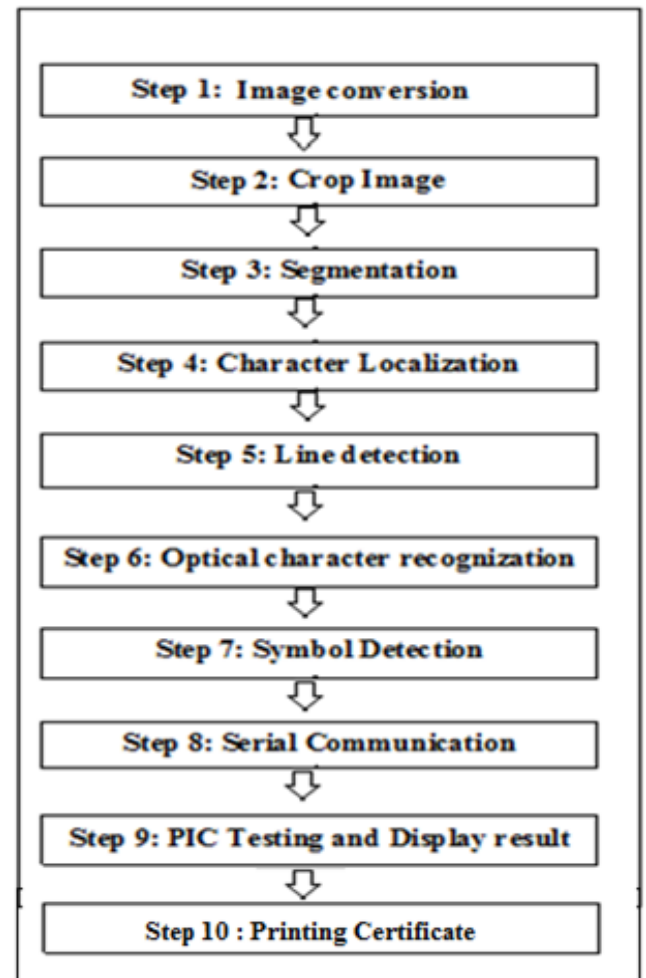


Figure 2 : ACCP Algorithm

2.3. Segmentation

The binary image is now segmented into different regions. This segmentation is done on the basis of histogram calculated; also lines in the image are detected. Both parameter lines and histogram are used for segmentation. The central area which has connection lines and contact representation is separated from image, hence forth it is called as connection area.[4][7]

2.4. Character locatiolization

Characters and number are then separated from segmented regions which are then transferred to

OCR (optical character recognition) one by one.[4][7]

2.5. Line Detection

Lines are detected in the image by hough transform, the longest line is found out by from that group of lines,[4] which are very necessary to detect which switch are responsible for operation of pin pair e.g. Test / service indicator switch and motor cut off switch.

2.6. Optical character recognition (OCR)

There are many methods for character recognition. The most commonly used methods are[1][2]

I) Character recognition by using neural network II) Optical character recognition

The OCR technique is used in order to recognize different digits. This approach is based on pattern recognition principles. The system of OCR engine is based on the template matching algorithm. The shapes identified as possible characters in the previous steps of the process are binaries and scaled to match the size of the templates in database. Each shape is compared with all the characters in the database by template matching and best match among them is selected. The commonly used techniques for the optical character recognition are

- 1) Distance measurement
- 2) Template matching using correlation
- 3) Template using inner product correlation [1][6]

Here OCR by template matching using correlation is used. Figure 2 shows algorithm in detail.

2.7. 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. This are detected from the binary image based on

peculiar properties of their symbols. For motor's symbol roundness of each closed symbol is found out and later it is compared with threshold value given to it. This pin pairs are only checked for short circuit.

2.8. Serial Communication

The serial communication is used to pass string containing pin numbers and their status to the PIC by MATLAB. The pause of 2 seconds is inserted between two ascii characters transferred by MATLAB so that PIC can easily store that file into its EPROM. The string has two pin number first one is left side input pin number and second one is right side output pin of the connection area. This two values are separated by ';'.

