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HIGH LEVEL LOADER AND RECOGNIZER OF ELECTRICAL AND ELETRONIC IMAGES DIAGRAMS

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ABSTRACT

The SRIDE (Recognizer of Electrical and Electronic images diagrams system) consists of analysis of electrical and electronic circuits, through their drawing which loaded in a computer.

This analysis is divided into two forms: syntatic analysis and semantic analysis. Later we can use the system as an analyser of on line circuits.

The main feature in the image loading system, the SRIDE, is that the image is not loaded pictorially, therefore the feature of the circuit studied here is considered,instead. To do this, we are using languages which are adequate to image processing, such as C language. We are also using an interface with a knowledge system, the OPS 5 system interpreter.

The SRIDE system has a complete basic software program shich is necessary to handle an image, from its scanning through a CCD camera to the loader it self, using image freezing, binary image, and so on.

BACKGROUND AND PURPOSE

Computer vision can be defined as the perception of images acquired from a computer. Under this definition, programs of computer vision can be throught of as programs which are written to "see" pictures as an input.

Man can distinguish things, because he has knowledge of the features of the things he keeps in his mind. For example, a photo which has scenes related to the commercial area of a given city, with streets, avenues, houses, etc, can be analysed by anyone. This person could easily know how to indicate where to find a car, for example. This can be done, because this person knows the kind of car and can easily find on the streets, and this is the first searching point.

There are other cases that are more sophisticated than this, where the necessary knowledge is more elaborate, for example, the analysis of a radio photo done by an expert professional.

In both cases, the information analysis from photos, were possible, because the knowledge about the scenes is avaiable to the analysers. These are examples of computer vision.

Some recent research, has focused on the visual recognition of diagrams and circuits done by computers, because they have many advantages, namely:

- process automation in the handling of diagrams (generation, loading and recovery);
- reduction of the necessary time to generate the diagram (generation, searching for mistakes);
- security of information.

This work has the purpose of building through the use of a computer a drawing recognizer which is used in diagrams, engineering problems, and electrical and electronic circuits.

The output of this system will be a high level description rather than a pictorial representation of input.

We are using knowledge based to organize a hierarchical system, which corresponds to several abstraction levels, thus becoming a flexible system, that is, although we are using an electrical system as data input, we can use other applications as data input, by changing only the knowledge bases.

IMAGE PROCESSING

Here, the system proposed is composed of a video camera, which scans the image of the circuit which has been studied, and a microcomputer, which processes the image.

The image can be processed by using many technologies, such as: ultrasound, laser, X ray, conversion of the reflected light in electronic signals, and so on.

Here, the process where the scanned image will be frozen was considered and represented by its gray level, and a function like $f(x)=f(x,y)$, where $f(x,y)$ is the light intensity converted in gray levels in the spacial coordenates (x,y).

After being frozen, the image is processed in order to obtain a binarized configuration of itself from the frequency study of certain range of gray levels. After this, the image is loaded in the computer.

The determination of the border of the objects in an image is very important, because this way we can detect these objects in the diagram being studied.

In an image which contains gray level pixels, a border is a frontier between two regions of different gray levels; in other words, it is the image place where the gray level in a direction changes very guickly.

Many studies have been done in order to obtain optimum operators, like:

- linear detectors
  . frequence filters
  . gradient
- no linear detectors
  . Rosenfeld's method
  . Herokovitzs and Binford method
- formal models
  . Griffth method
  . Hueckel method
  . Chow method

In this work, the description and linear feature extration were considered, proposed by Ramakant Nevatia and Ramesh Babu in 1979.

The lines search process consist of determining the magnitude and direction of the border, by the convolution of an image with many borders mask. It also consists of the limitation of this magnitude, as well as of the connexions among borders elements nearly based and finally of the approach of the linear segments connexion.

THE SYMBOL RECOGNIZER

A good procedure to interpret images, must begin with good information about the image which are being studied.

