A PROJECT REPORT

on

" GESTURE CONTROL GAME AUTOMATION USING COMPUTER VISION "

Submitted to
KIIT Deemed to be University

In Partial Fulfillment of the Requirement for the Award of

BACHELOR'S DEGREE IN INFORMATION TECHNOLOGY

BY

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UNDER THE GUIDANCE OF
PROF. DIVYA KUMARI

SCHOOL OF COMPUTER ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR, ODISHA - 751024
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School of Computer Engineering
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CERTIFICATE

This is certify that the project entitled

"GESTURE CONTROL GAME AUTOMATION USING COMPUTER VISION"

SUBMITTED BY

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is a record of bonafide work carried out by them, in the partial fulfillment of the requirement for the award of Degree of Bachelor of Engineering (Information Technology) at KIIT Deemed to be University, Bhubaneswar. This work is done during year 2020-2021, under our guidance.

Date: 15/04/2021

(Prof. Divya Kumari)
Project Guide

Acknowledgement

ABSTRACT

Hand-gesture recognition is a technology that is becoming immensely relevant, due to the recent growth and popularity of VR and AR technologies. It is a valuable aspect to Human-Computer Interaction(HCI), allowing for two-way interaction in virtual spaces. In the past few years, technology has evolved at a drastic rate inventing new methods for the humans to interact with computers using technologies such as Voice Recognition System, Facial-Recognition System and more.

The main aim of this project is to play a game through hand-gestures. A contour based approach will be implemented for recognizing hand gestures using depth image data. In this project, a motion based algorithm will be used to detect and track the human hand. Background subtraction will be performed and then, contours will be extracted from the frame to segment the hand region. Finally, the gesture can be recognized using a set of if-else statements. After the gesture is recognized, the corresponding basic functions or say the controls of the game can be performed. This application can be able to recognize gestures and trigger the basic controls of the game in real time.

Contents

Chapter 1

Introduction

1.1 Purpose

Hand-gesture recognition systems have received great attention in the past few years because of its ability to facilitate the efficient communication between human and machine through HCI(Human-Computer Interaction). An immense amount of research has been done in order to improve user experiences through simple hand-gestures for free-hand controller. In this project,we have tried to use the hand-gesture recognition system to control the basic functions of a game.A contour based method is used for recognizing hand gestures using depth image data obtained from live video-feed. Then,the recognized hand-gesture is used to trigger a specific action in the game.The proposed system uses hand gesture, mostly number of fingers raised within the ROI(Region of Interest) to perform various operations such as forward,backward,turn right and turn left.

1.2 Objectives of the Project

The objectives of this project are:

1) Study and apply the needed tools,such as:
   a) Python3
   b) The OpenCV Computer Vision Library
   c) Algorithms for computer vision

2) Develop a computer vision application for automating a game through hand-gestures
3) Test the computer application
4) Document the results

1.3   Goals of the Project

The goals of this project are:

1)   To create a system that will be able to detect the hand of a user through the web-cam and then identify the hand gestures.The recognized hand-gesture will then be mapped to a specific action in a set of predefined actions. Then,that action will be triggered in the game.
2)   To reduce the dependency of humans on the legacy systems such as mouse and keyboard which might get damaged or stop functioning properly.

Chapter 2

Literature Survey

This project has been made in accordance with various published research papers.Thus taking into consideration of a hand gesture recognition oriented literature review we have conducted a survey that discusses various existing systems available and various algorithms proposed.Various existing techniques and methods are being compared in this review.

The feature based hand detection techniques used by Viola and Jones detector and scale invariant feature transform based hand detection have been implemented. These algorithms provide result with high accuracy but these are more sensitive to background. The second approach is image segmentation which uses HSV color space model rather than RGB color space to determine the color of human skin. This algorithm gives better result for background separation and region boundary but it can't detect the object of skin color with similar color background. Another approach is for finding convex hulls. Many algorithms such as Graham's Scan Algorithm, Divide and Conquer algorithm, Jarvis's March or Gift wrapping Algorithm, Quick hull algorithm and Chan's algorithm can be implement to find out convex hulls. To implement the system for hand tracking and simple gesture recognition in real time, there is no need to touch or carry a peripheral device by user. By comparative analysis, we can conclude that only one detection technique is not enough because different kind of methods can deal with different problem during detection & recognition.After the gesture is recognized,it is mapped to it's corresponding function which is triggered in the game through PyAutoGUI.