2.9. Checking by PIC

The PIC then reads all characters from the EPROM memory. The two bytes of the string are considered input pins and on that pin write operation is performed by PIC, at the same time read operation is performed on pin number specified by third and fourth byte, if it is read '1' it means both pins are short and opposite to it, if it reads '0' it means both pins are open. This results i.e. 'NO' and 'NC' is displayed on LCD. These results are also transferred to MATLAB by same serial communication.

2.9. Printing of Tested/OK certificate

Finally information from scanned image is compared with information obtained from PIC, (i.e. whether actual pin pair is showing desired contact status or not is checked by MATLAB) if both are same Tested/ OK certificate is printed by MATLAB.

3. IMPLEMENTATION

I.

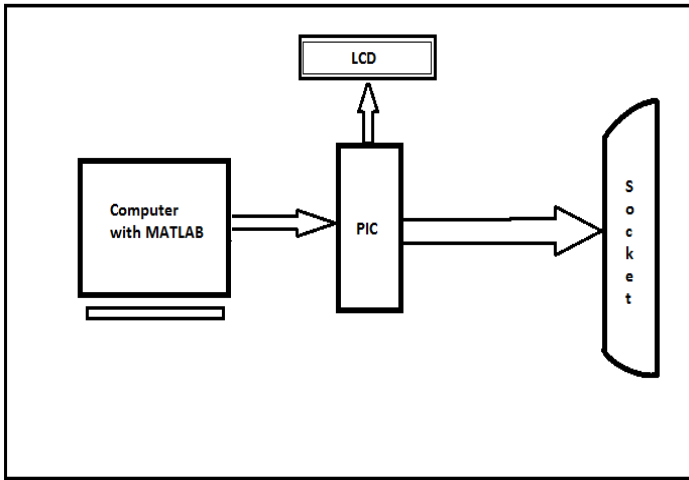


Figure 3:

Implementation

The CSCP contains computer containing MATLAB, the PIC 16F877a, LCD, female socket. The computer is connected to the PIC by RS 232 cable for their serial communication. The PIC is also connected to the LCD. The pins from socket are connected to PIC via male female socket pair. The PIC write on output pin specified by MATLAB, at the same time it reads the input pin which also specified by MATLAB. The socket block actually has connection for four different socket, as shown in fig 4.

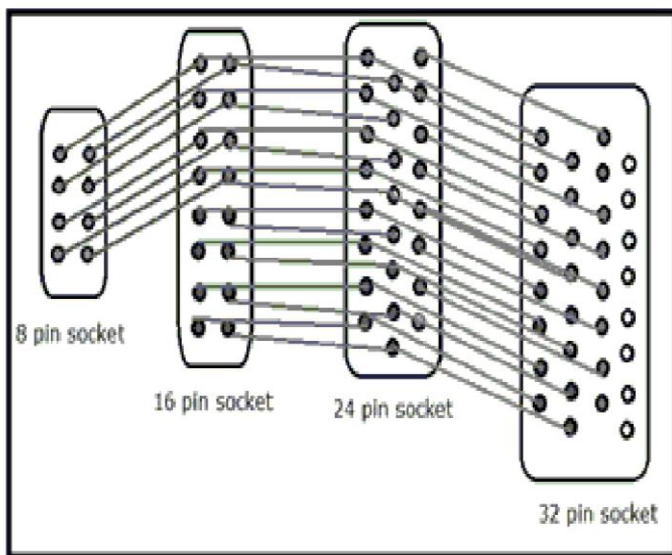


Figure 4: Socket Connection

This connection is important because we are not having only one type of socket to check instead we have 4 different non-standard sockets and one 64 pin socket which is the only one standard

socket. Presence of different sockets give rise to such connection, the first 8 pins of 16 pin socket are shorted to 8 pins of 8 pins socket, similarly first 16 pins of 24 pin socket is shorted to all 16 pins of 16 pin socket with respective numbers only, similar case is applicable to 32 pin socket and 24 pin socket connection. Also we can see that 8 pins of 32 pin socket remains electrically isolated to other socket pins because we don't have concern number in the previous sockets.

