ROCK PAPER SCISSORS GAME

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***Abstract— Receiving a specific object image in the video frame and classification process is used in many fields. With image processing methods, background cleaning and object detection are simplified and integrated into many systems. Image processing methods, especially used in industrial and military fields, are used to develop a game in this project. The background separation of an object, the extraction of HOG (Histogram Of Oriented Gradient) values, and the classification operations are among the processes used in the project.***

**Keywords — Skin detection; hand detection; openCv; histogram of oriented gradient; machine learning; supervised learning; image processing; video processing.**

***Özetçe—Video çerçevesi içerisinden belirli bir nesnenin görüntüsünün alınması ve sınıflandırılması işlemi birçok alanda kullanılmaktadır. Görüntü işleme yöntemleri***

***ile arka planın temizlenmesi ve nesnenin algılanması oldukça kolaylaştırılmış ve bir çok sisteme entegre edilmiştir. Özellikle endüstriyel ve askeri alanlarda kullanılan görüntü işleme yöntemleri, bu projede bir oyun geliştirmek için kullanılmaktadır. Bir nesnenin arka plandan ayırması, HOG değerlerinin çıkartılması ve sınıflandırılması işlemleri proje kapsamında kullanılan işlemler arasında yer almaktadır***

Anahtar Kelimeler — ten tanıma; el tanıma; openCv; yönlü; histogram; makine öğrenmesi; eğitimli öğrenme; görüntü işleme; video işleme.

# INTRODUCTION

Today, image processing is an important part of computer technology. Face and body identification and recognition, motion detection, serial production control of the production of these constitute only a few of them. The game market is also affected by this development and is in an effort to capture a virtual reality with special camera systems and motion sensors.

The goal in this project is to develop a rock-paper-scissors game, the well-known game, to play against the computer using standard computer cameras and image processing algorithms. The project is to detect the hand in a basic video frame, to identify the three basic movements made, and to match these movements from the generated database.

* 1. Preliminary Examination

OpenCV is an open source C++ library for image processing and computer vision, originally developed by Intel and now supported by Willow Garage.   
It is free for both commercial and non-commercial use. Therefore it is not mandatory for your OpenCV applications to be open or free.

It is a library of many inbuilt functions mainly aimed at real time image processing. Now it has several hundreds of image processing and computer vision algorithms which make developing advanced computer vision applications easy and efficient.[1]

As result of the researches carried out within the scope of the project, it has been observed that the most noticeable thing during the construction of the project is that the hand is perceived very cleanly inside the video frame. In similar projects examined under the project, it seems that they are cleaning the background very easy.[2] But in these projects the background is usually designed as a single color. It is also unclear whether it has been tested under different environmental conditions. For this reason, it has been decided to design the project in accordance with changing ambient conditions.

In summary, there are not found projects that can perceive hand in every environment with image processing methods. However, the sample projects found have contributed significantly to this project.

# SYSTEM DESIGN

When designing the system, it focuses on three basic algorithms. These are Skin Detection, HOG and K-NN (K-Nearest Neighbors).

* Skin Detection: By taking the average of the sample skin colors from the inside of the video frame, the hand object is found by changing the colors that fall within a certain range. This is done using the "inrange" function in the OpenCv library.
* HOG: The use of HOG was first proposed by Shashua[3] and Dalal[4]. In the HOG method, the aim is to define the image as a group of local histograms. These groups are the histograms of the magnitudes of the gradients in the orientations of the gradients in a local region of the view. The calculations necessary for the apprenticeship of HOG values of a view are realized as follows. First, apply horizontal and vertical Sobel filters to determine the edges, Ix and Iy (Equations 1 and 2). The following formulas are used to calculate the gradient and the orientation angles of these gradients (G and θ ) using the Ix and Iy images with the Sobel filter applied.[5]

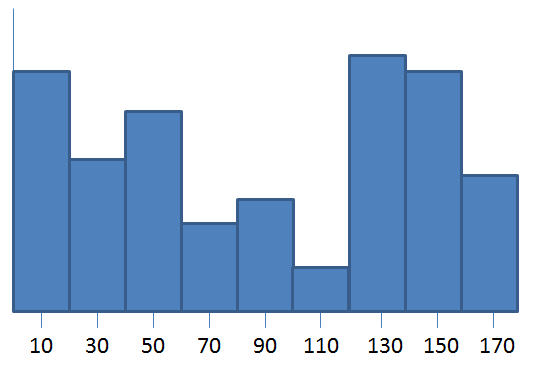
(1)

(2)

(3)

(4)

Each value calculated as a result of the formulas is placed on a vector divided at regular intervals of 0-180 degrees. Each bin that is allocated in this placement will have its own value. The bin graph of the resultant HOG operation is shown in Figure 1.



