

# Implementation of SIFT for detection of electronic waste

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## Abstract

The paper focuses on the investigation of image processing of Electronic waste detection and identification in recycling process of all Electronic items. Some of actually collected images of E-wastes would be combined with other wastes. For object matching with scale in-variance the SIFT (Scale -Invariant- Feature Transform) is applied. This method detects the electronic waste found among other wastes and also estimates the amount of electronic waste detected the give set of wastes. The detection of electronics waste by this method is most efficient ways to detect automatically without any manual means.

**Keywords:** Electronic waste, HSV, Object recognition, Scale Invariant feature transform.

## 1. Introduction

Emerging waste stream such as the electronic equipment, waste electrical or E waste is rapidly increasing with complex characteristics. The growing quantity of electronic waste has emerged to be a challenge in the field of waste management in both developed and developing countries. There are large portion of Electronic Waste is being failed to collect in an efficient manner. Most of electronic waste is disposed in landfills in large quantity. One of the effective methods is detection of e waste in the beginning stage of disposal. The method of object recognition with the help of image processing based on SIFT

Similarly the use of Scale invariant Feature transform on feature detection is taken in this implementation, for recognition of objects. The invariant feature which is extracted from the given images is used to perform predictable matching between different angles of an object or a scene. This features has shown to be proportional to the rotation and scale of the image and in addition of noise the robustness across a substantial range and change in illumination. This method is an efficient one on the extraction of the feature and has the ability to identify features in large numbers.

The existing method include eddy current separator, inducting sources, etc. This current mode of detection has only implied to detect metals. Another method such as Near Infrared Sensors and X-ray technology detect the waste based on the density if the material.

## 2. Literature Review

The recognition of the object proceeds by matching features individually to a main database which contains the set of features from a known set of objects using an algorithm known as fast nearest-neighbor. In a single object the clusters are identified by applying Hough transform thus it performs verification at the end for consistent pose parameters through least-square solution. This approach towards to recognize robustly to identify the objects

which are between irregularity and occlusion while obtaining near real-time performance.

To detect similar objects SIFT can be used in a set of two distinct images. This algorithm can help in identifying the similarity between two objects even when the object is partly covered in either one of the detected images, even when in the change of orientation and when the object is scanned at different angles. Implementation of this algorithm could be an advantage in the field of computer vision. As SIFT displays many special features, which are unique in the field of recognition of object, this algorithm could then fulfill the necessity of quality control of the product and separation of objects in industries.

The recognition of object is the most searching and demanding area in the field of research because of its significance in a wide range of applications as objects which may differ in all perspective. These descriptors which use the extraction of feature in the current method which are applied for recognition of object which is mostly based on intensity. In the object recognition with variation in the level in illumination in light, the color descriptors are used. The color descriptors that are applied in the system of object detection are based on the level of intensity in HSV (Hue, Saturation and Value) for the respective object image based on the value of their histogram. The system is employed on a single object mode of recognition with a plain white background. The features that are applied for the recognition are mostly in the dimension and the intensity values of HSV corresponding to the image of the object. The two key modules are object recognition and feature extraction.

The recognition of object is obtained by two different types of methods, On the basis of ANN (artificial neural networks) and SIFT in which the classification of the feature extraction of object image are obtained. The adaptation of the Euclidean distance measure metric algorithm to match the features that are extracted in the image of the object. In this work for the application of object recognition they have implemented three different methods. Performances evaluations totally based on ANN and SIFT related feature methods that have been applied using the similar object recognition and the rate of detection. Evaluation during

experimental process shows that extraction of features based on SIFT has a better performance in rate of detection (98 percent); while artificial neural networks based method has a better performance in terms of rate of recognition (83.33 percent) form the database consist of 80 objects.

### 3. Scale Invariant Feature Transform

The SIFT is defined as an algorithm in the field of computer vision that helps in detection and extraction of the features in given images. Patent rights were given to this algorithm by the University of British Columbia in the United States and in 1999 David Lowe published it. Given SIFT [2] ability which helps to find key Points that are distinctive and also invariant to a location, orientation and scale, and is also good in affine transformations and changes in illumination, they are mostly usable for the recognition of object.

SIFT features are obtained from the input image. These features that are detected are matched to the SIFT feature which is present in the database that are taken from the set of training images. Euclidean-distance helped in matching the feature ability based on nearest neighbor approach. This helps in to increase the robustness, the ratio of the nearest neighbor distance to the second nearest neighbor distance for the matches that are rejected for those key Points for which is greater than the value 0.8. This help in discarding many false matches that are detected from background image clutter. Thus to eliminate the complicated searches that are required to find the Euclidean-distance based for the nearest neighbor, best-bin-first algorithm is applied for better approximation.