Based on all these methods, we are going to implement the system by using HSV color model for background subtraction & noise removal, convex hull algorithm for drawing contour around the hand.There are multiple software for image processing but OpenCV stands out to be really efficient for real-time image processing,object tracking and gesture recognition.We implement the proposed system on OpenCV library using Python3 on Windows environment.

Chapter 3

Software Requirements Specification

3.1 External Surfaces

There are not many software, hardware and other system requirements that the user must ensure to achieve smooth access to all features of the application. These are listed out as follows.

3.1.1 User Interfaces

This project is based on an application which does not require a GUI(Graphical User Interface).It is an executable python script which is launched before running the game that provokes the web-cam.Then the user can make gestures in front of the web-cam to perform certain basic controls of the game.The user needs to have knowledge of web browsers and executing python scripts.

3.1.2 Hardware Interfaces

The user can load the executable python script in a computer which might have a 32/64 bit Windows -based or Linux based operating system and a web-camera connected to it.Otherwise,no such hardware interfaces are required.

3.1.3 Software Interfaces

The application is loaded with various computer-vision algorithms for background subtraction,noise elimination,segmentation and indicating the contours.
● Operating System:Windows 10
● Language(s) used:Python3
● Libraries used:
      1. OpenCv4
      2. PyAutoGui
      3.NumPy

3.1.4 Communication Interfaces

There are no such requirements for any communication interfaces.

3.1.5 Memory Constraints

This application consumes a secondary memory space of 100KB .When it is launched,it can consume up to 1GB RAM.

Chapter 4

Requirement Analysis

4.1   Functional Requirements

In the functional requirements, we have to design the system interface with the functional entities for achieving real time visualization of system response and parametric variation. It is important to visualize the hand position, its movement and response being generated. On the basis of these parameters the precise output can be accomplished. The real time presentation of the hand movement and its responding results, division of shapes,area etc., would ensure optimal gesture recognition and precise response or command generation for applications. The overall system designing will be done using the OpenCV library in Python3.

4.2   Non-Functional Requirements

1) **Usability:** The user is facilitated with the control section for the entire process in which they can arrange the position of hand at the centre of ROI under consideration, the variation of palm position and respective command generation etc can be effectively facilitated by mean of user interface. The implementation and calibration of camera and its resolution can also be done as per quality and preciseness requirement.The frame size, flow rate and its command variation with respect to threshold developed and color component of hand color, can be easily calibrated by means of certain defined thresholds.

2) **Security:** Application will be permissible to be used only in secure network so there is less feasibility of insecurity over the functionality of the application. On the other hand, the system functions in a real time application scenario, therefore the camera, color and platform compatibility is also must in this case.

3) **Maintainability:** The installation and operation manual of the project will be provided to the user. The web-camera needs to be clean before the application is run to ensure precise captivity of video feed.

4) **Extensibility:** The project work is also open for any future modification and hence the work could be defined as the one of the extensible work.

