A Review: Identification of Annotations for Circuit Symbols in Electrical Circuit Images

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Abstract: Though electrical circuit annotations are integral part of Electrical circuit symbol, special attention is yet to be given on their interpretation, identification and storage. This paper presents a proposed method for segmentation and identification of annotations associated with electrical symbols in a circuit diagram images. Our proposed method will first separates the text region around an electrical/ electronic circuit diagram, then identifies the annotation of electrical circuit part of the segmented text corresponding to that particular annotated electrical symbol. In symbol identification morphological operations can be used. At the end an efficient OCR will be used to get the numerical values of the symbols along with their units with comparing it with stored database in MATLAB environment.

Keywords: Symbol recognition, electrical symbols, morphological operation, text annotation, OCR.

I. INTRODUCTION

In electrical/ electronic engineering use different standard symbols in their drawings to convey useful information. Systems that can convert this electrical circuit drawings into vector form are in high demand today. This vectored representation of electrical symbol has many advantages like reduced storage space and ease of maintenance of heavy electrical circuit, and this information can be very useful in simulation systems. Such a representation can readily be used for editing or browsing information from database or indexing, and filing of standard images given in [5], [6], [7]. Exclusive systems have been designed, therefore, over the last few years, for example image and diagram extraction given in [3], [4], logo detection etc. An overview of these, along with their performance evaluation, may be seen in [6].

The electrical circuit symbol have different orientation in the specified drawing, the symbols present in an electrical drawing are usually oriented horizontally or vertically, and associated with some text annotations that mainly represent the values of the electrical components along with their electrical units. The segmented annotations of component that are associated with an active component (diode, transistor, etc.) in an electronic diagram represent the type of the component.

Text annotations make an integral part of an electrical engineering drawing and have immense importance in attaining its completeness. Out of all existing approaches, however, quite a few have focused on recognition of electrical circuit symbols in an electrical drawing present in the input image of a digitized document after separating out the text from the graphics. The earlier approaches in consider only logical electronics circuit diagrams (e.g.; Gates: OR, AND, and inverter) as input to the system; other electrical symbols are not taken into consideration in the circuit diagram drawings in earlier approach, since this symbol identification is pretty difficult as compared to this logical components. And this logical symbol can be identified only by design and no values are specified as annotation text available on the electronic circuit drawing image.

II. PROPOSED METHODOLOGY

The proposed method first segments the text annotated region present around each electrical/ electronic symbol. Next, the segmented text annotated regions are process edusingmorpho logical operations to identify associated with that electrical circuit. After necessary pre-processing, a classifier system which is tree based OCR will be used to get the numerical values of the symbols and their units. Figure 1 shows the flow of the proposed methodology
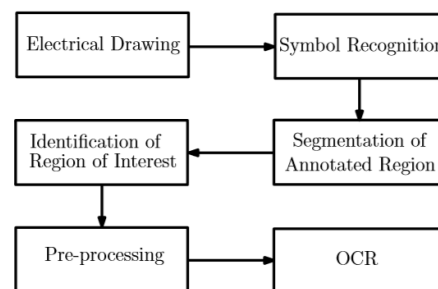

Fig 1. Proposed Methodology

III. SOME ELECTRICAL SYMBOLS ANNOTATION PROPERTIES

The acronyms and the typical digital images of the symbols that will be used in this proposed method will be stored as database for further identification and comparison. Here we are explaining below the structural properties of electrical symbol with respect to their first orientation (Horizontal). All other orientations are either by rotation or flip of the first orientation and hence characterized by equivalent properties depending upon orientation. Such properties will be used for their detection.

• RES A resistor may be symbolized by three or more zig-zag periodic strokes in a single line.

• IND An inductor closely resembles RES but having more circular curly strokes.

• TRF A transformer consists of two oppositely facing INDs with two or more same length line segments between them.

• CAP A capacitor symbolically has two plates symbolized by a pair of parallel lines (vertical line with horizontal orientation or vice versa) close to each other.

• BAT A D.C. Source symbol resemblance similar to CAP with two parallel lines line (vertical line with horizontal orientation or vice versa), expecting that one segment is longer than the other.

