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Machine Vision System for Industrial Parts Recognition

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Abstract- These days in different kinds of product manufacturing industries (e.g. locks, tools containers, alarm clocks, engines and motors and many others.) and packaging industries with huge scale production devices automatic assembly structures are broadly used. They used mechanized devices including image taking unit, conveyor, element recognition unit, component feeder, element selection unit, and smart robots that observe constant sequence of steps to gather the product. The performance of general product production and inspection method can be elevated with commercial automation and it also minimizes resources and saves time. This paper affords a computationally efficient 3-D computer vision based approach to apprehend the machine CAD parts. In this paper features based totally commercial object detection techniques are applied in MATLAB to recognize the presence of the commercial CAD parts inside the question image. In the end the actual industrial tool images also are used to expose the accuracy and robustness of the proposed smart machine vision system for industrial production automation.

Keywords: Machine Vision, Industrial Parts, Image Processing, Object Recognition, Industrial Automation.

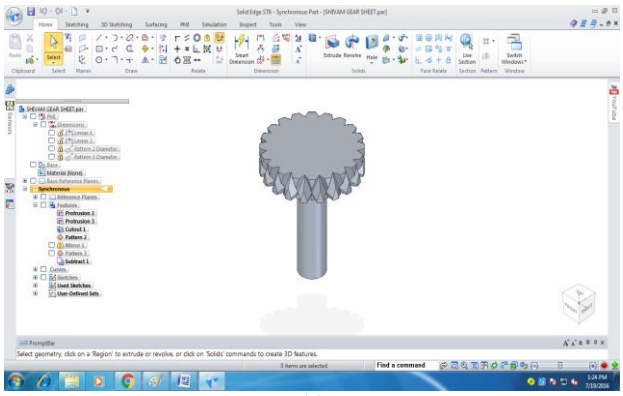
1. Introduction

In well-known with appreciate to productivity there are three classes of assembly structures namely low, medium and excessive extent manufacturing devices. The assemblies systems are completely automated in high extent manufacturing, assembly of elements in different lessons are completed in semi-automated or manual via hand. The price for establishing such systems to start with is excessive, but in longer run it saves time, money, and exertions. The advantages of such machine are big amount of manufacturing, stable product design with properly great and reliability.

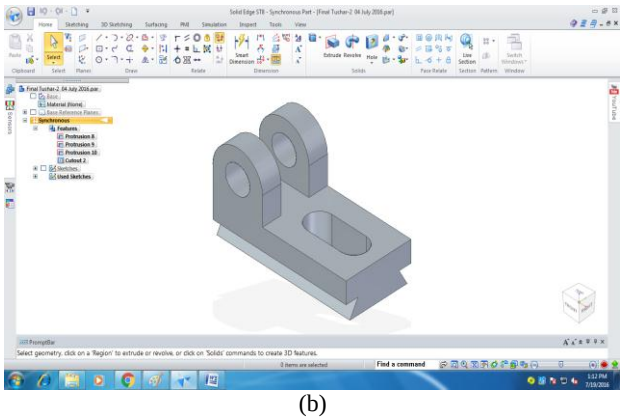
In automated meeting structures the device elements identity is totally one of a kind from easy item recognition; furthermore the potential of human to differentiate among accurate and no correct machine components are better but it's far a difficult project for a machine. In preferred with rapid moving machine parts on conveyor guide defect detection through human inspectors are impractical additionally its miles pricey, erroneous, and subjective, eye straining and other health troubles to quality manipulate inspectors. A laptop imaginative and prescient based non-contact inspection approach is evolved with image processing strategies by way of thinking about those troubles, for disorder detection in commercial gadget components. The prevailing work will help the economic robot used in meeting technique and industrial inspection systems.

2. Machine Parts Designing Process

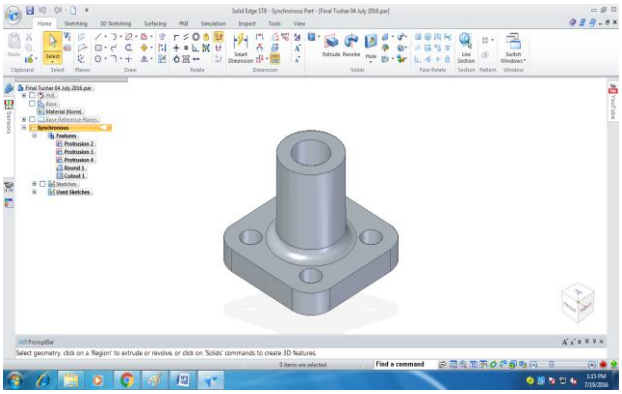
In the present research work the machine CAD elements are designed with Solid Edge ST8 PLM software. The design is created by means of 2D drawings to 3D object. Because the Solid Edge ST8 helps an immediate interplay with the designer, for this reason the need to put in writing program isn't required at all and we will effortlessly find out the exclusive surfaces. Solid Edge is a mixture of various software program gear that encompasses all steps of the product design and development techniques like 3D parts advent, layout simulation, components manufacturing, design elements management. Solid Edge presents consumer pleasant bendy interface to combine the speed with simplicity the use of synchronous era for the manipulate of parametric design. Fig. 1 suggests the examples of machine CAD elements designed using strong side ST8. Fig. 2 indicates the set of eight images used in the experiments.



