Enhancing Sales by using information with the help of Object Detection and Object Storage.

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***Abstract*— In this project by using the Haar Cascades, the logo of the product is detected and information is gathered from XML files located at remote database, which resides on object storage (swift). Web scraping is used to obtain the data stored in the XML file. The information is displayed which can include the reviews, price, contact or official website to order. The ADA-BOOST machine learning is used to weigh the positive and negative images and separate them according to the requirement of the logo. All these features are cascaded to create a strong classifier. The use of Cam-Shift can be done to create a real time tracking. Every object/logo detected by Haar-Cascade can have its corresponding detailed entry in hosted XML file. This helps in boosting the sales where the user forgetting the product to purchase will be reduced if he has no prior information about the product. The use of object storage allows us to access large amount of product data via REST API at fastest rate of time, which reduce time complexity, and latency of information gathering.**

Keywords—Object detection; swift; Haar; Real-time; WebScrapping, REST API

I. INTRODUCTION

The E-Marketing or the E-Commerce is having a boom in today's generation. Online marketing and door-to-door delivery system is taking the sales to next level. Awareness among the people is increasing to a higher extent about the products and their services or their quality. However with the increase in awareness also comes the increase in competition among the vendors. Hence most of the people might tend to forget the product in a matter of time, which might make them go for a rival company with other offers. Hence it is important to create awareness about the products if it is unknown to the user.

Hence this project comes in picture where by just scanning a product logo can show necessary detail about that product over camera screen for better accessibility of information about product. Main challenge in the project is accessibility to credible and accurate information about product/logo. To solve that problem object based storage solution is used as centralized database of product information. To gather information from object storage REST API is used over HTTP protocol and web scraping is used to filter required data from XML database.

Here for detecting the object the algorithm suggested by Viola-Jones for Haar detection using ADA-Boost is used. This helps in detecting the positive logos and elimination all the unnecessary noises from the image. The feature in every object is 1,60,000+ out of which only strong features are selected where the classifier is created in the XML format containing these features. This XML is then fed to the program (python code), which then recognizes multiple images. To increase the optimization of the program the use of Parallel Python along with to speed up the operations of detection. In this way a credible and reliable information about the product can be presented at real-time and on demand to boost the sales and services about the products.

II. METHODOLOGY

The following diagram describes the flow of the project design and the connectivity between the components.

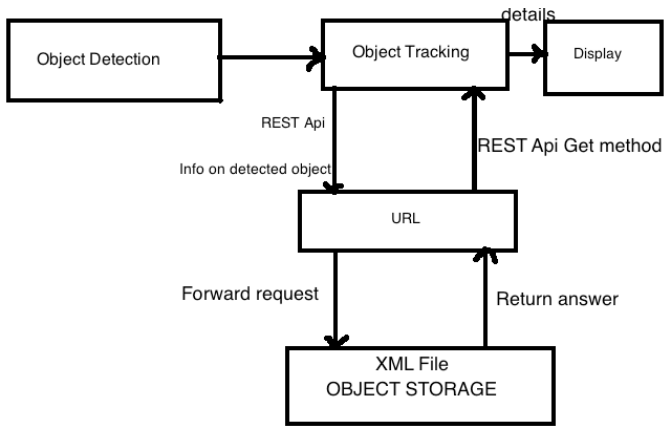

Fig. 1 Flow of the components

1.) Object Detection

a. Haar Features
b. Integral Image
c. ADA-Boost
d. Cascading classifiers

2.) Object Tracking

a. Mean shift

b. Histogram Back Projection

c. Cam-Shift

3.) Rest API

4.) Object Storage (Swift)

III. Object Detection

A. Haar Features:

Convolution matrix also known as mask is a matrix used for image processing operations such as embossing, edge detection etc.

