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Research on Crazybit

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***Abstract:** The author of the project is aimed at developing a small scaled Computer Vision based Gaming Application, which can increase and promote physical activities to cope with the problems such as obesity, hypertension, cardiac disease. Author used an open CV HOG algorithm for mapping the user's hand as a controller to the game, which can increase the frequency of hand i.e. 60-270 oscillations per minute for a proactive user.*
***Keyword:** Histogram of Oriented Gradients, RT-Detection, Artificial Neural Network, TensorFlow, Optimization.*

I. INTRODUCTION

Video games have been increasingly appealing not only as an entertainment for children and adults, but also as an object of interest in academic research. Psychology and cognitive science research have been investigating the effect of video games on the players in the means of development of personality and cognitive abilities. In this research paper the author endorses the human body as an interactive input device for the computing purpose. The human body controllers can be more and more popular than physical hardware controllers as it provides better interface, communication and can potentially cut the cost of hardware and increases the portability of the conglomeration. Human body controllers can be a potential replacer for many hardware devices which are generally used in gaming and can promote more of a physical exercise which can result in physical as well as mental wellness of a user.

II. METHODOLOGY

A. Problem Statement

The Author task is to reduce the complexity of the problem of detecting as well as tracking human hands in real time for a gaming application which can be used in personal computers. However, for a computer to sync and to follow as a model, there are many challenges involved. One of the challenges faced in hand detection and tracking is the difference of shapes and height of fingers. Like other fixed objects, hands are of different heights & shapes. In a case where two objects have the same height, body shape, it may be quite difficult for a system to differentiate and distinguish between them [4]. The dataset used for hand gesture recognition in the work are not easy to scan. Another problem is the detection through the hypothesis neural network. Because if we are using the neural network for sending the coordinates of the hand this seems not as easy as the movement of hand involved.

B. Solution Approach

Crazybit is a game in which users can control an onscreen paddle simply by moving their hands in front of a webcam. It is done by using the Lightweight Convolutional Neural Networks that are used to detect the user's hands which is then mapped to the controls of the game. The system demonstrates how the integration of a well-trained and light weight hand detection model is used to track player hands and enable "body as an input" interaction in real-time. The histogram of oriented gradients (HOG [2]) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape context, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy. Currently our program is very brittle, Biological programs can adapt to new environments but not perfectly, they die in some environments, but often they can adapt certainly a program compiled for one architecture cannot run on another architecture.

C. Datasets & Real Time-Detection

The Author has trained a hand detector using TensorFlow. The most difficult part of the process is finding or creating the right (annotated) dataset. The Author was interested specifically for detecting hands so used first with the Oxford Hands Dataset [16] the result was not fulfilling and used the Ego hands Dataset which came up with the better results [8]. The goal is to showcase how neural networks can be used for the problems of tracking hands. The Author used and exported the models using the Tensorflow.js converter and then converted and casted it a JavaScript library for Json and better performance.

Fig. 1 EgoHands, A Dataset for Hands in Complex Egocentric Interactions

D. Using with Deep Neural Network

The way of make the program more sound is to combine the knowledge of differentiating between objects and hands with other detectors. Unfortunately, while our hand detector can detect hands, it cannot detect other objects. To create a detector that classifies multiple different objects would need a long process of assembling datasets for each class and with a lengthy training process [18]. A potential gain can be evaluated if we explore structures that allow us to differentiate output from multiple pretrained models for various object classes and have them detect multiple objects on a single image.

E. Algorithm

It is really a difficult task to choose appropriate algorithm for your program which can enhance the functionalities and standards of your program. Different algorithms might have different approach but you have to figure out the best suited approach by going through different tests and use cases. As in our project we went through different algorithms for object detection they are: - Spatial Pyramid Pooling, Single Shot Detector and the histogram of oriented gradients. As per our situation the histogram of oriented gradients was the best fit for our program. HOG algorithm actually decomposes the input image and breaks it into cells then compute histogram and normalizes each cell result with block wise approach. Histogram of Oriented Gradients [2] for function f(x,y), the gradient is the vector (fx,fy). An image is a discrete function of (x,y) so image gradient can be calculated as well. At each pixel, image gradient horizontal (x-direction) and vertical (y-direction) are calculated. These vectors have a direction atan(fy/fx) and a magnitude (sqrt(fx^2+fy^2)) Gradient values are mapped to 0-255. pixels with negative change will be black, Pixels with large positive change will be white, and pixels with little or no change will be gray.