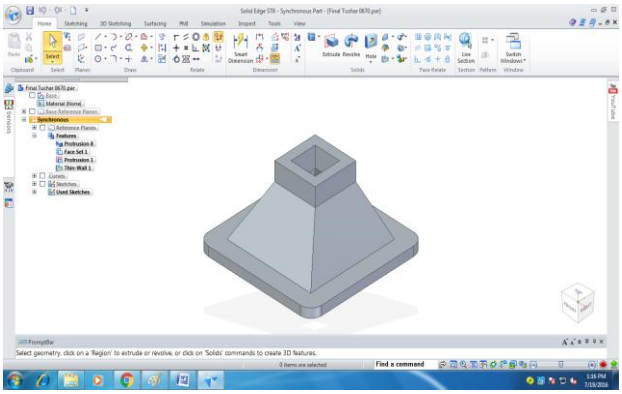
(a)



(b)



(c)



(d)

Fig. 1 The examples of machine CAD parts designed using Solid Edge ST8

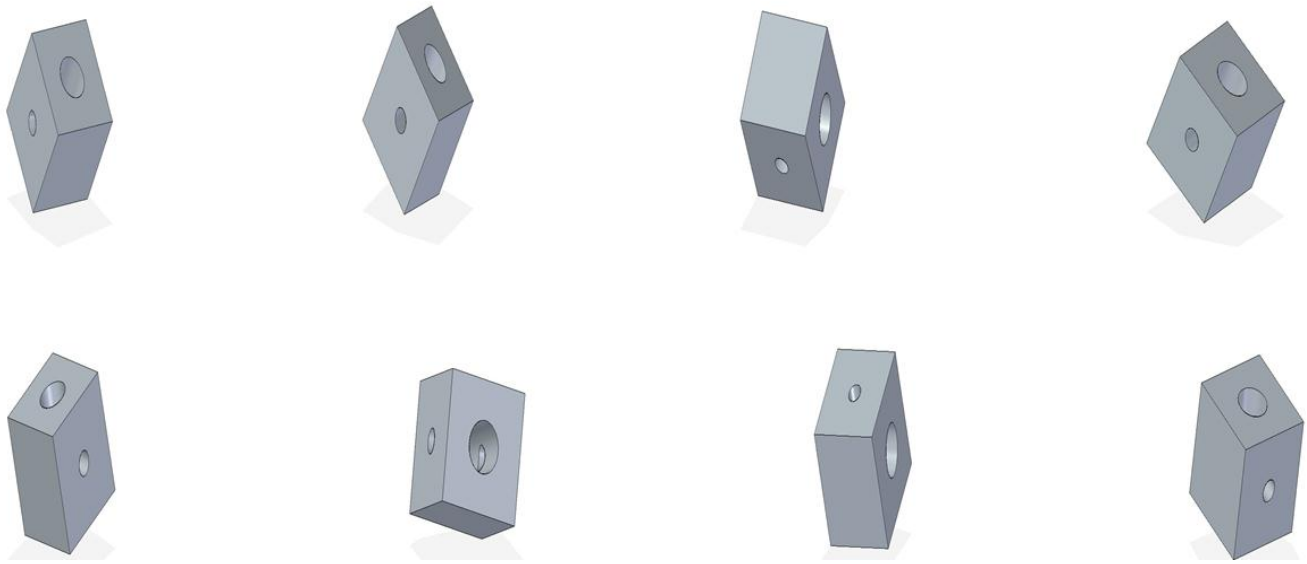


Fig. 2 The set of 8 images of machine CAD parts used in the experiments

3. An Overview of Speeded Up Robust Features (SURF)

These days Speeded Up Robust Features (SURF) has been widely utilized in device imaginative and prescient programs. SURF can work efficaciously in specific obligations like image recognition, detecting objects in a actual image, object matching and classification and many others. Scale invariant characteristic remodel (SIFT) is predecessor of SURF. There are different algorithms to be had to us with similar capabilities named as BRISK, FAST, HOG, FREAK and many extra. SURF detector labored as nearby characteristic extraction for the given image. SURF descriptors are invariant to rotation and scaling means no matter role of object on conveyer belt for matching and inspection this set of rules can easily locate that object with accuracy and performance. This paper indicates this surely on machine CAD components and commercial equipment. Compared to SIFT in feature extraction and object recognition SURF is much quicker and strong.