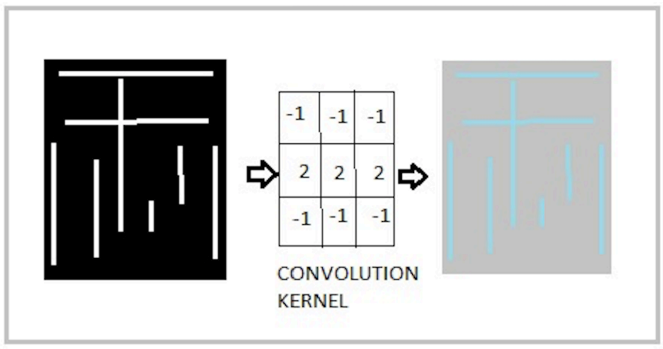

Fig. 2. Convolution Kernel.

Convolution kernel pixels, which are derived from the white pixels in the black background from the input image perfectly matches with the high intensity pixels in the output image. Here any object detection performance includes scanning of the particular required object and filling the image in the form of black and white pixels. Afterwards, calculation for the every haar feature is done where sum of black intensity pixels and white intensity pixels are calculated. There are different haar features used for the detection of the object are as following:

1.) Edge features.

2.) Line features.

3.) Four rectangle features

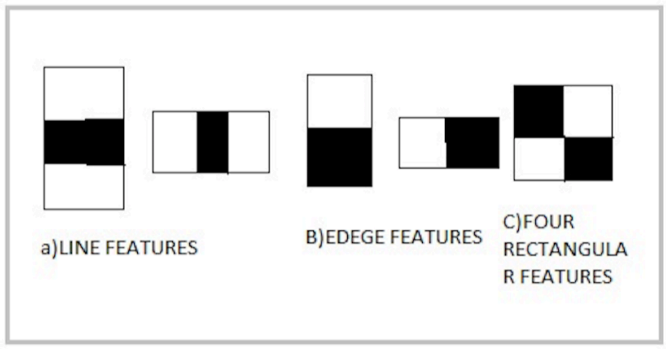

Fig. 3. Types of Haar Features

For example in a particular object detection, in a standard 24*24 pixels sub window, there are total of around 162,336 features which are too much costly for evaluation point of view. In object detection framework, to train the classifiers and selection of the best features AdaBoost algorithm is used. To make efficient classifier for the object detection minimum 6000 positive images and 10000 negative images are required. Integral image is a new innovative method for the calculation of sum of the pixels.

B. Integral image:

Integral image also known as summed area table used for the effective and fast calculation of the sum of the pixels in a rectangular subset. It is necessary condition that image used is gray scale for the calculation. To calculate an integral image we have to first calculate the summed area table. In summed area table every pixel is calculated as summation of pixels present in the left and above of the position of current pixel value.

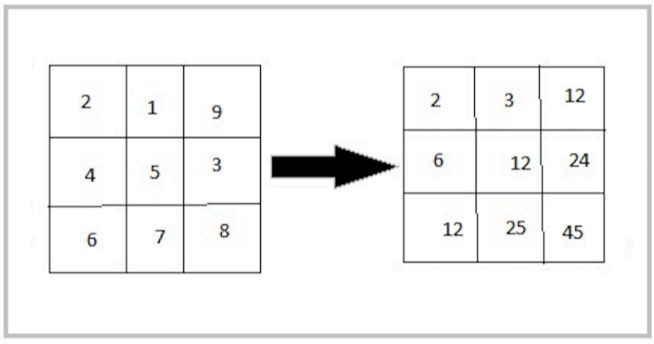

Fig. 4. Integral Image.

