Analysis

We started with taking into consideration the SURF features. Once the SURF Descriptors are extracted we matched them, the reason for using SURF was because SURF is one of the most robust algorithm least susceptible to image quality and orientation transformations like change in brightness of surrounding lighting or change in orientation.

The use of minimum eigenvalue feature algorithm enables us to detect not just corners and edges but also blobs (in other words plain surfaces), because of this we are able to precisely pinpoint the boundaries of all objects present in the scene.

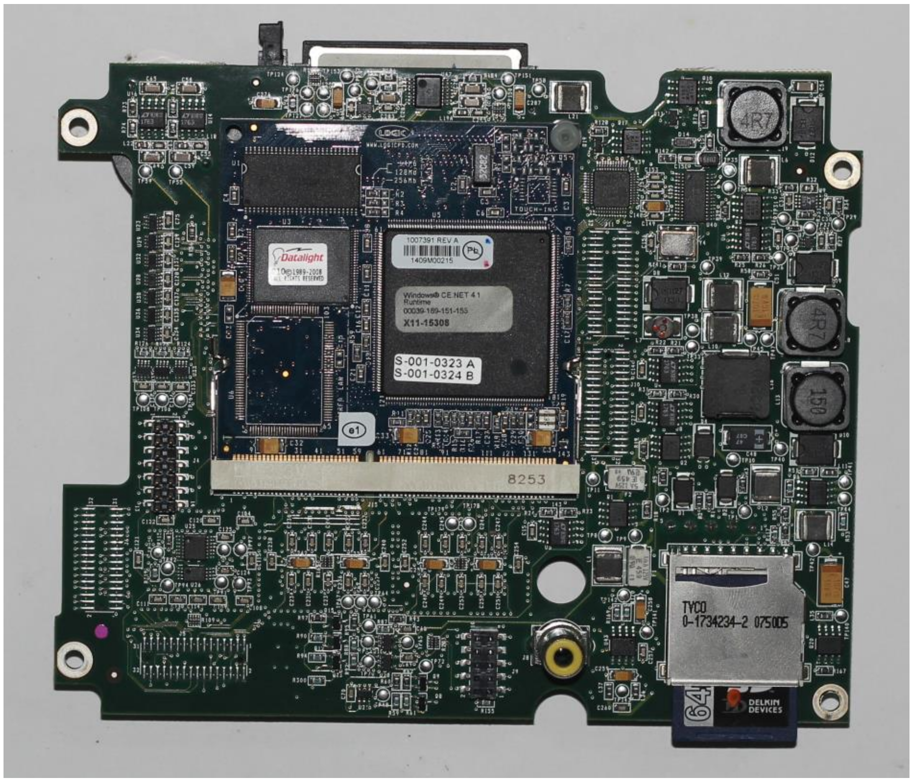
The two MAIN algorithms: The two main algorithms that we deal with are SURF and Minimum Eigenvalue features.

1. SURF
   The object with less greyscale variations

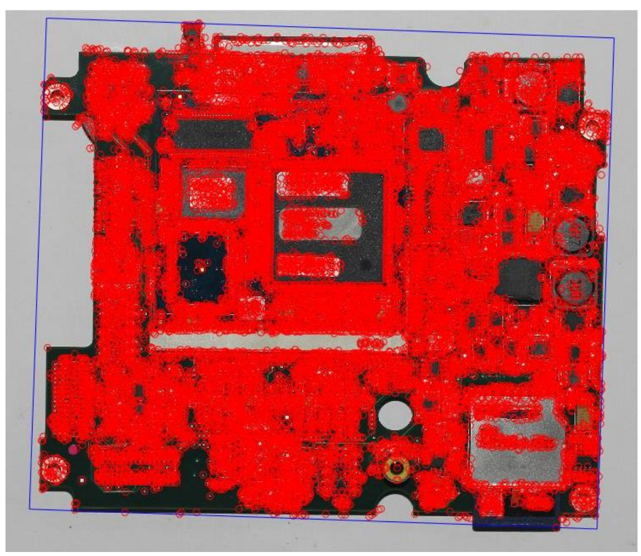
Surf applied to object with less greyscale variations

