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International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 6 June, 2014 Page No. 6620-6623

A Pattern Recognition System To Improve Quality Assurance For Manufacturing Industries Using Image Processing

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Abstract-

In various domains of engineering image processing is being used widely. In the manufacturing industry for example manufacturing of finished products like wooden furniture and other finished products, human eyes are required to check the quality and standard of the finished product. We have proposed a system in which the quality of finished products is monitored by the image processing system. We have used various features of image processing system like morphological operations and image segmentation process to analyze the product images and raise an alarm for the particular product if some defect is found in the finished quality of the product. For example in a paint shop where different panels of the cars are being painted, it is very difficult for the human eyes to find any discrepancy in the quality and texture of painted panels. Hence, an image processing system can be used to find any kind of discrepancy in an efficient manner. Our proposed work will help in optimizing the conventional methods of quality assurance for various products and will also help in cutting down the cost of human resource for a manufacturing plant that manually check the quality and standard of products. We will de developing and implementing the system in real time and will use the MATLAB software for the development of proposed software.

Keywords- Image Processing, Pattern recognition, quality, image segmentation, morphological operations.

Introduction-

In manufacturing industries like wooden furniture, paint shop painting the different panels of the car and many more industries where the quality of the finished product matters a lot. For example, a factory produces thousands of floor carpet every day. Now there may be a possibility that there may be some defect during the carpet manufacturing like the color on the carpet is not consistent, or the fabric quality is not good in some of the carpets. In a conventional method, manufacturing plants hire humans to check the quality of carpets coming out from the machine. Humans, checking the color and texture of the carpet may consume a lot of time; it may also happen that some of the time human eye may miss some of the discrepancy found in the carpets. To solve this issue, automated image processing system may be of great help. These systems will check the carpet coming out from the machine and will tell if there is any problem in the texture or color of carpet. This will not only increase the process of quality check but will also help the industries to cut down the cost on human resource. Applying this concept of automated system which can recognize patterns can be implemented to wider concept. Taking an example of manufacturing of floor tiles. The floor tiles come in the market in various patterns and colors. Inside a manufacturing plant, humans are hired to check the color and texture of these tiles coming out from the machine. But, if the production is on very large scale like thousands in a day. Then to maintain the quality and brand name, humans are hired to manually check each floor tile coming out from the machine which consumes a lot of time. Our proposed

system which will check the each floor tile coming out from the machine will only take fraction of seconds to check whether it is good piece or a defected piece. Our proposed system will help in cut down the cost of industries and will give high quality products.

Block diagram of the proposed System-

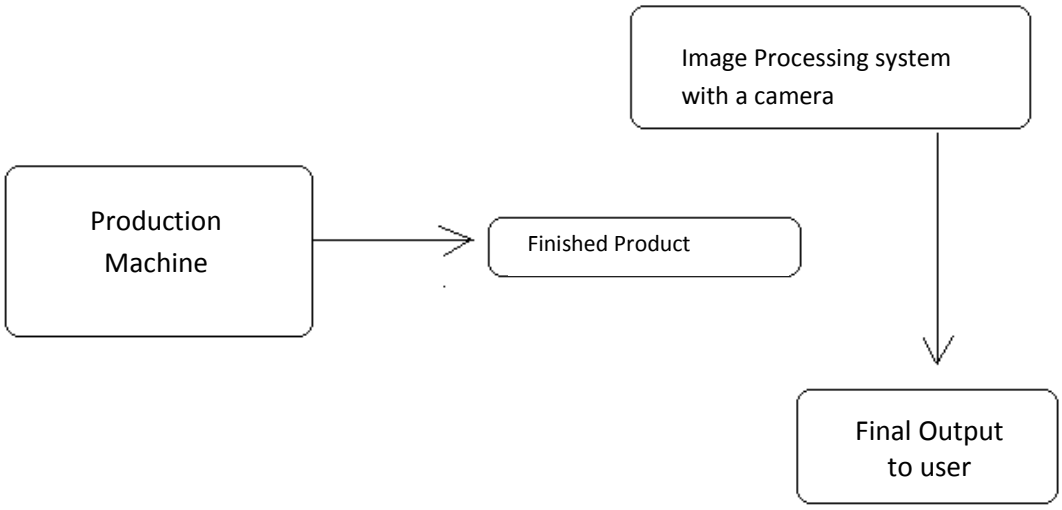

Fig 1. Block diagram of the system

The heart of the system lies in the image processing system, where the state of the art algorithm will come into play and will check the quality of the finished product against different parameters defined the input to the system. The next section will describe about the proposed algorithm for the system. This is a generalized algorithm which may be used in the real system during the implementation but it is subject to efficiency and correctness of approach which can only be determined during its real implementation.