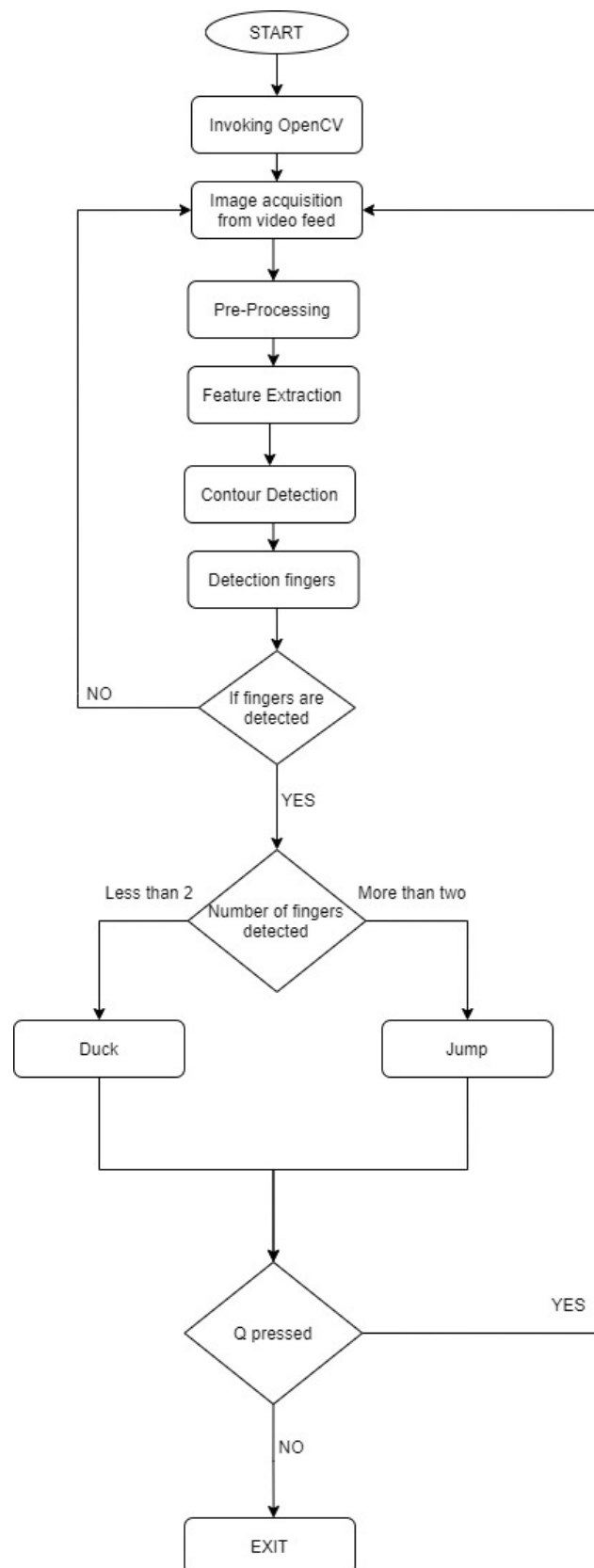5) **Portability:**This project can be run on both Windows and Linux based 32/64 bit operating systems.