4. RESULTS

The figure 5 shows image histogram calculated from binary image. The two higher lines are shows the middle connection area.

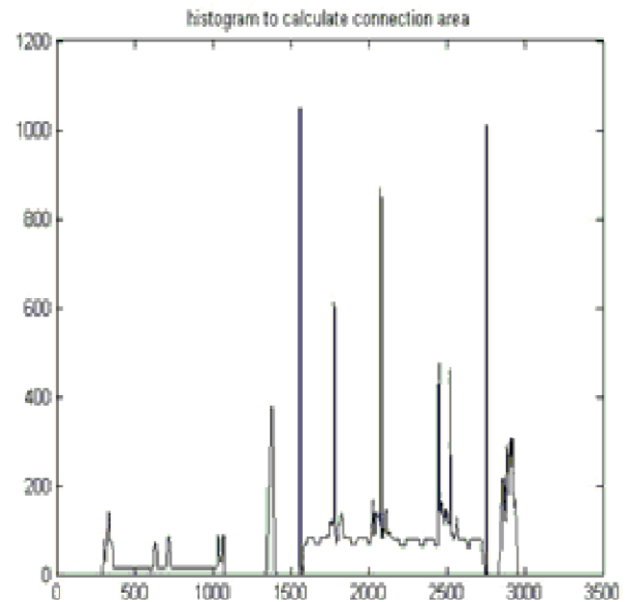


Figure 5: Image histogram

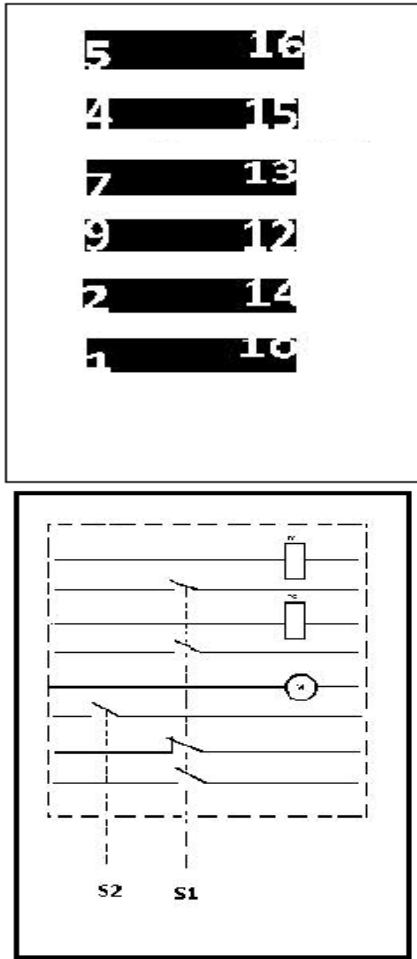


Figure 6: Segmentation of image

Figure 6 shows the parts of image after its segmentation

Left image shows output from character localization while right image shows segmented connection area.

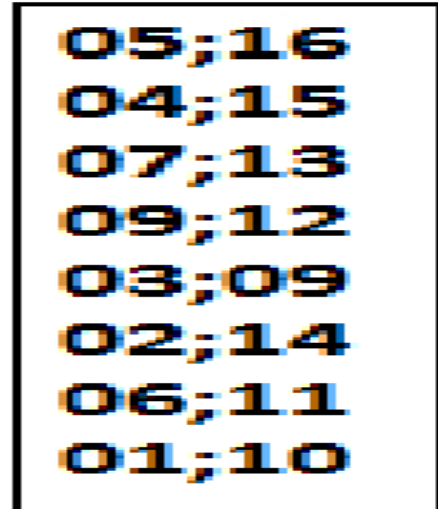
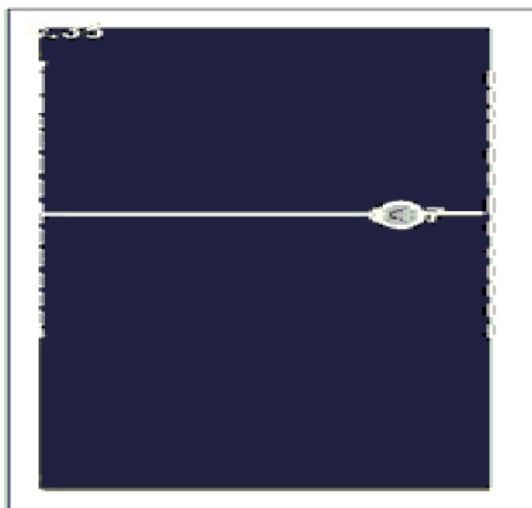