4. Literature Review of Feature Based Algorithms

The sped up robust capabilities (SURF) [2] and Scale Invariant feature remodel (SIFT) [8] descriptors extracts a specific object in an occluded items image or to hit upon exact matching among images. The functions extracted corresponding to a selected item in an image need to be invariant to rotation and scaling for best matching and recognition. SURF and SIFT are the trendy characteristic extraction algorithms that worked at the concept of invariance. In present state of affairs these strategies are applied to real time item popularity, item matching and inspection, question photo retrieval and so forth. SIFT is widely utilized in different system vision applications, but on the fee of computationally steeply-priced SIFT feature points calculation for the given object. In comparison to this SURF descriptors are comparatively more computationally green in comparison to SIFT [2]. That's why system vision utility regions for object reputation prefers SURF over SIFT. Further in other research work greater high-quality utilization

of SURF strategies is proven [3], [6]. The contrast of SURF [2], SIFT [4] and a new descriptor named Maximally Stable Extremal Areas (MSER) [7] is surely mentioned. MSER features extracts regions with uniform intensity and additionally suggests independency approximately scale. In lots of situations these characteristic types shown better consequences [9, 10, 11].

5. Proposed Approach

A non-touch system imaginative and prescient primarily based CAD parts detection device is proposed on this section. The collection of steps accompanied inside the proposed gadget is: image capturing, image preprocessing, contour extraction, functions extraction, similarity matching and CAD device component popularity. These steps are summarized in flow diagram in Fig. 3.

The image acquisition device acquires data from the transferring gadget components in line that is part of the assembly line setup. To transform the information appropriate for in addition processing the captured gadget CAD element image information undergoes image preprocessing techniques like binarization, noise elimination, heritage subtraction etc. to convert the information suitable for further processing. Then a contour of the device components are extracted and normalized by using identical element place approach to explain the features of the components. It offers essential clues for device component shape popularity. For experimental motive a version form for each machine component is developed in CAD software program stable part ST8, the parts popularity is carried out with most effective reference to the version shape [16].

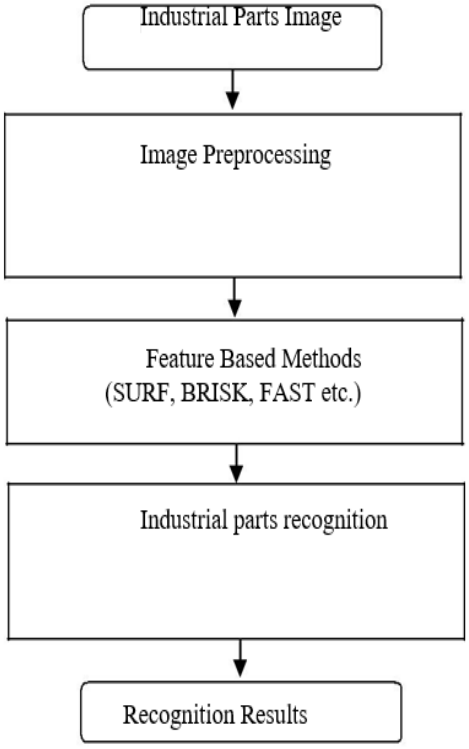


Fig. 3 Proposed industrial parts recognition system

6. Experimental Results and Discussions

The experimental results using SURF, BRISK and FAST approach of machine CAD parts recognition are presented in this section with relative proposed approach. The Fig. 4 (a) and Fig. 4 (b) shows the machine CAD parts first image and second image respectively with scaling and rotation of first image so that these two images are compared for CAD parts recognition. Fig. 4 (c) and Fig. 4 (d) represents the strongest features of first and second input image using SURF. CAD parts image with matched features and matched points are shown in Fig. 4 (e) and Fig. 4 (f) respectively. Fig. 4(g) represents the final CAD object detected image using proposed SURF method invariant to scaling and rotation that may be the conditions of actual industrial system.

Similar experiments results are also shown in Fig.5 to Fig. 7 for different CAD parts. Here in Fig. 6 we used SURF for feature extraction whereas in Fig. 6 BRISK algorithm and in Fig. 7 FAST an algorithm is used. The only difference in these algorithms is based on the feature extraction. For classification tasks the HOG and SURF techniques are used. Whereas, BRISK and FREAK binary descriptors algorithms are specifically applied to find point mapping between objects images. Binary descriptors are normally faster but with less accuracy than gradient-based descriptors.