Chapter 5

System Design

5.1   Use-Case Diagram
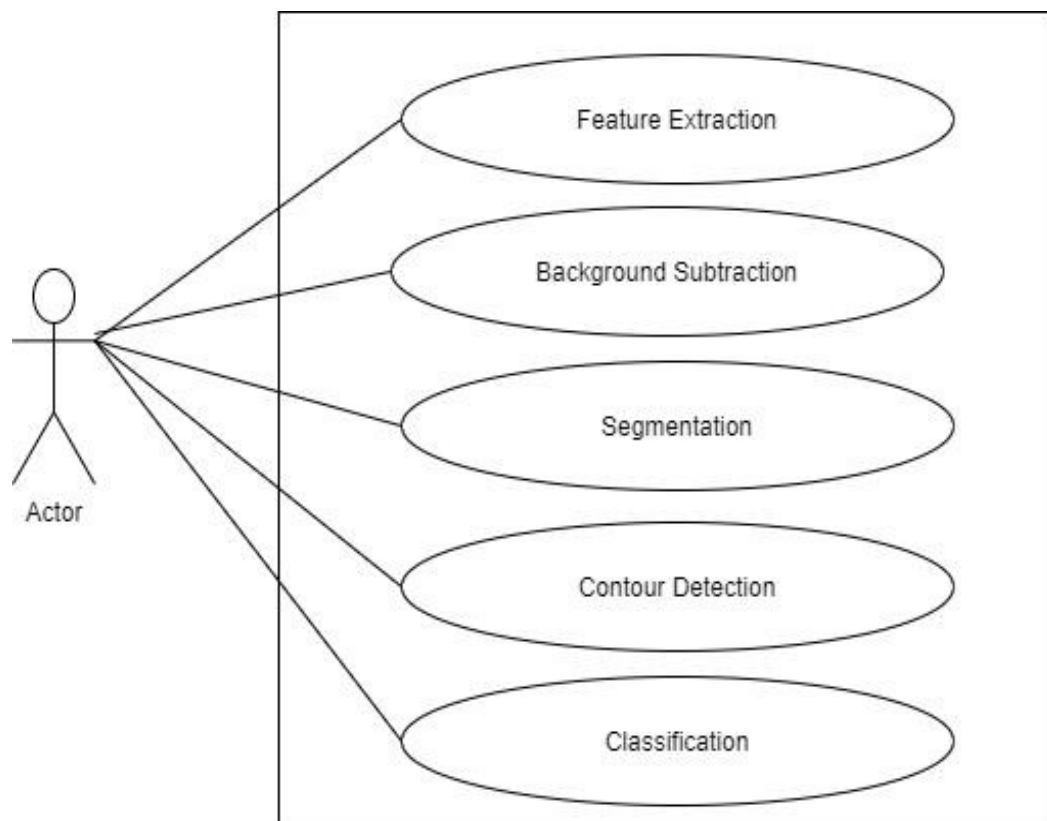
5.2   Data-flow Diagram

Chapter 6

System Testing

System Testing is a level of testing that validates the complete and fully integrated software product. The purpose of a system test is to evaluate the end-to-end system specifications. In our project as well, it is very important to perform a proper system test with various test cases covering all domains of the project application.

6.1   Test Cases and Test Results

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	Jump	Two or more fingers	Space Bar Pressed	Should Jump
T02	Duck	Less than two fingers	Arrow Down Pressed	Should Duck

Note: Testing was performed manually

Chapter 7

Project Planning

7.1   Understanding Requirement

The potential requirements for a product like ours was evaluated in the beginning, in order to get a sense of the requirements and expectations of potential users. This helps us plan the project better, and with clearer and stricter guidelines, and also gives us a path to handle edge cases in the project.

7.2   Model for the project

Based on the requirements identified in the previous phase, a model for building the project is chosen, according to which the project timeline is decided. Also, the individual work is divided among the entire team, based on specific individual proficiency, and a common understanding.

Chapter 8

Implementation

The application helps to perform some basic operations in dino game through automation using computer vision .This automation is obtained through a script written in Python3.This script is developed using the python libraries of OpenCv and PyAutoGui.The OpenCv library is utilized to implement computer vision through the python language.The PyAutoGui library helps the script to access the manual keyboard through certain commands written in python. When the script is executed,the web-cam gets activated.Through the web-cam,the number of fingers are counted by finding the ROI(Region of Interest) after the following steps:

- A frame is read from the video.
- The data of the hand is collected from the rectangular sub-window on the screen.
- The frame is eroded to remove white noise.
- Then it is converted to grayscale.
- Then the Gaussian Blur is performed.
- Then a threshold is performed using THRESH.BINARY
- The contour with the maximum area is obtained.
- Then the convex hull is acquired.
- The ROI is marked through drawing the contours inside the hull and drawing the exterior hull.
- The number of convexity defects are obtained.
- The number of fingers present in front of the camera is just one more than the number of convexity defects obtained earlier.