Figure 7. Motor Detection

Figure 8. Data to PIC

Figure 7 shows output after symbol detection step. Figure 8 Shows the character which transferred to PIC by serial communication.



Figure 9 Motor Detection

Figure 9 shows the motor detected segment which is based on its roundness.

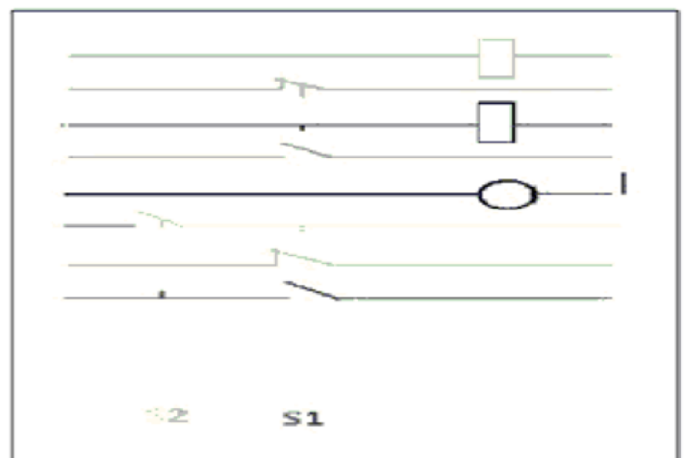


Figure 10 Labelled Connected components

Figure 10 shows labeled connected components which are used to sense NO and NC status as well as which switch operates which pin pair.

5. Conclusions

In this paper, the checking system for control panel using MATLAB program and PIC18f877a 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 system is implemented in MATLAB and its performance is tested on images of wiring diagram consisting of different pin numbers. The results show that the system robustly detects and recognizes the pin contacts using license plate against different and can be implemented in the manufacturing plant and automate the tedious work to increase efficiency of plant.

REFERENCES

- [1] Character Recognition Systems, A Guide for Students and Practitioners, John Wiley & Sons Inc., Hoboken, New Jersey, 2007
- [2] A simplified OCR system Hardware Implementation in FPGA, McGill University, 2008
- [3] A Standalone OCR System for Mobile Camera phones - Mikael Laine, Olli S. Nevalainen, Department of Information Technology, University of Turku and Turku Centre for Computer Science, 2006
- [4] V. Kasmat, and S. Ganesan, "An efficient implementation of the Hough transform for detecting vehicle license plates using DSP's," IEEE International Conference on Real-Time Technology and Application Symposium, Chicago, USA, pp. 58-59, 2005.
- [5] Muhammad Tahir Qadri, Muhammad Asif "Automatic number plate recognition system for vehicle identification using optical character recognition", international Conference on Education Technology and Computer, pp. 335-338, 2009.
- [6] Y. Zheng, H. Li, D. Doermann, "Machine printed text and handwriting identification in noisy document Images," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 26(3), 2004, pp. 337-353.
- [7] R. Kandan, Nirup Kumar Reddy, K. R. Arvind, and A. G. Ramakrishnan, "A robust two level classification algorithm for text localization in documents," Proc. 3rd International Conference on Advances in Visual Computing (ISVC'07), Vol. 2. Springer-Verlag, Berlin, Heidelberg, 2007, pp. 96-105.