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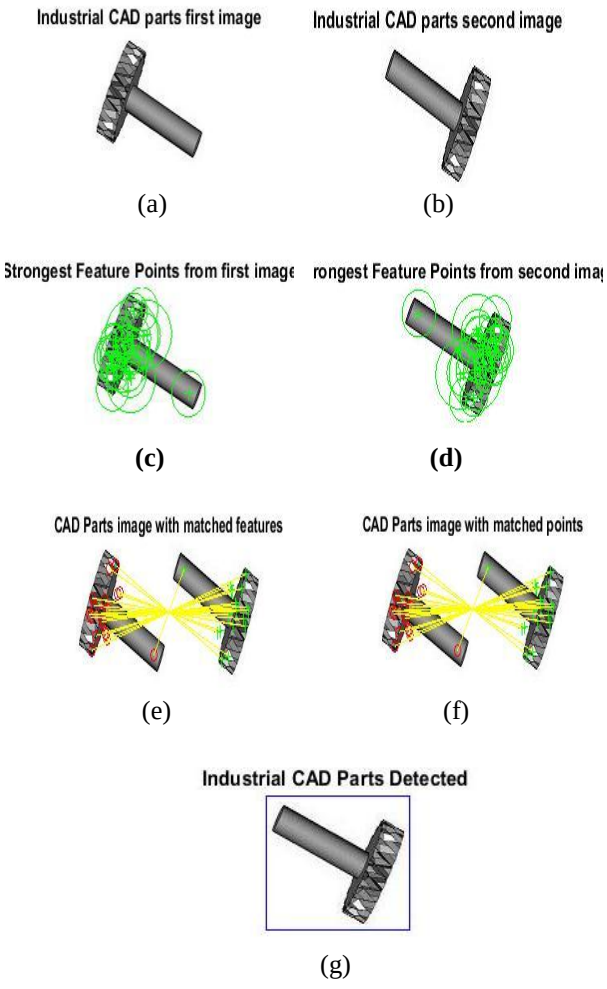