**Figure** 1. Bin Graph

* K-NN: In pattern recognition, the k-Nearest Neighbors algorithm (or k-NN for short) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression.
  + In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbor.
  + In k-NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbors.

The three algorithms described above are used in the following order.

1. Skin detection process for hand detection from video frame.
2. HOG operation to extract the HOG description values of the detected hand object.
3. The extracted HOG description values are stored in the database together with the class tag.
4. The K-NN algorithm is used to compare the HOG description values of the hand object with the data in the database during the game.

# EXPERIMENTAL STUDY

The project has applied testing operation at certain intervals. The results obtained after these testing operation are examined below.

The vectors generated as a result of HOG Description are recorded together with the shape tag (class information) in the database in the training section. After this step, we try to estimate the hand shape of the user in the game section by looking at this database from the nearest 1 neighbour to K-NN.

Within the scope of the project, this data has been tested in a program other than the project. As a result of the tests performed with this program named WEKA, it was observed that the success rate is 80%. Within the project, this classification process is compared in two ways. These;

* Before trained by the user: This section does not include the user's hand shape in the database. The success was tested on the data of the old users and the success was determined as 63-86%. According to Weka results shown that confusion matrix Table 1. and Table 2.

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | Classified as |
| 3 | 7 | 0 | a = 1 |
| 0 | 10 | 0 | b = 2 |
| 0 | 4 | 6 | c = 3 |

**Table** 1**.** Confusion Matrix1

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | Classified as |
| 3 | 7 | 0 | a = 1 |
| 0 | 10 | 0 | b = 2 |
| 0 | 4 | 6 | c = 3 |

**Table** 2**.** Confusion Matrix 2

* After trained by the user: In this section, the hand shape of the user in the database is already available. Success was tested on the data of the old users and their own data and the success was determined as 83-96%. According to Weka results shown that confusion matrix Table 3. and Table 4.

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | Classified as |
| 3 | 7 | 0 | a = 1 |
| 0 | 10 | 0 | b = 2 |
| 0 | 4 | 6 | c = 3 |

**Table** 3**.** Confusion Matrix 3

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | Classified as |
| 3 | 7 | 0 | a = 1 |
| 0 | 10 | 0 | b = 2 |
| 0 | 4 | 6 | c = 3 |

**Table** 4**.** Confusion Matrix 4

# RESULT AND DISCUSSION

When the results are examined, the recognition of the hand shape of the user with training data is higher than that of the successful, non-training user. Also, as the number of training data in the system increases, the success of the system in recognition will increase.

Advantages of the project :

* Easy color calibration
* Works on every operating system
* Multi-user
* Ttraining and test data are saved both on the hard disk and in the database.
* Training data can be output as weka file format

Disdisadvantage of the project :

* Because color-based recognition is performed, recognition of hand may not work correctly in all environments
* There should not be any other objects with the same color manually in the web camera field of view.
* As the amount of training increases, the speed of system recognition may decrease

# CONCLUSION

In the project, it was observed that the overall hand recognition performance was approximately 80%. As a method, identification and training were done by using HOG methods in OpenCV library. With the K-NN algorithm, classification of HOG values for new arrivals is provided. In the K-NN algorithm, 1-nearest neighborhood has been used to determine the class. As the number of neighbors increases in K-NN, success has been observed to decrease.

Application success has been tested by accepting certain restrictions. These;

* There should be only a hand image on the screen, body parts without clothes on the face, arm etc. should not stay in the frame.
* The user must perform the calibration process completely each time.

Apart from these, if background is a single color, success rate increase.

In future work, this system can be developed with higher resolution cameras or using Kinect. The distinction between the samples with increasing color quality on this side may be more evident. The system using Kinect can provide quite high performance due to distance information.

##### REFERENCES

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