SURF algorithm has failed to recognize most of the features in this image

Object with a lot of greyscale variations



Surf applied to object with a lot of greyscale variations



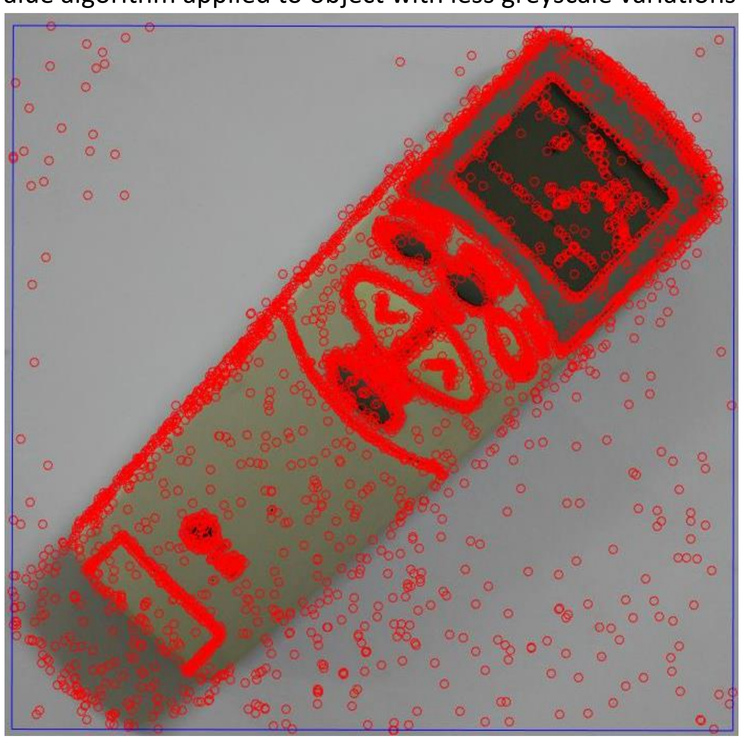
(In the image descriptions state that the red circles are SURF features)

SURF successfully identified a lot of features in this image full of greyscale variations