Fig.4 Industrial CAD part 1 SURF algorithm results

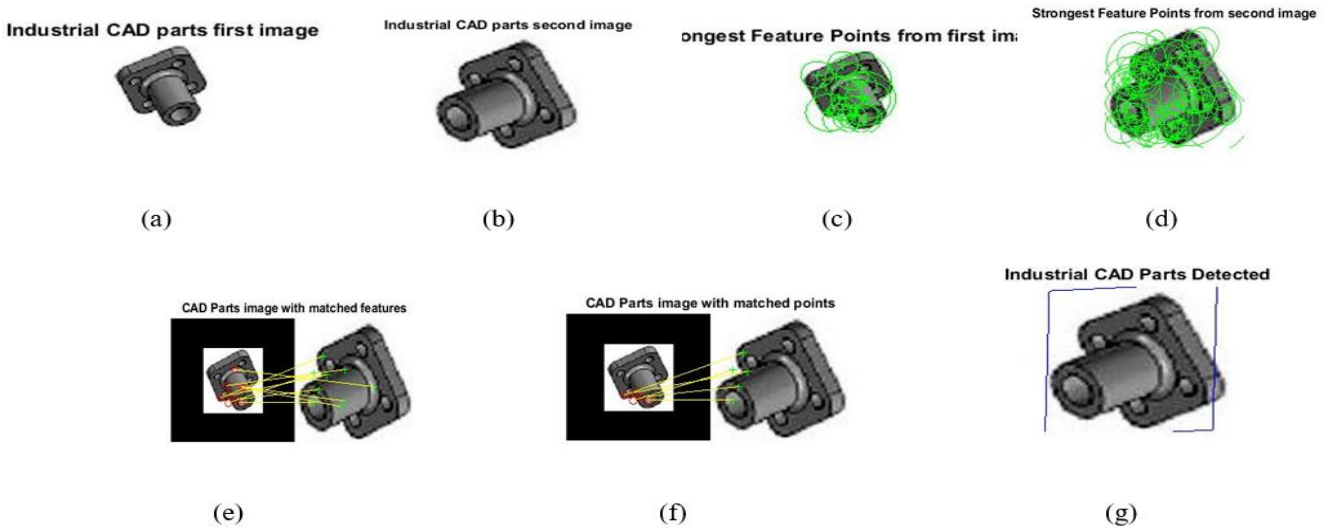

Fig.5 Industrial CAD part 2 SURF algorithm results

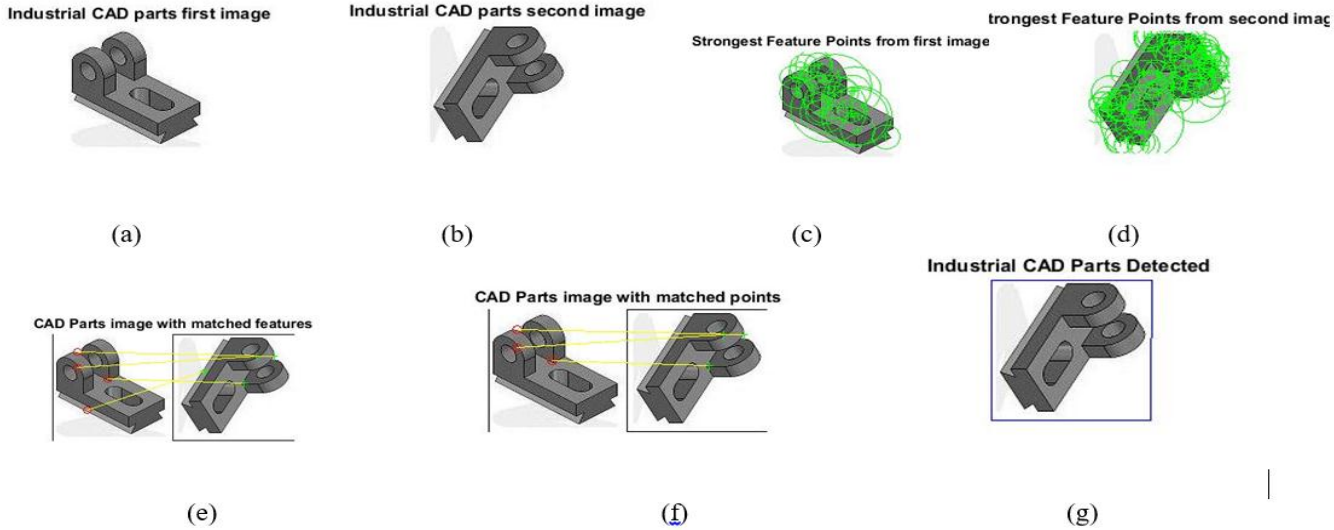

Fig.6 Industrial CAD part 3 BRISK algorithm results

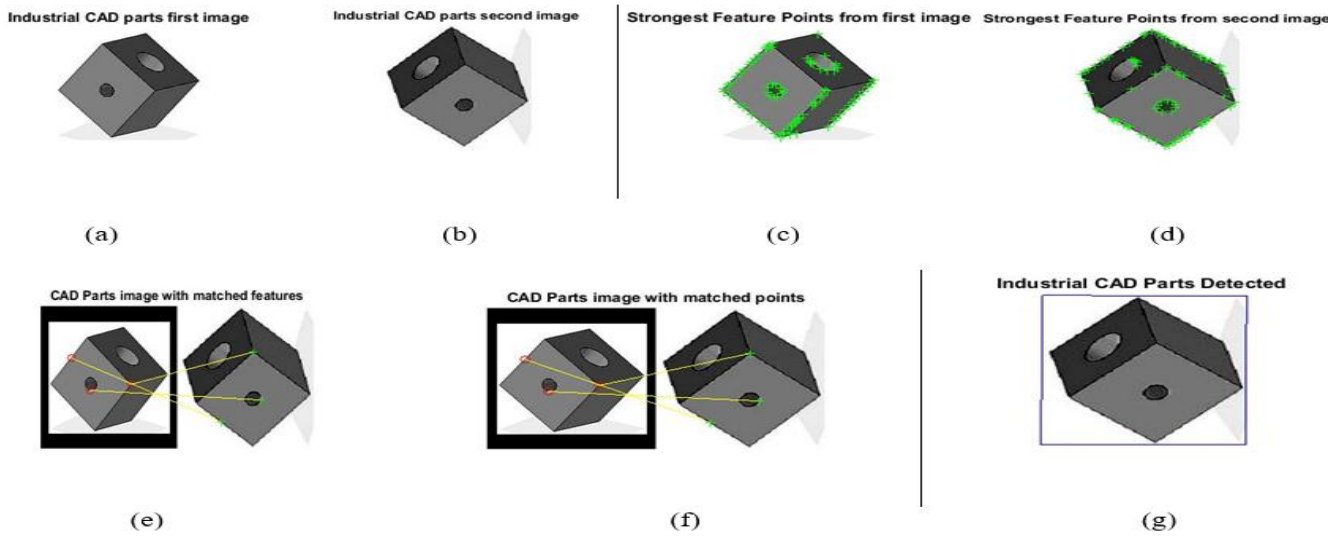

Fig.7 Industrial CAD Part 4 FAST algorithm result

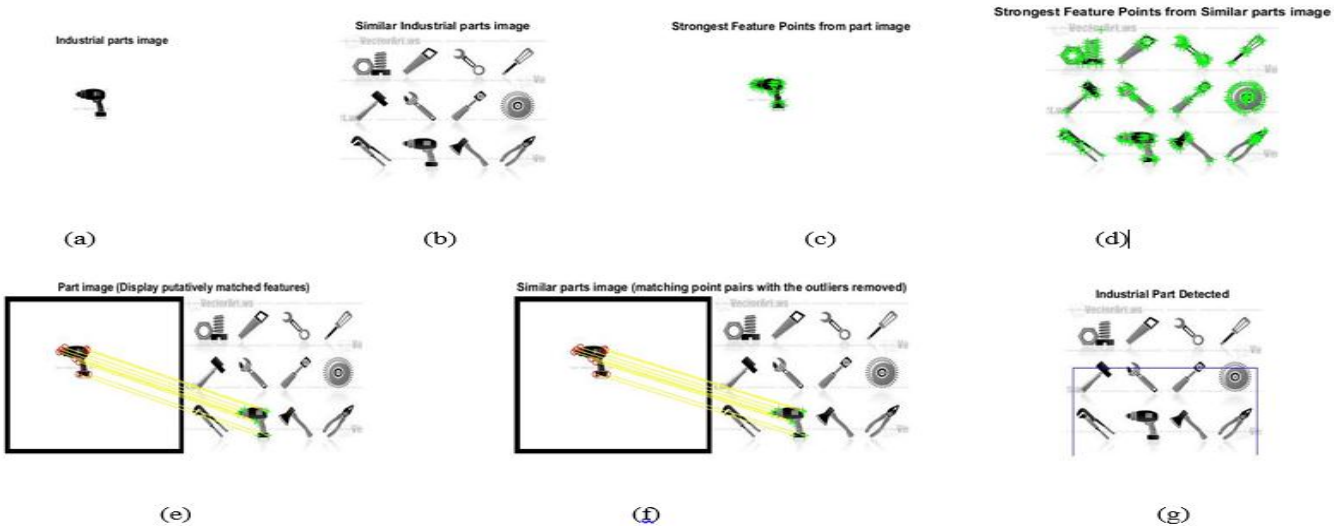

Fig.8 Industrial Tool 1 FAST algorithm results

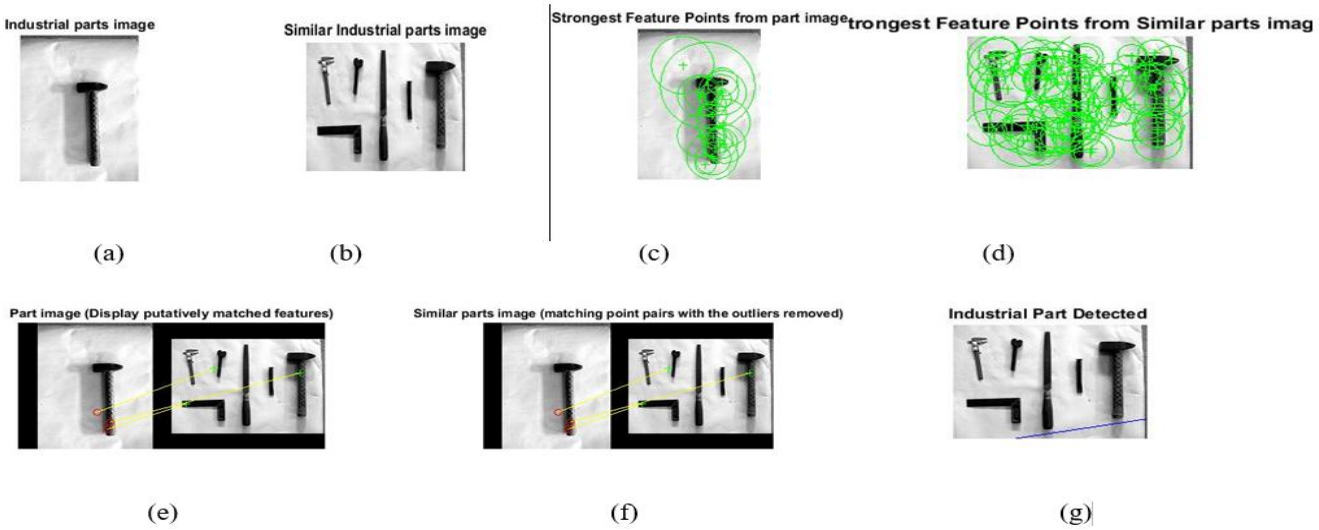

Fig.9 Industrial Tool 2 SURF algorithm results

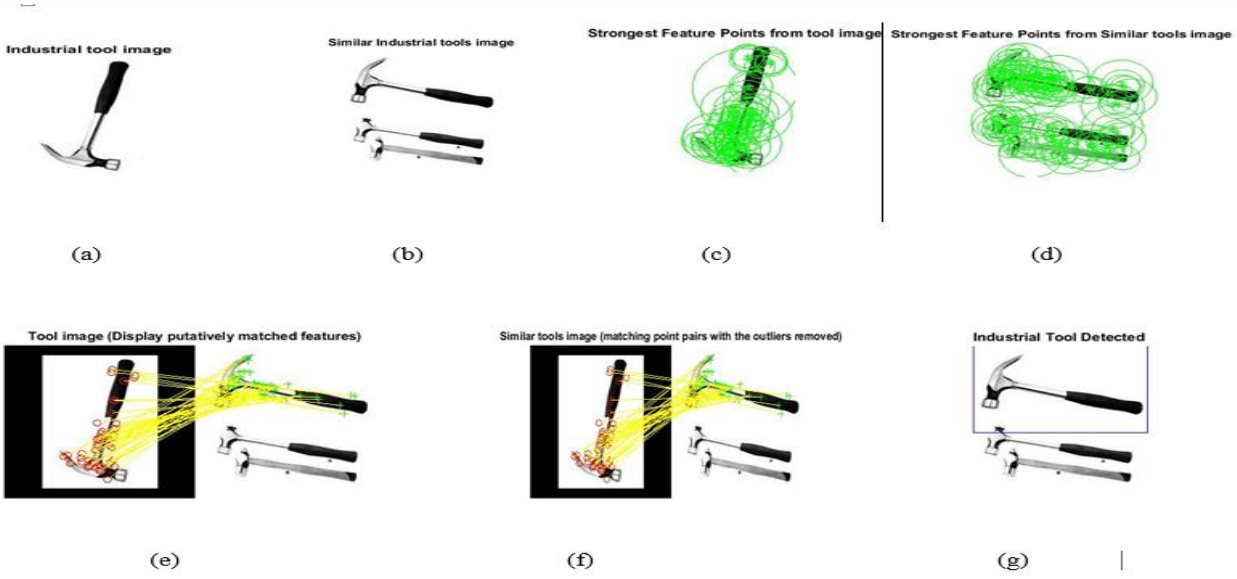

Fig.10 Industrial Tool 3 SURF algorithm results

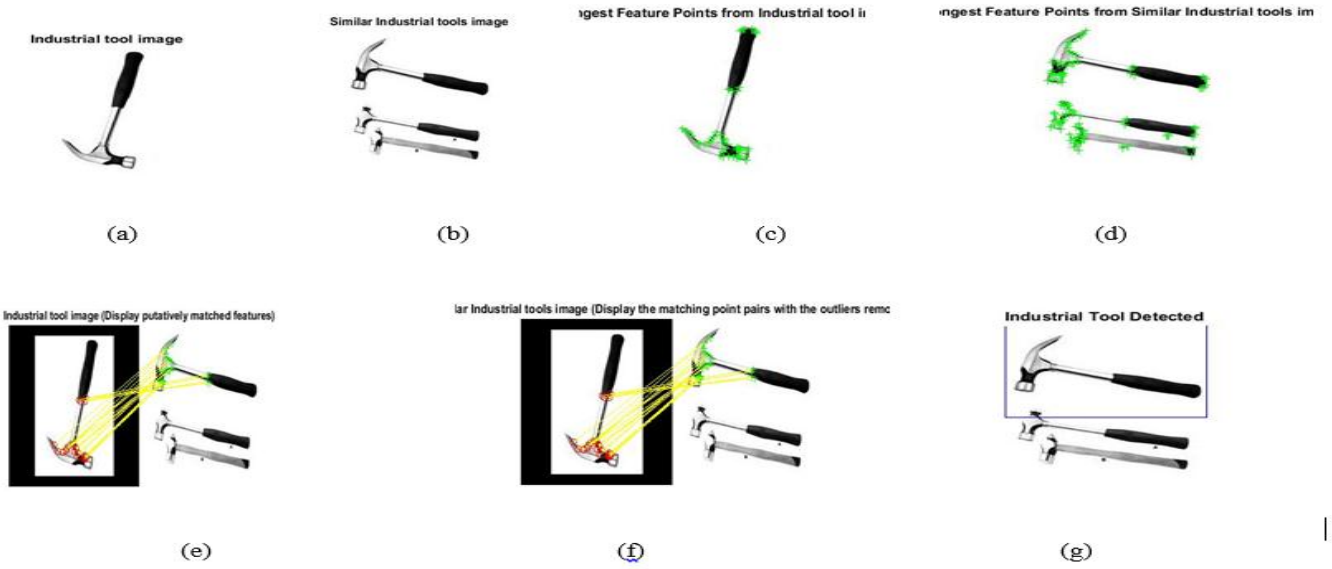