There are three kinds of objects which are necessary to a components recognizer: lines, curves and circles. Each one of these objects can have a recognizer object primitive.

In this work, the primitives that usually are linking lines and the primitives that constitute logical symbols, are the best keys to the interpretation. When some symbols are identified, input and output lines connected to them can be easily interpreted.

In a system like this, the symbols are recognized by using the models thenselves, which describe the structure of each symbol with their primitives and their kind of links.

Once the global structure of a certain diagram is recognized, the acquired information can be used in many objectives.

THE USE OF KNOWLEDGE FOR RECOGNITION OF DIAGRAMS

Computer vision research has been conducted on the highlevel, and lowlevel procedure. The lowlevel procedure research emphasizes data preprocessing by using many border detectors technics. Thus the original data themselves become the basis for a future recognition work.

The highlevel procedure research uses previous knowledge to reduce the work of recognition of an image. This kind of program recognizes image objectives more quickly because it knows what it must expect.

In this work, the recognizer recognizes components which are in a components library. The recognizer uses highlevel knowledge to do the recognition task. The results are used by other modules of the system to validate the obtained knowledge.

DESCRIBING THE SRIDE SYSTEM

The key to an interpretation of an image system is the interection between the high level knowledge (image feature).

While the information main flow in botton up, that is, the system organization is oriented by the input data (from pixels to object models), several other systems have been using the information flow top dow, or putting it another way, the orientation is done by the goals (from object models to the image feature).

To do this complex task, the drawing recognition, the knowledge about the domain of applications is needed.

There are several kinds of information,like:

1) knowledge of the symbols which are in the drawing;

2) Chain relationship knowledge between those symbols;

3) knowledge of the technical applications thenselves.

The SRIDE system could be descripted as having the followings features:

a) it is a knowledge based system;

b) it is a hierarchical system, the knowledge is divided into levels, corresponding to the abstraction levels;

c) it is avaiable to interactions between levels and opportunistic strategy to solve problems;

d) A level division could be done as a:

   a) Point
      actions: scanning and image binarization
      knowledge: theresholding.
      The image is acquired, and converted into a matrix. Its contents are represented by its gray level.
      The first step in this process is the binarization of the image, through methods like gradient or theresholding.

   2) Line
      action: growping algorithms
      knowledge: which kind of line segments are expected
      A classical aproximation to do the adjusting between lines and an image, is obtain the line through the minimal square distance method. Another form for adjust of lines is using clusters methods.

   3) Symbols
      actions: template matching and pyramide algorithm
      knowledge: which symbols the image has.
      Here was used a template matching to the adjust of the symbols in an image. Its was possible because the number of class and its variations are not great.

   4) Syntatic Diagram
      action: structure matching
      knowledge: how the symbols may be arranged in the image.
      Once the symbols that are present in an image are identified, we can recognize the drawing of the diagram through the use of knowledge based. In this way we can analyse it syntatically.
      The idea is to establish recognition structures in order to obtain information

from the image. The objective here is to find out whether or not the acquired symbols are valid as a representation of the studied diagram.

5) Semantic Diagram
action: logical inference
knowledge: restriction to the chain wich was heuristics.

Here the objective is to establish the diagram validity obtained from the knowledge of its technical use.

Therefore, that purpose of this semantic diagram is to find out if the symbols obtained are logically validated by mean of logical and heurishic inferences.

THE SYSTEM MECHANISM

1) After an image is scanned in gray level, it is digitalized and loaded in a computer.
2) The lines which compose the image are obtained through a border detector processing.
3) An intermediary image is obtained either through incomplete lines a through unknown symbols.
4) A knowledge base is formed through a symbols libraty and basic patterns. This base has the necessary knowledge to infer the expected image.
5) The image which had been obtained can be described by connexions of symbols and lines.
6) This image (top down) must be analysed, in order to find out wether or not the statements which describe it are valide.

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