2. Minimum eigenvalue feature detection algorithm

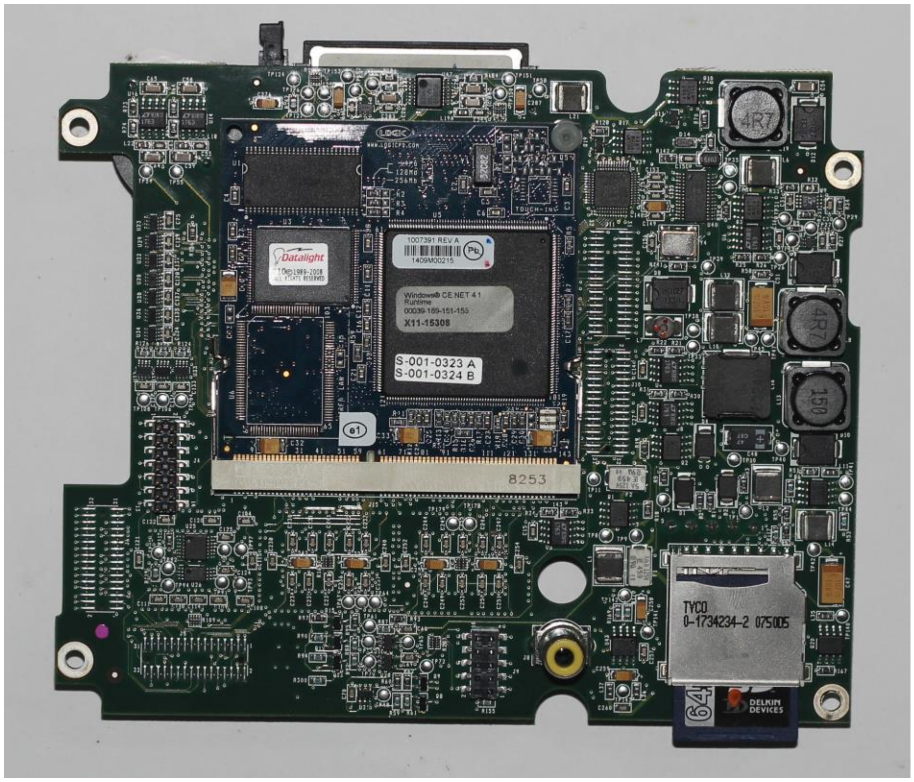
Object with less greyscale variations

Minimum eigen value algorithm applied to object with less greyscale variations

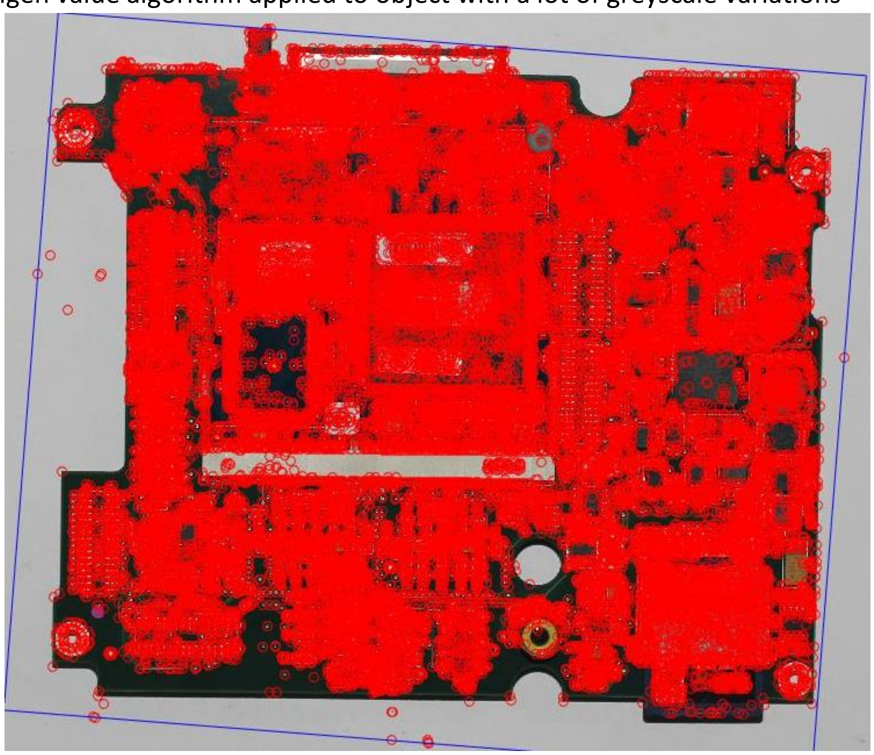


(In the image descriptions state that the red circles are Minimum eigenvalue features)
Minimum eigenvalue algorithm was successfully able to determine not only corners and edges but also slight variations in blobs too.

Object with a lot of greyscale variations



Minimum eigen value algorithm applied to object with a lot of greyscale variations



As the SURF algorithm performed well on this image full of greyscale variations so did the min eigenvalue algorithm

By seeing the above images we can conclude the following things

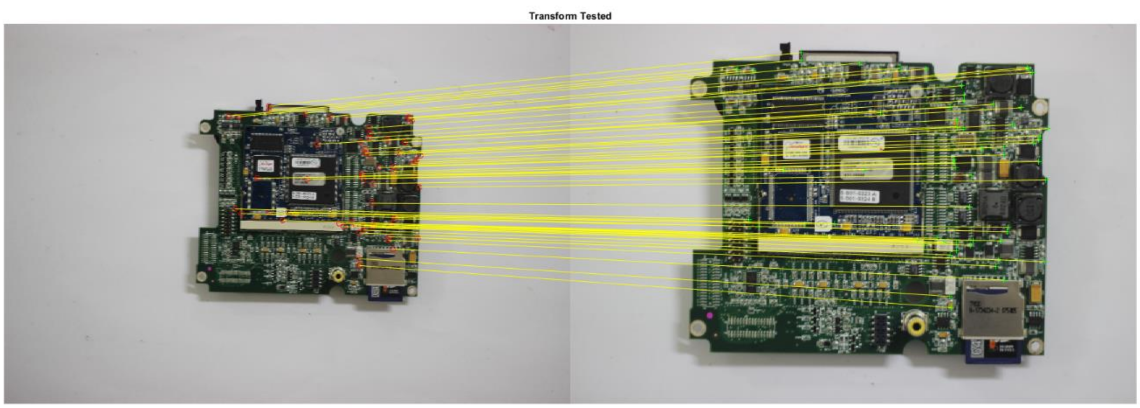
1. SURF feature as well as Minimum eigenvalue feature detection algorithm both

Advantage of our approach: For considering the advantage, we consider few examples clearly stating the advantages of our combined method over only surf or only Minimum Eigenvalue.