Fig.11 Industrial Tool 3 FAST algorithm results

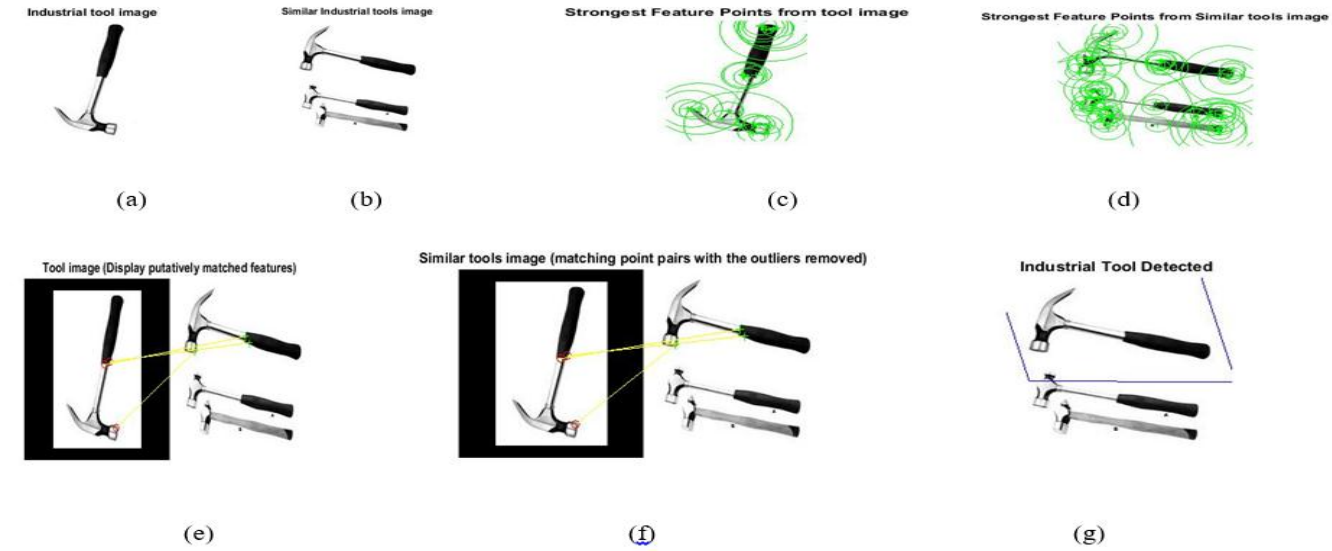

Fig.12 Industrial Tool 3 BRISK algorithm results

The experiments results as shown in Fig. 8 to Fig. 12 are for actual smart industrial automation machine vision system. In Fig.8 FAST algorithm is used for tool detection we can get even better results while using SURF. Similarly Fig. 9 (a) shows the results of actual hammer tool image and Fig. 9 (b) shows a combined machine tools image. The SURF algorithm is used to detect the hammer and finally in Fig. 9 (g) the tool is correctly recognized. Fig. 10 shows another hammer detection results using SURF. Three hammers combined images are taken in this case as shown in Fig. 10(b) and the query image of Fig. 10 (a) is recognized clearly. Fig. 11 and Fig. 12 also show good actual industrial tools results with different algorithms.

7. Conclusions and Future Work

This technique affords an efficient object image detection algorithm for CAD components matching machine. Speeded-Up Robust Features (SURF), are used for extracting features from reference elements and query image. A few makes use of this machine are the automatic identity of CAD components on the net. This gadget is used to discover both close to reproduction parts as well as components with some variability of their look. To examine the effects of device CAD components matching structures FAST, BRISK and SURF algorithms are applied using MATLAB. The overall performance is also evaluated with the aid of changing the size as properly the rotation angle. The experiment indicates that the proposed smart vision system constantly outperforms other current system in parts matching and detection. For future work greater items both CAD elements and industrial tools can be taken for recognition and detection of defects in them if any for automatic inspection purpose.

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