For an object present in an image, the "description of feature" when detecting the major keypoints on the object can provided. From the training image the description are extracted, these features are then be used to detect also for identification of the object. When in process of locating the object in a test image that consist of set of many other objects. For a more reliable recognition performance [3]. It is considered that the features that are extracted can be detected even when there is a partial vision of the object and also change in other parameters of the image. Usually these points are found to be on high-contrast regions of the image, such as ends and corners of the object. One of the basic characteristics of the feature is that the positioning between the original scene that does not change from one image to another image. Features that are located in objects which has blunt edges will fail to work if their internal geometry changes between the two given images in the whole set when it is being processed. However, in practicing Scale invariant feature transform it helps in detection and use a huge amount of features from many images, thus reducing the occurrence of the error which is caused by these alteration in the local points in an average amount of error from all the errors detected by matching the features. It can strongly help in identification of objects even from the pile of objects and under a partial visibility of the objects, because the descriptor of SIFT feature is not variant to orientation, uniform scaling and illumination to change and partially not variant to a small distortion.

It's one of the efficient methods which gives a high probability for returning the nearest neighbor, which can also give an accelerating by factor of thousand when acquiring the nearest neighbor 95 percent of the time. Therefore, to increase the robustness when identifying the object. The set of features that are belonging to the equal object is clustered and rejected by the matches that fail to be similar in the process of clustering. Hough transform is applied in this process. This algorithm identifies clusters of features which are similar for the same position of the object. When these features are made to identify for the equal as that of the object pose, the probability becomes high in the analysis of being right when compared to any of the single feature. Every key Point that chooses for the set of object positions which are said to be dependable with the key Point's scale, location and angle of orientation.

### 3.1 Feature Detection

Many algorithms are mostly used for the detecting the rotation would be based on finding the average value of some set of features [4]. This part basically based on taking the average value in some set of features. The feature detection characterizes the detection of certain set of features and also different processing algorithms [5][6].

### 3.2 Edge Detection

The edge detection includes certain set of methods which are used to find the edges of the detected objects in the image given for processing and also to find contours of the object. The detection process is done by detecting the sudden change in the intensity at some of the borders. There are many different methods that can be applied to detect edge detection. The choice of algorithm is based on the individual circumstances [8].

#### Edge detection with Sobel derivate:

The operators of sobel approximate the gradient value of the intensity function of the image along with Gaussian smoothing. Within the approximated differentiation the edges are located when there is an occurrence of a jump. Accurately, a sobel mask is being applied as a convolution kernel.

For a mask consist of 3x3 is given as.

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

When there is spatial distribution of the design points in a regular manner this helps in the process of sobel distribution. In this case there are both advantages and disadvantages with in it. In sobel derivative is very much easy to implement and also processes relatively rapid. The drawback of this is that the edges may appear thicker than the requirement.

Y axis is given as:

$$\begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & 2 & 1 \end{bmatrix}$$



Fig. 1: Sobel edge detection



Fig. 2: Result image of sobel detection.

### 3.3. Laplacian Edge Detection

Laplacian edge detection it applies the calculations used for the second spatial derivative for detecting the regions where there is a rapid change in intensity. Compared to sobel Laplace image detection can help in practical implementation with the help of convolution. But the difference between two are in lapalcian the second derivative is used directly compared to sobel. Thus making it unique in image detection even though the working concept is same in gradient. The localization of edges in the image can be done much better in laplacian. But the major drawback is detection the corners and curves of the image than that of sobel detection.

### 3.4 Line Detection

The Hough transform [7] is a well-known algorithm used in line detection. It is based on a voting system for the pixels present in an image. This system decides line segment parameters and also resulting in outlining the running algorithm eventually. Thus resulting in an effective way to detect the lines present in the image. The main benefit of this is its robustness to noise and a drawback is it has relatively high complexity. The Hough transform presents a steady output of lines for particular type of objects.