Below formulae show the calculation of the current pixel value the summed area table. Complexity calculation is done in the o(1) time which is very much fast as compared to other algorithms. Formula can be expressed as in simple terms as:

$$P(x,y)=P(x,y)+P(x-1,y)+P(x,y-1)-P(x-1,y-1) \quad (1)$$

$$AREA(Z)=D+B+C-A \quad (2)$$

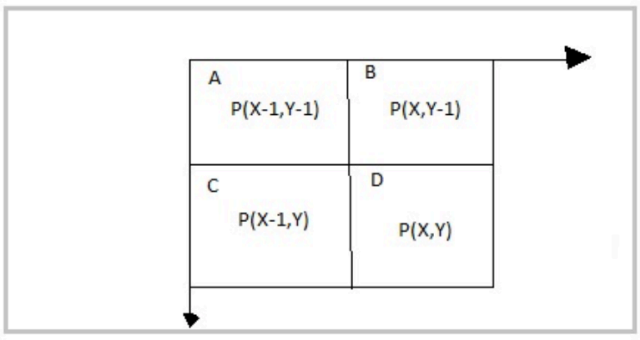

Fig. 5. Calculation of Area.

So using these features, it is easy to calculate the calculation of current pixel value and aggregate the performance of haar features.

C. Ada-Boost Algorithm:

Ada-Boost is a machine-learning algorithm used to detect features present in a particular sub window. After finding out all the features, to detect particular object weighted compilation of all these features are taken into account to check object is present or not. Ada-Boost algorithm boosts the process of finding out the classifier. It is just the summation of all the weak learning classifier. Weak learning classifier predicts the object detected belongs to which class. Strong classifier is made up of summation of all weak learning classifier. Strong classifier gives the absolute value, which gives the confidence in that classification. In every weak classifier is each sample is assigned some weight equal to the current error on that sample. Ada-Boost is used to find the threshold in accordance with the single rectangular object features that separate out positive and negative training samples according to the weighted error. Every weak classifier can detect half of the positive features. Remaining features can be detected with the help of chain of weak classifiers.

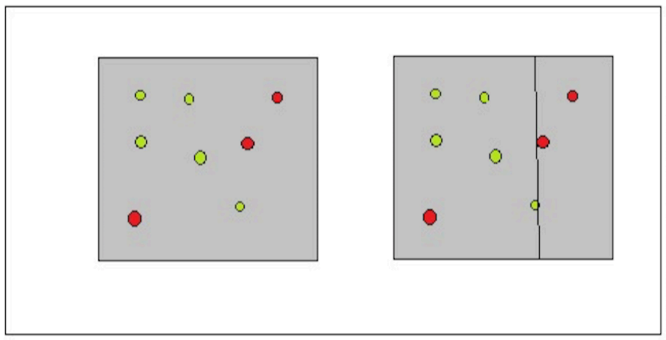

Fig. 6. Transformation using ADA-Boost I

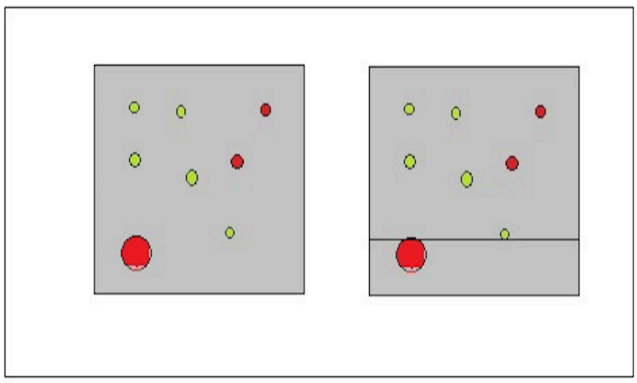

Fig. 7. Transformation using ADA-Boost II

Suppose in given figure, most of the positive features are detected as marked with small green circles. But it contains some negative features also. Now the weight of negative features is increased according to the error. In the next image negative features are detected but it still contains some negative features. Finally, weight of all negative features is increased and results are obtained by increasing the weight of false detection and final classifier is made which is summation of all weak classifiers. Final result is shown below:

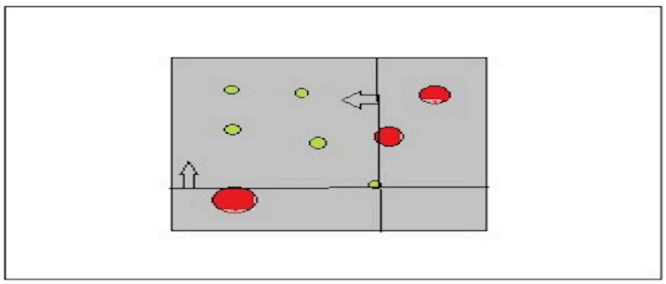

Fig. 8. Transformation using ADA-Boost III

ALGORITHM:

1.) Error should be calculated for each feature and effective ones are chosen.