IV. SYMBOL RECOGNITION AND IDENTIFICATION OF SEGMENTED REGION

All the electrical symbols are first recognized from the scanned image of the electrical/electronic circuit diagrams using the technique proposed in [2]. For each symbol, its type, orientation, and the coordinates of the bounding box (segmented elements separated in a window fashion) will be used by us for annotation identification.

Annotations in electrical circuits are found to have wide variations, we will made some observations based on the premise that the width and the height of a symbol are given by the respective horizontal and vertical dimensions of its bounding box. Observations could be

(i) The symbols from electrical circuit may have annotation either left or right side of components symbol.

(ii) The electrical/ electronic symbols bounding box may be horizontal or vertical depending upon the orientation of symbol.

(iii) Depending upon the symbol size and orientation the width and height of symbol will differ from each other.

V. IDENTIFICATION

The segmented output of annotated text region of electrical component symbol usually consists of symbol name (R1, R2, L3, C4…etc.) and equality symbol (=) and value along with the unit of measurement, possibly some unwanted text. The goal of the symbol identification phase is to detect the region in the electric circuit drawing that contains the value and the unit of the symbol. The steps are

(i) The equality symbol is detected first

(ii) If the segmented region only have symbol and its name than morphological closing operation will be performed.

(iii) Counts of text annotated symbol will be performed on both the side of electrical symbol called as symbol blobs.

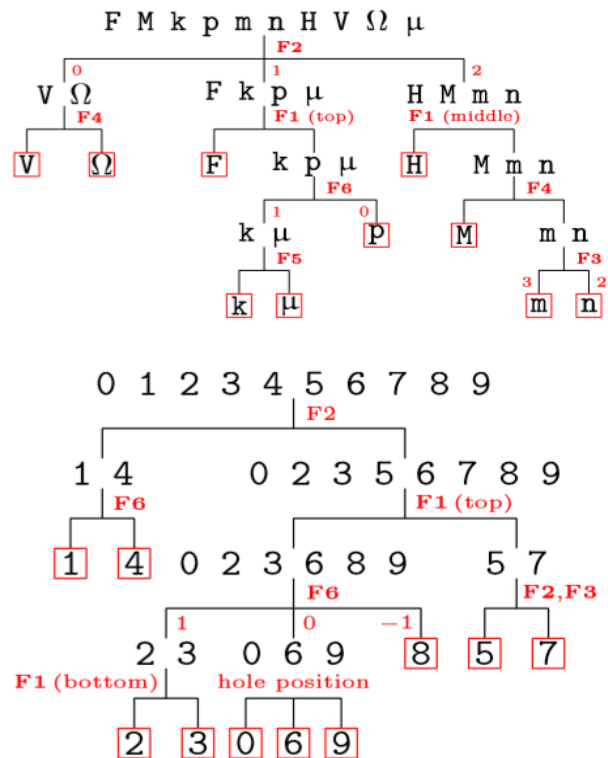(iv) Small components are treated as noise, hence removed.

Fig 2. Classifier tree

VI. PREPROCESSING

The region of identified phase will may contain some touchingandsomebrokencharacters.Hence,beforeapplying OCR algorithm on input image pre-processing is done to resolve such problems. An efficient OCR system will be designed to recognize only the numerals 0 to 9 , which is treated as value, and a set of non-numeric characters {H, F, k, V, M, m, p, n, Ω, μ}, which are used to represent the units of electrical symbols.

We know that our set is relatively small compared to the complete English alphabet and it contains a few Greek characters for some passive components, This system will built for OCR in MATLAB software exclusively to make the recognition fast, efficient, and robust. Features set will be used for classification of text annotation of drawn circuit. Based on these features, two tree classifiers are designed, one corresponding to non-numeric characters and another for numerals (Figure 2). At each node of the tree, a decision is taken on the basis of presence or absence of these features.

VII.   CONCLUSIONS AND FUTURE SCOPE

The proposed segmentation and identification algorithm will be implemented successfully to extracts the annotations linked with the symbols from the paper based electrical drawing. This Proposed work will be specially designed for electronically digital images of electric or electronics logical circuitry. A digital or hand drawn circuitry analysis system can be develop separately to have better contribution for such work.

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