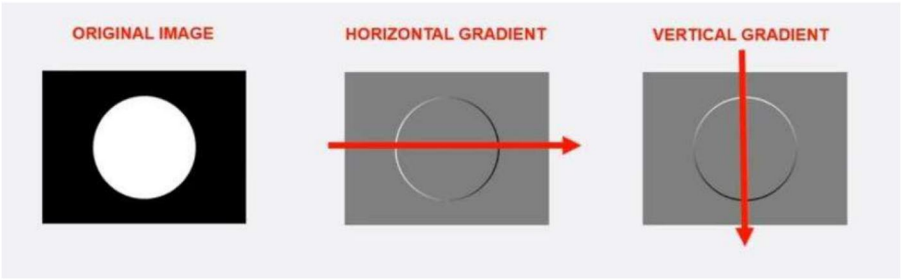

Fig. 2 Gradients

Here is short approach for calculating gradient with python:

```
import skimage.io, skimage.color
import numpy
import matplotlib.pyplot
def cal_grad(img, tp):
    x = tp.size
    conv_image = numpy.zeros((img.shape[0] + x - 1, img.shape[1] + x - 1))
    conv_image[numpy.uint16((x - 1) / 2.0):img.shape[0] + numpy.uint16((x - 1) / 2.0),
```

```
numpy.uint16((x - 1) / 2.0):img.shape[1] + numpy.uint16((x - 1) / 2.0)] = img
fn = numpy.zeros((conv_image.shape))
for i in numpy.uint16(numpy.arange((x - 1) / 2.0, img.shape[0] + (x - 1) / 2.0)):
   for j in numpy.uint16(numpy.arange((x - 1) / 2.0, img.shape[1] + (x - 1) / 2.0)):
      now_region = conv_image[i - numpy.uint16((x - 1) / 2.0):i + numpy.uint16((x - 1) / 2.0) + 1,
               j - numpy.uint16((x - 1) / 2.0):j + numpy.uint16((x - 1) / 2.0) + 1]
      curr_fn = now_region * tp
      score = numpy.sum(curr_fn)
      fn[i, j] = score
fn_img = fn[numpy.uint16((x - 1) / 2.0):fn.shape[0] - numpy.uint16((x - 1) / 2.0),
         numpy.uint16((x - 1) / 2.0):fn.shape[1] - numpy.uint16((x - 1) / 2.0)]
return fn_img
```

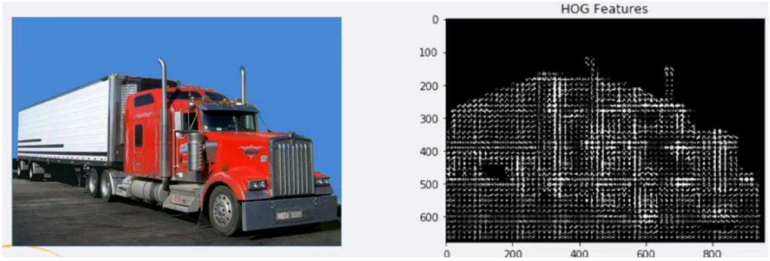

Fig. 3 Decomposition of Object

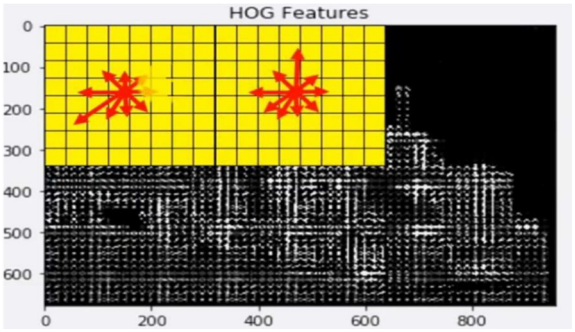

Fig. 4 Gradient Objectifying

F. Metadata

Published in 2010 11th International Conference on Control Automation Robotics & Vision
Date of Conference 7-10 Dec. 2010, Date Added to IEEE Xplore -04 February 2011
ISBN Information
INSPEC Accession Number 11805936, DOI: 10.1109/ICARCV.2010.5707916
Publisher: IEEE, Conference Location: Singapore, Singapore [2]

III. THOUGHTS FOR OPTIMIZATION

These things might enhance the performance of the project:

A. Splitting

It is really a heavy task to process the input image from a webcam and if they are directly processed over the main program it can lag a whole program and can crash it. Author took some of the ideas from [Adrian Rosebuck on parallelising image capture across multiple worker threads] [10]. This leads to a FPS increment ranging about 9-10 frames. By taking low quality of pixels from input image will show increment in fps without performance and quality degradation.

B. Quantization Modelling

Required memory reduction for storing up can be done via shifting from 32-bits to 8 bits modelling.

IV. FUTURE SCOPE

Further scope of hand gesture applications is very wide. They have a potential for being used in various fields such as:

A. Sign Language

A language that employs signs made with hands and postures of body make it easier to interpreting the conversation to others. But not everyone understands the sign language with the help of this application everyone could understand the sign language. For ex-some deaf individual in Madagascar use Noreign sign language.