2.) Positive features are assigned lower weights and negative features are assigned higher error weights. Repeat from step 1 till it forms good classifier.

Equation of ADA-Boost algorithm is given below:

$$F(x) = \alpha_1 f_1(x) + \alpha_2 f_2(x) + \alpha_3 f_3(x) \ldots \alpha_n f_n(x) \quad (3)$$

α = Random weight

f(x) = weak classifier

F(x) = strong classifier

D. Cascading Classifiers:

While designing a strong classifier it is necessary to consider number of features, stages and threshold of the classifiers. Classify the same image with different window size is overhead in terms of time and energy. Even if the image contains some positive features but it may contain more negative features. Hence the algorithm should be efficient enough to capture negative features and discard it. For this purpose efficient classifier should be made with all strong classifiers. It is difficult and time consuming to obtain it in a linear fashion. So new technique came to existence known as cascade of classifiers. It contains all strong classifiers arranged in cascade form. If first classifier detects the object then it pass the sub window of an image to the next classifier otherwise it discards the whole image. Input to the classifier is in the form of sub window. Then at next stage classifier again checks for positive features in an image. Thus cascade of classifiers is formed in order to fast and efficient detection of positive features in an image. Cascading classifiers has degenerate tree structure. Cascading classifiers are shown in below schematic representation:

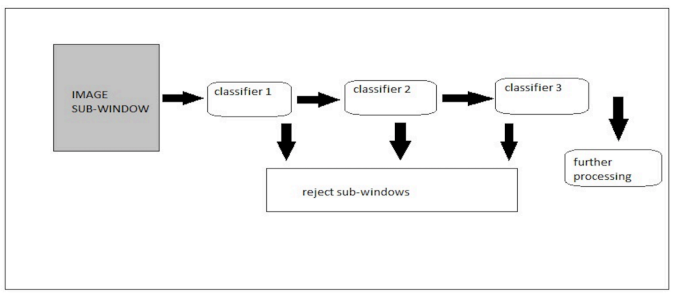

Fig. 9. Cascading Of classifiers

IV. OBJECT TRACKING:

A. *Mean Shift:*

This algorithm is used for processing the face in a real time environment by controlling camera.

1) RGB images captured in real time are converted to HSV
2) Selection of the hue value (H) of the image is made.
3) Dimensions of the window are chosen.
4.) Primary location of the search window must be chosen.
5.) Center Of Mass of the object is calculated
6.) Center of the window is found at the center of Mass
7.) On convergence the parameters are computed or else the algorithms restarts at step number 5.

B. *Histogram Back Projection:*

A random window is initially chosen to track the face. The hue values from the window are calculated and histogram is constructed from those values. This histogram is used for reference to convert the further RGB pixels into Histogram pixel values and is used for future calculations.

C. *Cam-Shift:*

This algorithm is used to adapt to the change in screen size when the object is being tracked. The following formula can be used to show the parameters of CAM-Shift.

$S=2* \sqrt{M_{00}} /256$ (4)

S = width of the window.
M = Moment of order zero for the camera.
Length of the window = 1.2*S

V. OBJECT STORAGE

Object storage is capable to handle any kind of data like pdf, jpg, tar, machine images like vmdk, ami etc. Following steps define the use of Object storage in this paper.

1.) Proxy server is used to handle the incoming or outgoing requests.

2.) This proxy server forwards the incoming reques to ring as shown in the diagram.