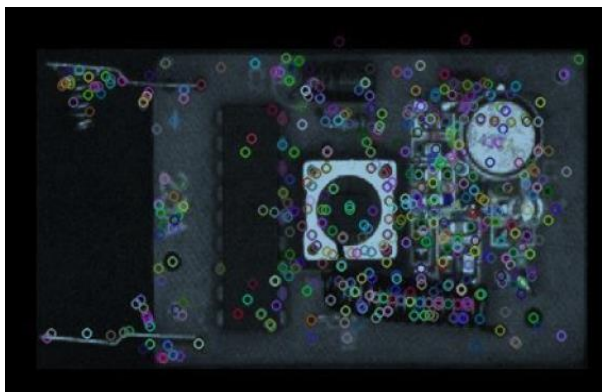
### 3.5 Points of Interest Detection

There are many types of algorithm for the detection of points of interests that help in make the image stand out. In these cases these used algorithm have robustness towards orientation, noise and other certain features while in use. One such is the SURF descriptors which uses integral images and hessian matrix. This is based on detection measures, compared to others.

It can also displays results are relatively fast on detecting points of interest effectively. in openCV it has a high level function. There are many applications for the point of intersection one important one is that it could help in relating to find the orientation angle of the image.

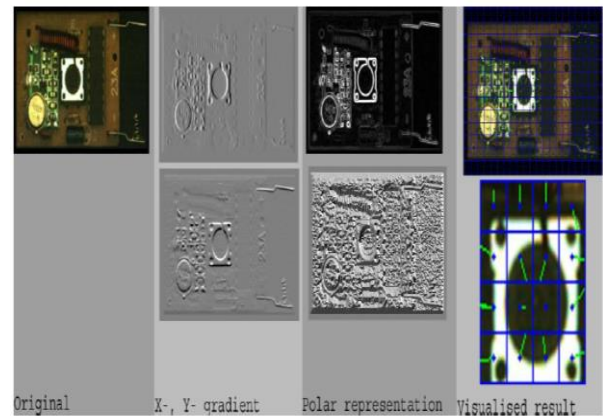
### 3.6 Histogram of Oriented Gradients

The histogram helps in implementing an algorithm for the orientation of the object in the image. Using sobel edge detection to find the intensity gradient for every pixel. The change in intensity in the slope represented by the derivative for every pixel. It's applied for both the axis(x and y) where these results are separately stores .



**Fig. 3:** A number of points of interest are detected for a circuit card

Cartesian coordinates are converted into polar coordinates and thus stored in form of histogram values. For all average polar coordinate the average value of angle is calculated. This is the angle of algorithm outputs.



**Fig. 4:** Histogram of Oriented Gradients applied image

### Background subtraction

The image segmentation algorithm important part is the background subtraction method. The process is imagining that everything but the foreground objects have a same color. Thus by using color detection which help is retiring the objects.

### 3.7 Mixture of Gaussians

Based on Grimson and Staffur an approach using Gaussian, the background subtraction algorithm for background mixtures modeling is done. With the help of Gaussian each is modeled in each color. The final step in background subtraction is done by collecting the information given by each pixel and help is construction of Gaussian. In the standard deviation in intensity when the pixel has a value different than the constant number these pixels are kept away from the rest of the distribution. one more way used in modeling each pixel as a function of Gaussian distribution depends on the color present over time . If the pixel value is stable the it is recognized as background pixel. Different values represent the foreground has taken place.

### 3.8 Image Classification

It is the description for object classification which is applies as the final step for the processing method. There are many time constrains for this methods described. Thus choosing a relatively simple algorithm such as template matching algorithm [10][16] . This has been showing results in a successful rate. Detection process is basically the most important part and many algorithms have complexity in implementing it. Opti sort is one where the image is retrieved by this method across each pixel. Thus comparing to the same corresponding pixel in the stored image which represents each object. The iteration of most pixels is done to collect all the objects that are having resemblance.

### 3.9 Key Point Descriptor

The invariance is ensured to the location, scale and rotation of the image. For each key Point detected in the image to compute the descriptor vector such that the descriptor becomes highly distinctive and partly not variant compared to the remaining variations which include illumination, 3Dimension view, etc. This step is applied on the image closest in a scale to the key Point's scale.

The first a set of coordination in histogram values are generated on the basis of 4x4 pixel neighborhoods with eight bins each [9]. These generated values are noted. The values of a 16 x 16 samples in theregion from orientation and magnitude values of samples in a 16 x 16 region neighboring the keyPoint such that every histogram samples consist of sub-region of original neighborhood region from a region of 4 x 4 . With the help of Gaussian function the magnitudes are weighted with equal the descriptor window's

one half its width. This descriptor finally inclines to a vector of all the histogram values. The unit length is normalized in this vector thus enhancing the invariant ability to affine changes in illumination. A0.2 threshold value is applied vector normalization and reduction of nonlinear effects.