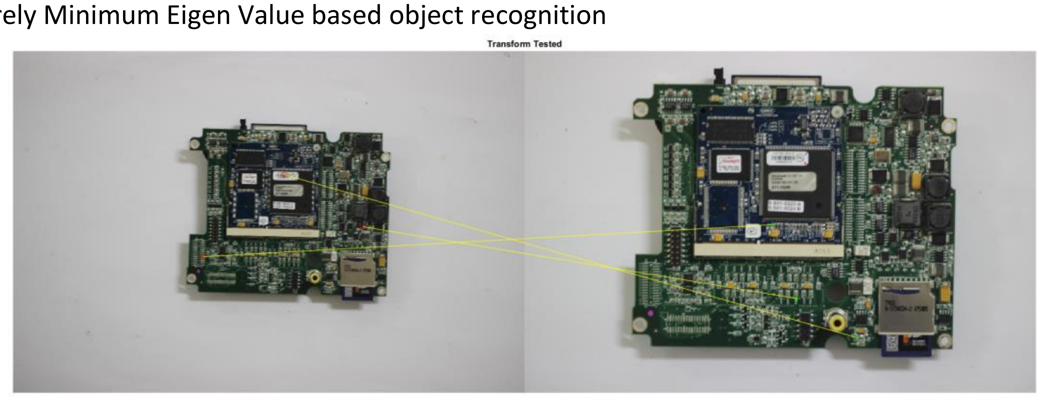
Consider the following cases

1. Purely SURF based object recognition
2. Purely Minimum Eigen Value based object recognition
3. Combination of both

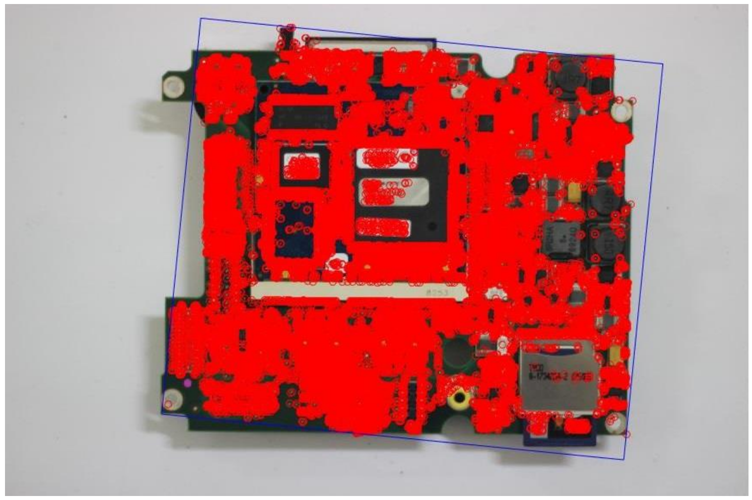
1. Purely SURF based object recognition



2. Purely Minimum Eigen Value based object recognition



3. Combination of both



It is not only able to appropriately select the object from scene but also able to detect its edges. The locations points obtained after running SURF feature matching algorithm are further used to select the best clusters of points of minimum eigenvalue features.

Disadvantage of our approach

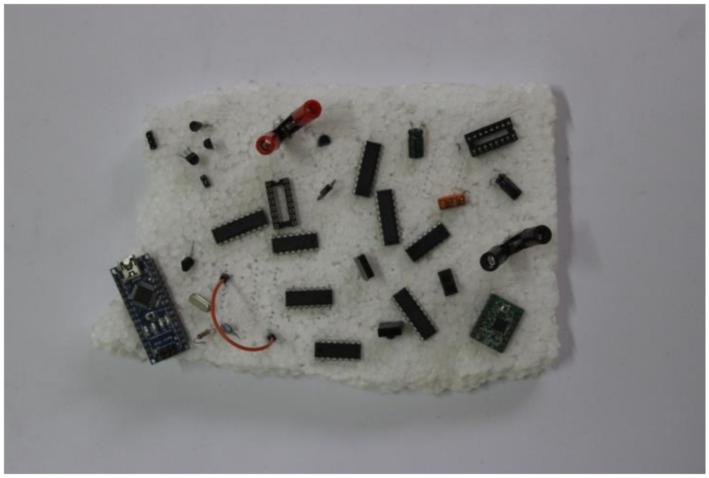
1. A lot of data acquired from SURF feature descriptors algorithm applied on object as well as scene image gets solely used for the purposes of matching object with scene but is not used to match the scene matched SURF descriptors with Scene minimum eigenvalue features.
2. The algorithm runs on parallel processing thus might yield different correct results for same pair of images. Although this may not be considered as a disadvantage, the algorithm may yield different description for the same image after multiple iterations.