3.) This ring is used to map the physical locations to the name of the entities stored on the disk.

4.) Now the hashing is applied to the file name and binary format of the answer is obtained which is used to map the physical location in storage cluster.

5.) Object can retrieved via RESTful API.

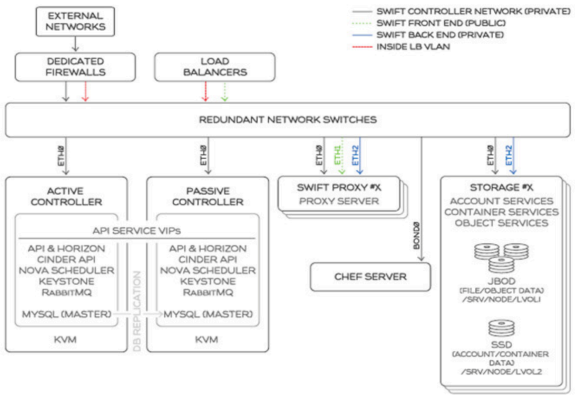

Fig. 10. Object Storage Swift

This RESTful API is used to get the XML file information about the product whose logo is detected by haar cascade. The storage capacity is exponentially large as compared to the traditional storage system that makes this a perfect choice for handling large data with low latency.

V. IMPLEMENTATION:

The following flow diagram describes the path of the components that are connected:

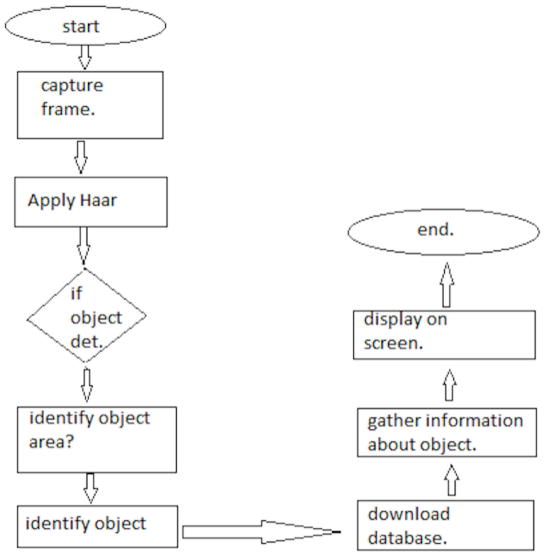

Fig. 11. Flow Chart

In the flow diagram the following steps are being performed:

1.) Initial step is to get the frames at 60 fps.
2.) The Cascade Xmls are used to detect the respective objects.
3.) Once the objects are identified the string associated with them is mapped to index attached with them.
4.) This index then makes a request to object storage using RESTful APIs
5.) The required database file (XML format) is downloaded to the system.

6.) The data from the file is fetched using Web Scraping and displayed on (n+1)th frame. Where n is the captured frame.
7.) The information contains the reviews, ratings, contacts and price

Here the object storage is updated with the database where the data is added every time a new Haar Cascade file is added. This helps to keep the information intact without spamming the user with wrong or exaggerating information.

VI. RESULTS:

For the Results, this project was tested on products launched by Hatcube. Here the product was shown to 10 random people in an exhibition form in morning.

Fig. 12. Product without app use.

There was no guide and the products just had their Logo present in them. Later on it was observed that only 1-2 out of 10 people on an average remembered the product and ordered it in the evening. This test was performed on 100 people in the first day.