Based on the gesture provided ,the following operations are performed in the game:

- Two or more fingers entered in the contour area results in a jump.
- Less than two fingers entered in the contour area results in a duck.
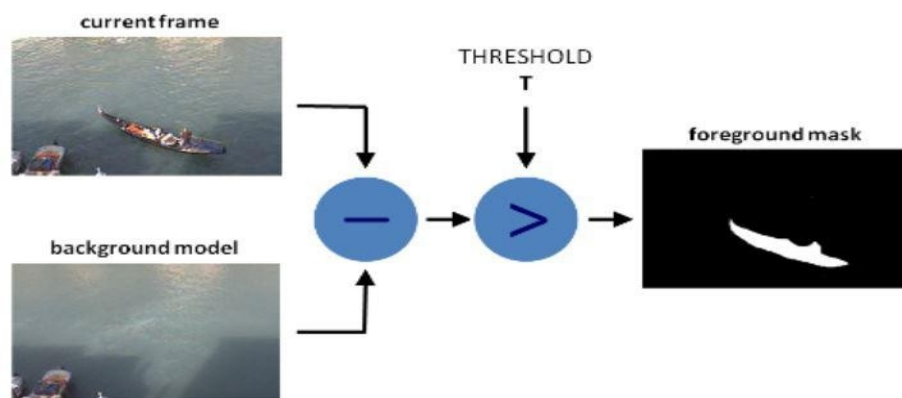
Chapter 9