### 4. Results

In this Experiment with the help of MATLAB [11] simulation we process the Printed Circuit Board as a template image and the input image using SIFT algorithm as shown in Fig.5. In the first step of the SIFT process the template image is being converted into grey scale image [12] as Fig.6 and thus the Gaussian process takes place to the grey scale image. Thus results of the Gaussian image are given as Fig 6.

The Gaussian image undergoes pixel compression so that the template image can be recognized in any pixel size in the given input image shown as Fig 7.



Fig. 5: PCB board as the template image

The key points are generated for the template image as shown in Fig 8.

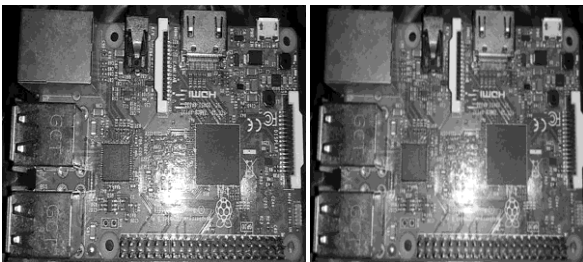


Fig. 6: The Grey Image and Gaussian Image.

After the SIFT process in the template image is done, a test image is given as an input for the detection. The test image is being also processed for key point generation to mark the key descriptors as shown in Fig 9.

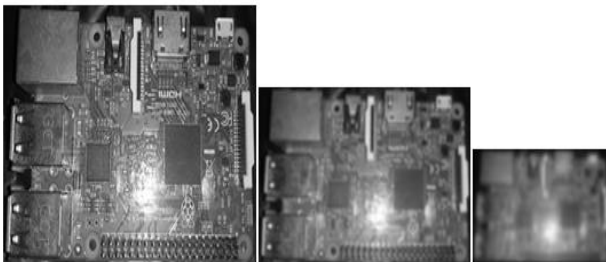


Fig. 7: Pyramid Image

The key point of the test image has been matched with the background key point [13] of the template image as shown in Fig.10



Fig 8: Key Point generation for the template image

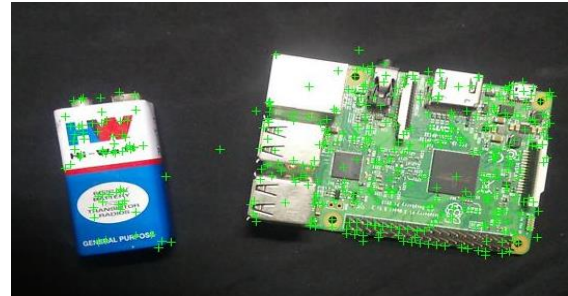


Fig. 9: Key Point generation for the test image

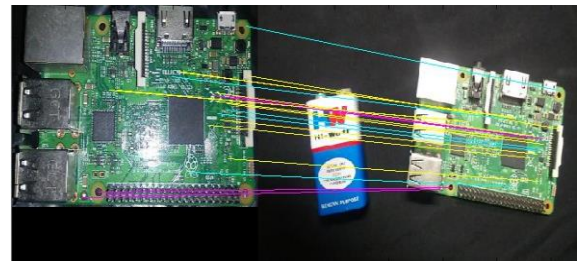


Fig. 10: Matching the Key Points

The object which has been matched with the template image has been selected from the test image and converted into a binary image. Before the conversion of the binary image the test image on the whole gets converted into binary image [15].

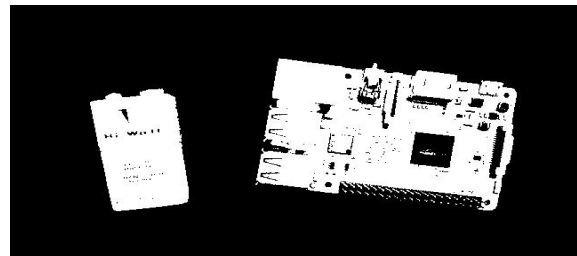


Fig. 11: Binary images



Fig. 12: Elimination of small blobs in the image

Thus the converted binary image of both the test image and the detected object undergoes subtraction thus to obtain the area acquired by the detected object.

In the results it has detected 20 key points that has been matched with the template image.

The Total pixel values are  $360 \times 640$

The occupied area value is 45837

The area is calculated by

Occupied area = Number of white Pixel

Occupied Percentage =  $(\text{occupied area} / (\text{row} \times \text{column})) \times 100$

## 5. Conclusion

In this paper we studied about the detection of Electronic waste form a pile of other waste using SIFT. The results produced by the simulation gives an accuracy of 75% Furthermore this method along with feature extraction can be evolved in real time for detection of Electronic Waste in a larger amount.

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