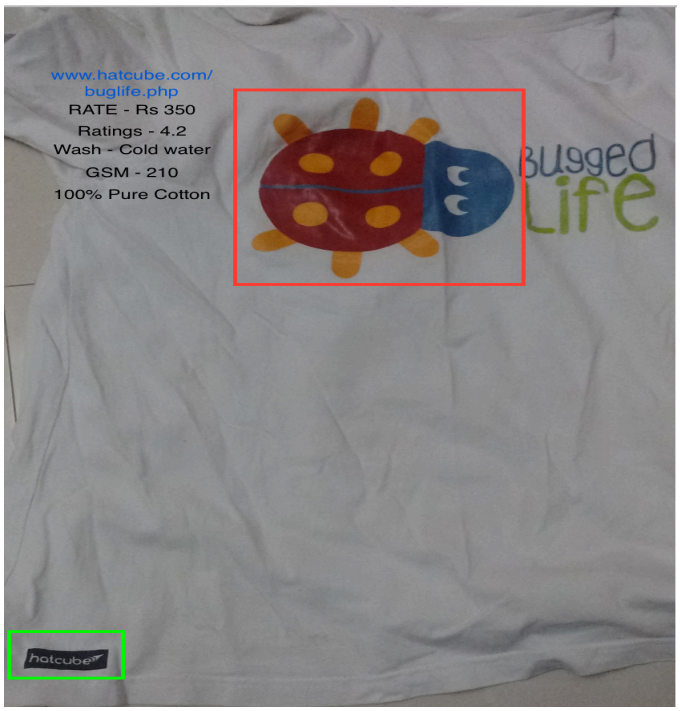

Fig. 13. Product with app use.

The next day same test was performed on 100 people, which did not include the people on previous day. These people were given this application, which included the logos of the HatCube product. It was found that the people used the application and found the review of the products and it's rate on the spot and ordered the product if it inclined with their interest. Around 3-5 people in every 10 ordered the products. So the total sales in the first scenario was 18 orders for the products and in second case it was 43 orders. Therefore even the people can use this application on the roads to scan any vehicles or other products and find their information, which boosts the sales of the products by placing them in people's memory.

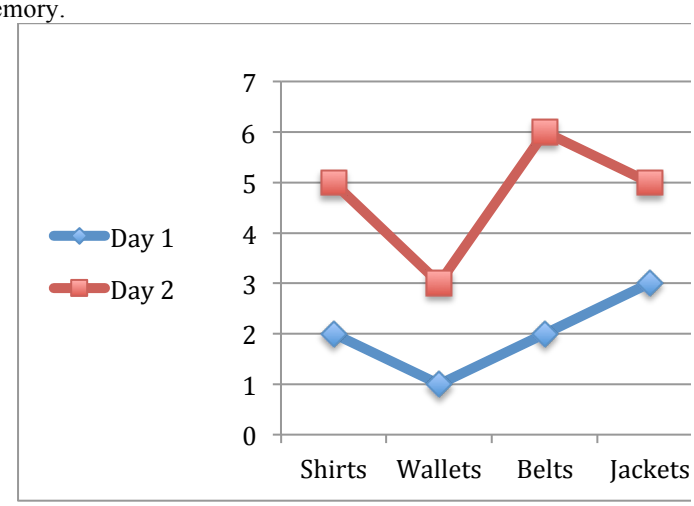

Table. 1. Comparitive study between the products

VII ACKNOWLEDGEMENT:

We would like to thank our friends, parents and HATCUBE for providing their products for the research purpose and funding us for the same.

VIII FUTURE WORK:

Making this project open source for supporting more logos and product shape identification and enhancing the cloud database server by making a private cloud.

IX CONCLUSION:

Information is very crucial in the sales and marketing environment. The lack of information may mislead the buyer or may cause heavy loss for the manufacturer. It's the human tendency to forget the product's name, which is necessary to find the information online. Therefore the use of Computer vision algorithms is done in order to track the object and the logos on them and identify the products. Based on this identification a token number is associated with them which is passed via REST API to object storage where the xml file containing the product information is stored. The web scraping tools are used further to get the required information from the xml file and display it in text format on the product itself including the website URL from which it can be ordered. Since the user ratings and all the properties are shown the product quality can be judged convincing the user to buy them. They can be used in the real life scenario where a user may like some product in real-time and can obtain the information by just scanning the logo and the product shape. Hence this on-demand information delivery can be promising and can boost the sales of the product.

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