For analysis of the algorithm we use a sample image with moderate variation of colors with change in orientation to analyze the robustness of our algorithm. Discussed is the result of one such analysis of set of images whose parameters are as given in the table below,

Polar Angle "φ" (Approximate)	Average Luminous Intensity of Image
0^o	6.253280 %
45^o	6.208900 %
60^o	6.245270 %

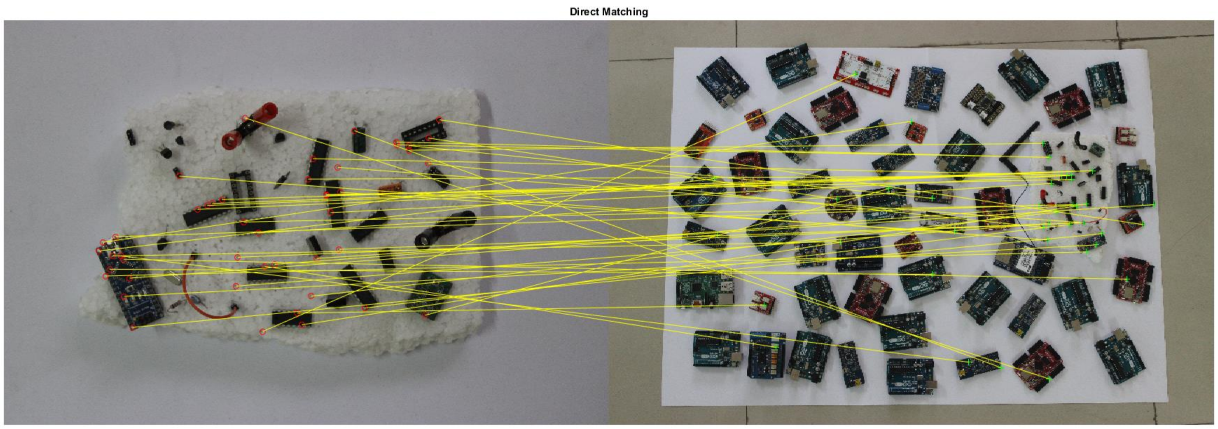
The luminous intensity of image is calculated giving 29.9 % weightage to Red values, 58.7 % Weightage to Green values and 11.4 % Weightage to Blue values and average being carried out by Root mean square method, values being selected with reference to Digital Consultative Committee for International Radio 601 (Digital CCIR 601)