B. Medical Visualization

Human body gestures start to take part in the research after the idea of touch-less based interaction is introduced. This is because of gesture are chosen based on the significant relationship with the operation that will done. For example, user can rotate the visualization in any direction by pointing, dragging, zooming.

C. Device Control

Human hand is capable of performing complex task. It receives its commands from a human operator through hand gestures. Even google is also bringing a device which can understand gestures and can be controlled by it.

D. User Compatibility

Day by day Games are becoming an important part of our life. By this software it can seek user attention and increases the users also as it is very compatible for user as user doesn't have to do nothing, it just run by user's hand. It enhances not only physical as well as cognitive development.

E. Traffic Controller

For controlling the traffic signals as per the wish of traffic controller to reduce the problem of traffic jam at peak hours.

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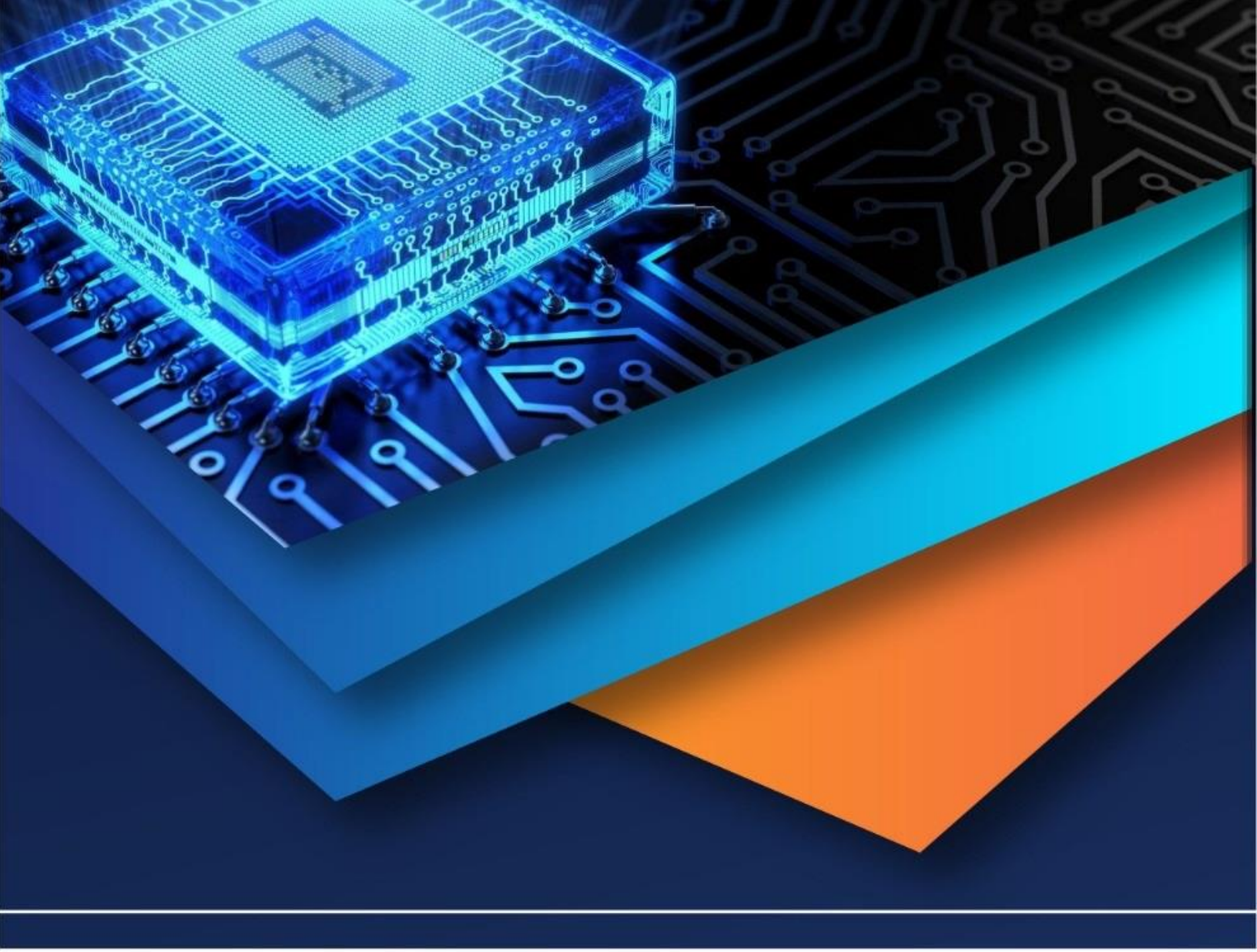

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