The pattern recognition algorithm-

The ability of humans to solve identification and pattern recognition is rooted in their perceptual and cognitive abilities to collect and analyze information from the environment. The field of pattern recognition focuses on mechanizing these abilities with the goal of automating the identification process [54][65][91]. In contrast to biological systems, automated pattern recognition systems use algorithms to process data collected either electronically (via monitors or sensors) resulting in an identification of the group of which the data are most representative. Figure 2 illustrates the parallel between living organisms and automated pattern recognition systems.

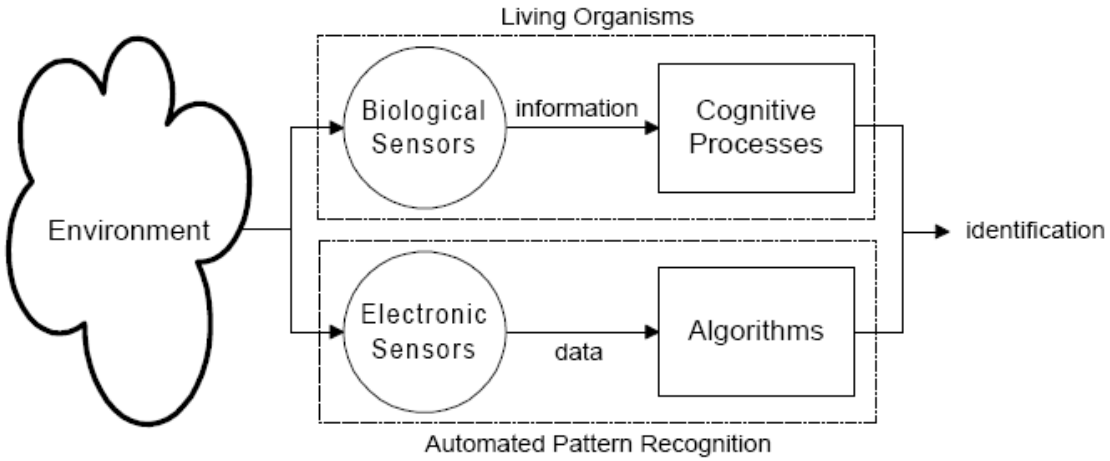

Fig. 2

The algorithms used by pattern recognition systems are commonly divided into two tasks, as shown in Figure 3. The description task transforms data collected from the environment into features—i.e., any value that can be derived from and is representative of the data—which are used in the classification task to arrive at an identification. The description task can involve several different, but interrelated, activities:

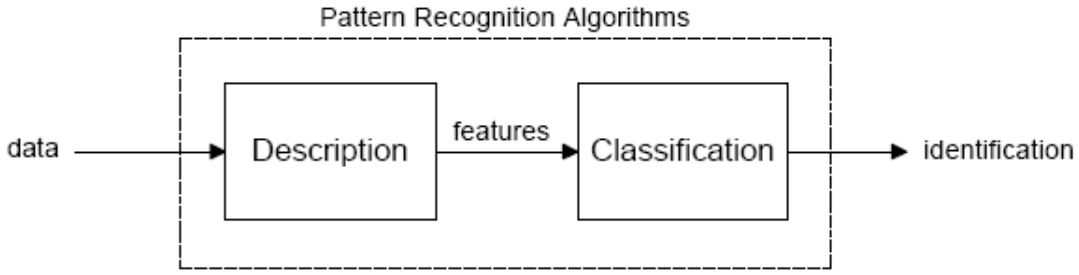

Fig 3.

The basic 3 processing task that are in the algorithm are-

-> Preprocessing is sometimes necessary to modify the data either to correct deficiencies in the data due to limitations of the sensor, or to prepare the data for subsequent activities later in the description task or in the classification task.