The object of choice is an image of ICs at 0 degrees from vertical



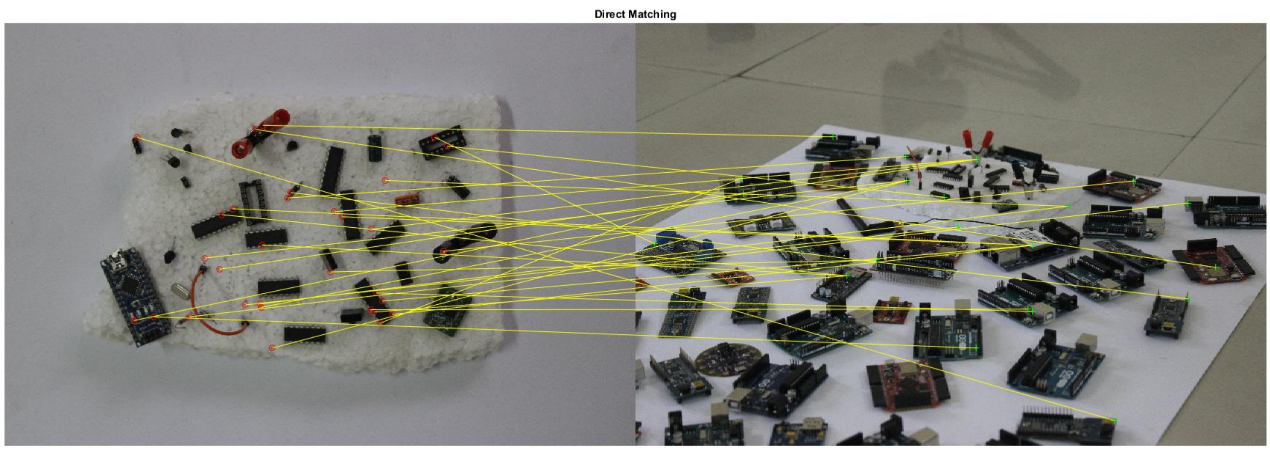
Scene at 0 degrees

Matching at 0 degrees

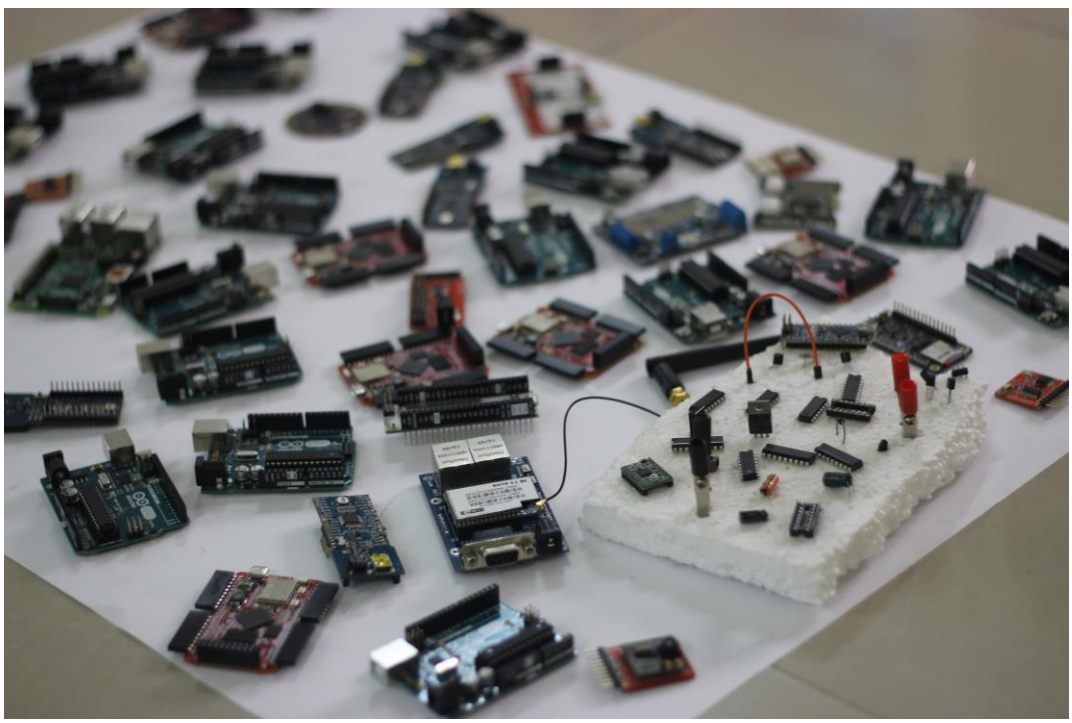


Scene at 45 degrees

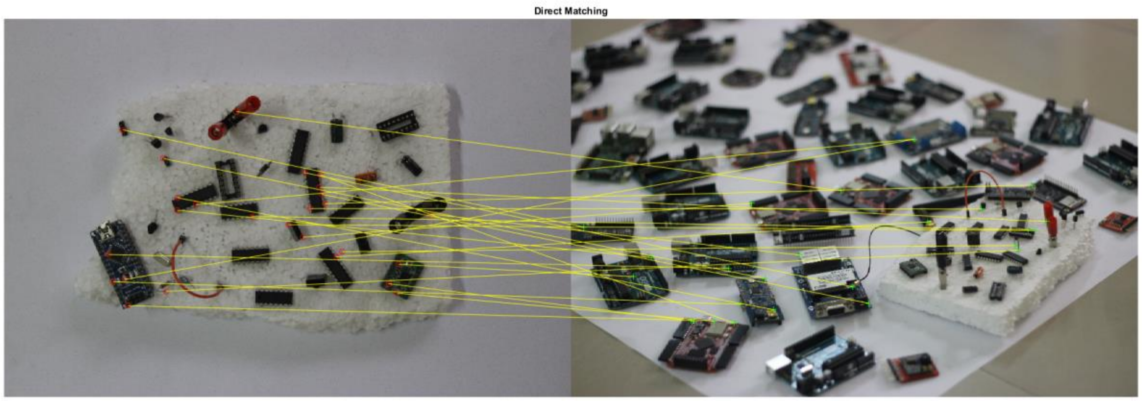
Matching at 45 degrees



Scene at 60 degrees

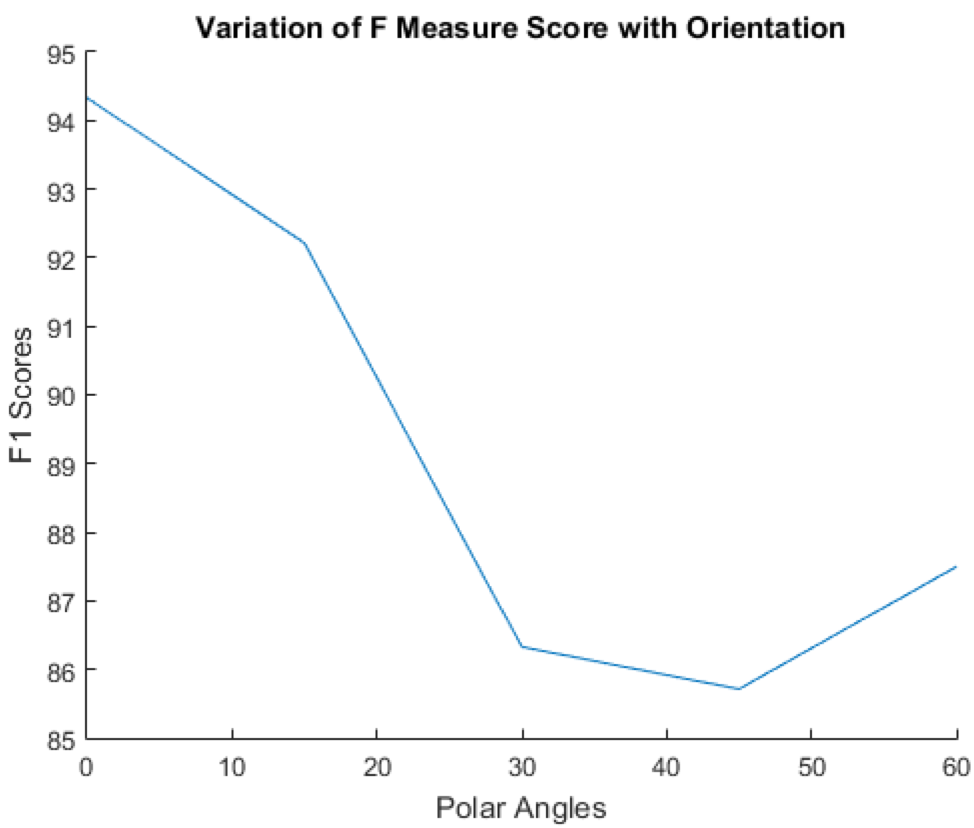


Matching at 60 degrees



Application of F-Measure:

We use the concept of F-Measure and obtain the F1 Score of the object scene pair at every 15 degrees change in orientations to analyze them.



For analysis purposes we consider 3 of them.

The (relative) F1 scores are as follows

Angle with the vertical (Approximate)	F1 Score
0^o	94.339623 %
45^o	85.714286 %
60^o	87.500000 %

The F1 score ideally speaking should have reduced gradually with increase in the angle with the vertical. But it seems to have increased dramatically by 1.785714 %

There exists two explanations for that,

1. As we can see in the table of luminous intensity, the average luminous intensity of image has increased by change in orientation of the image thus increasing the number of features detectable on the image.
2. The image of the object in the scene with 60 degrees orientation is much sharper than the image with orientation of 45 degrees the reason being image of object is not in the center of the scene thus another parameter comes into consideration, that being the azimuthal angle "θ"