Screen shots of Project

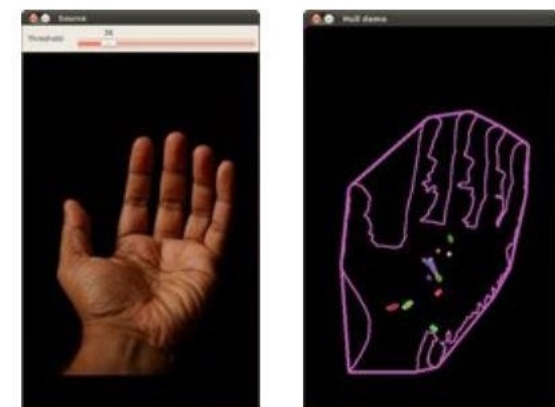Figure 9.1: Background Subtraction

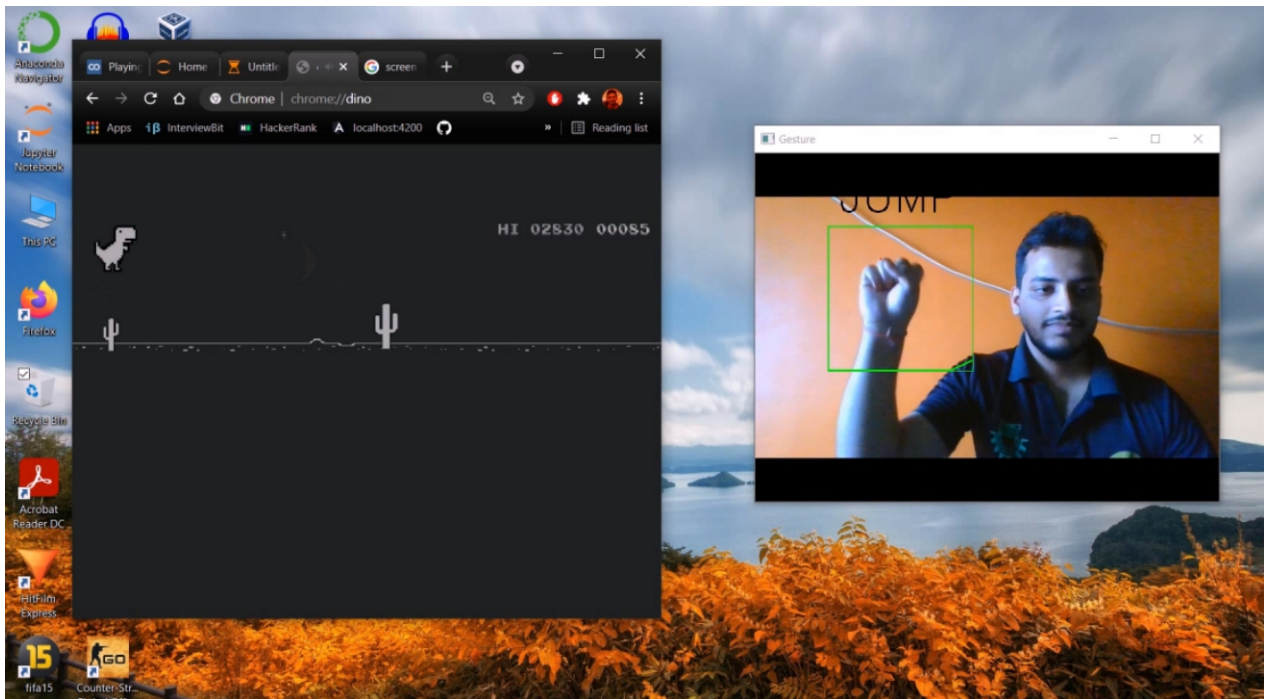
Figure 9.2: Convex Hull

Figure 9.2: Convexity Defect

Figure 9.4: Frames of Algorithms used for detecting hand gesture along with the gameplay environment

Chapter 10

Conclusion and Future Scope

10.1 Conclusion

In a world filled with mechanical eyes(cameras), it has become increasingly important to provide these mechanical eyes with the functionality to process the images they see in real time, and that is where Computer Vision comes into place. Our project demonstrates an application of Computer Vision through OpenCV, in the domain of online gaming, by replacing keyboard commands with hand gestures. Moreover, as is evident by the positive test cases, our application does its task successfully and in real time, thereby improving the functionality of the game, and creating a potentially better playing environment for the gamer. Also, with the rise of nerve problems such as carpal tunnel syndrome, which might be caused due to long periods of time spent on the keyboard, our application becomes a viable alternative to combat this problem.

10.2 Future Scope

The project can have many applications in the future with a host of changing technologies.

1) Since our project essentially maps various hand gestures to corresponding keyboard strokes, it can modified and ported to perform a whole host of hand detection based commands, even such as full typing.
2) With the changing landscape of video games, and the increasing usage of technologies such as VR, along with a host of sensors for today's games, revered games of the past have begun to fade since they can no longer keep up with the amazing technology provided by today's futuristic games. Our project can, in the future with many modifications, help them stay competitive.
3) The underlying technology used in Computer Vision, and that opens up a wide spectrum of possibilities in the future for our project. With better cameras and increasing processing power, along with modifications in the software to harness these improved resources, our software can be ported to perform various functions to increase performance and further enhance the user's experience on various games and not just limited to games.
4) Our software can also be modified slightly in the future to perform the function of a mouse using our hand, which in itself could lead to a multitude of functionalities.

References

1. YouTube Channels:
    1.1. KnowledgeShelf
    1.2. Programming Knowledge
    1.3. Sentdex

2. Documentation:
    2.1. https://opencv.org/
    2.2. https://opencv-python-tutroals.readthedocs.io/

3. Websites:
    3.1. GeeksForGeeks

INDIVIDUAL CONTRIBUTION REPORT:

AUTOMATION OF DINO GAME USING COMPUTER VISION

The total work for the project was divided equally among the members of the team based on their specific proficiency and skills.The entire project was built with the unified teamwork of the whole group. Devansh Kashyap(Roll Number 1706036) handled the background subtraction algorithm and implemented the erode functionality. He also implemented the THRESH_BINARY technique to threshold the frame. Harsh Singh(Roll Number 1706038) implemented the functionality to recognize the contours for structural analysis, implemented the convex hull algorithm and counted the convexity defects. Himanshu (Roll Number1706040) used PyAutoGUI to implement Keyboard Mapping, and mapped each gesture to the corresponding keyboard strokes. He also managed the system resources by releasing the resources, and handled the edge cases for managing potential issues. Moreover, the Presentation, Demonstration and Project Report of the project were made with the unified teamwork of the entire team working together with the cross-pollination of ideas in harmony.

PLAGIARISM REPORT

RESULTS

100% Completed: 100% Checked

8% Plagiarism

92% Unique

Sentence Wise Result | Document View | Matched Sources

| Unique | Hand-gesture recognition is a technology that is becoming immensely relevant, due |
| Unique | to the recent growth and popularity of VR and AR technologies. |