-> Feature extraction is the process of generating features to be used in the classification task. Elementary features are explicitly present in the data and can be passed directly to the classification task. Higher order features are derived from elementary features and are generated by performing manipulations and/or transformations on the data.

-> Feature selection reduces the number of features provided to the classification task. Those features which are likely to assist in discrimination are picked out and allowed to be used in the classification task. Features which are not selected are discarded; higher order features which are determined to be unnecessary for classification can be eliminated from the feature extraction process.

General Approaches to pattern recognition-

There are two fundamental approaches to implementing a pattern recognition system: statistical and structural. Each approach employs different techniques to implement the description and classification tasks. Hybrid approaches, sometimes referred to as a unified approach to pattern recognition , combine both statistical and structural techniques within a pattern recognition system. Statistical pattern recognition draws from established concepts in statistical decision theory to discriminate among data from different groups based upon quantitative features of the data. There are a wide variety of statistical techniques that can be used within the description task for feature extraction, ranging from simple descriptive statistics to complex transformations. Examples of statistical feature extraction techniques include mean and standard deviation computations, frequency count summarizations, KarhunenLo` eve transformations, Fourier transformations, wavelet transformations, and Hough transformations. The quantitative features extracted from each object for statistical pattern recognition are organized into a fixed length feature vector where the meaning associated with each feature is determined by its position within the vector (i.e., the first feature describes a particular characteristic of the data, the second feature describes another characteristic, and so on). The collection of feature vectors generated by the description task is passed to the classification task. Statistical techniques used as classifiers within the classification task include those based on similarity (e.g., template matching, nearest neighbor), probability (e.g., Bayes rule), boundaries (e.g., decision trees, neural networks), and clustering (e.g., hierarchical).

The quantitative nature of statistical pattern recognition makes it difficult to discriminate among groups based on the morphological (i.e., shape based or structural) sub patterns and their interrelationships embedded within the data. This limitation provided the impetus for the development of a structural approach to pattern recognition that is supported by psychological evidence pertaining to the functioning of human perception and cognition. Object recognition in humans has been demonstrated to involve mental representations of explicit, structure oriented characteristics of objects , and human classification

decisions have been shown to be made on the basis of the degree of similarity between the extracted features and those of a prototype developed for each group [4][41][72][86][87]. For instance, a proposed recognition algorithm comprises of following steps-

(1) The object is segmented into separate regions according to edges defined by differences in surface characteristics (e.g., luminance, texture, and color)
(2) Each segmented region is approximated by a simple geometric shape.
(3) The object is identified based upon the similarity in composition between the geometric representation of the object and the central tendency of each group.

This theorized functioning of human perception and cognition serves as the foundation for the structural approach to pattern recognition. Structural pattern recognition , sometimes referred to as syntactic pattern recognition due to its origins in formal language theory, relies on syntactic grammars to discriminate among data from different groups based upon the morphological interrelationships (or interconnections) present within the data. Structural features, often referred to as *primitives*, represent the subpatterns (or building blocks) and the relationships among them which constitute the data. The semantics associated with each feature are determined by the coding scheme (i.e., the selection of morphologies) used to identify primitives in the data. Feature vectors generated by structural pattern recognition systems contain a variable number of features (one for each primitive extracted from the data) in order to accommodate the presence of superfluous structures which have no impact on classification. Since the interrelationships among the extracted primitives must also be encoded, the feature vector must either include additional features describing the relationships among primitives or take an alternate form, such as a relational graph, that can be parsed by a syntactic grammar.

Conclusion –

In this paper we have proposed a image processing system which can recognize various patterns for a finished product and can be deployed in a manufacturing industry to speed up the quality assurance process. We have also discussed the approach of our algorithm which will be used to implement in real time system. The approaches are statistical and structural. The three basic components of the algorithm for our system will be preprocessing, feature extraction and feature selection. Finally, the feature selection will be used by the system to recognize the pattern. The entire system will be developed in the MATLAB and will tested on real time images. We will try to improve the efficiency and will make sure that the proposed system will work up to the expectation of manufacturing industry and will serve as boon for the quality assurance process of various manufacturing industries.

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