

Interaction with virtual game through hand gestures based on computer vision

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Human Computer Interaction
CSE 4015

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AIM & SCOPE:-

To create a human computer interaction video game which can be played with the help of hand gestures. Gesture recognition based interactions, provide a more realistic and immersive interaction compared to traditional peripherals.

ABSTARCT:-

Hand gesture is a very natural form of human interaction and can be used effectively in human computer interaction (**HCI**). Hand gesture interaction has been the trending technology for human-computer interaction (HCI). Frequently a number of research works are carried out in this area to expedite and contrive interaction with computers. In this project, we propose a real-time human-computer interaction system (HCI) using two different hand gestures - hand pointing and clenched fist gesture. This project involves the design and implementation of a **HCI** using webcam or front cam of laptop. It analyses hand gestures in real time 2D space of hand using Hand segmentation, thresholding ,conturing and convex hulling is used to identify hand gestures.

Objective:

Primary objective of the game is to provide a fun and interesting way of playing a video game. The game controls are much more natural and adaptable than the usual keyboard controls. Using hand gestures also promote physical activity which improves health and general wellbeing as opposed to traditional keyboard control

Proposed Methodology:

The player would play the game with the help of his/her fist or palm. When the palm is gestured up, the character moves up and vice versa. The computer's front camera is the sensor which detects motion.

Expected Outcome:-

Designing a game where random obstacles would be created for the player who must dodge them in order to achieve a high score. There will be a timer when the game starts and it stops when the player collides with any of the obstacles. This game will be different from others due to the interesting and easy method of controlling the character in the game.

The game is made to be user friendly, so that users from all sections of society will be able to easily play the game without any prior practice or learning of controls as the controls are the natural human movements to achieve a high score. There will be a timer when the game starts and it stops when the player collides with any of the obstacles. This game will be different from others due to the interesting and easy method of controlling the character in the game. The game is made to be user friendly, so that users from all sections of society will be able to easily play the game without any prior practice or learning of controls as the controls are the natural human movements.

Introduction:

Background and motivation of the project:

Hand gesture recognition systems provide users an enhanced interaction experience as it integrates the virtual and the real world object. Gesture recognition based interactions, provide a more realistic and immersive interaction compared to traditional peripherals. The gesture based interaction interface showcased here can be applied towards many applications like virtual reality, communication techniques and Games. The focus of our project is on games as the application domain for this interaction method.

Gestures, particularly hand gestures are also faster and possibly could be more accurate than using the keyboard–mouse combination of peripherals. The non-touch system is a modern method of computer-interface technology capable of revolutionizing human-computer interaction.

Project Novelty:

Our hand gestures are easy to use and learn for first time users. The handgesture recognition system can be used in many game which has the same key binds. No need to alter or have different implementation for these games. It also provides a more fun and exciting way to play games as well as help the disabled people who have issues with utilizing the traditional methods of input. This form of human – computer interaction definitely is improving every day and has a lot of potential in the future for development and usage in everyday life. Key advantage here is that games can be played in a virtual space through the same movements in the real world, without installation of special controllers.

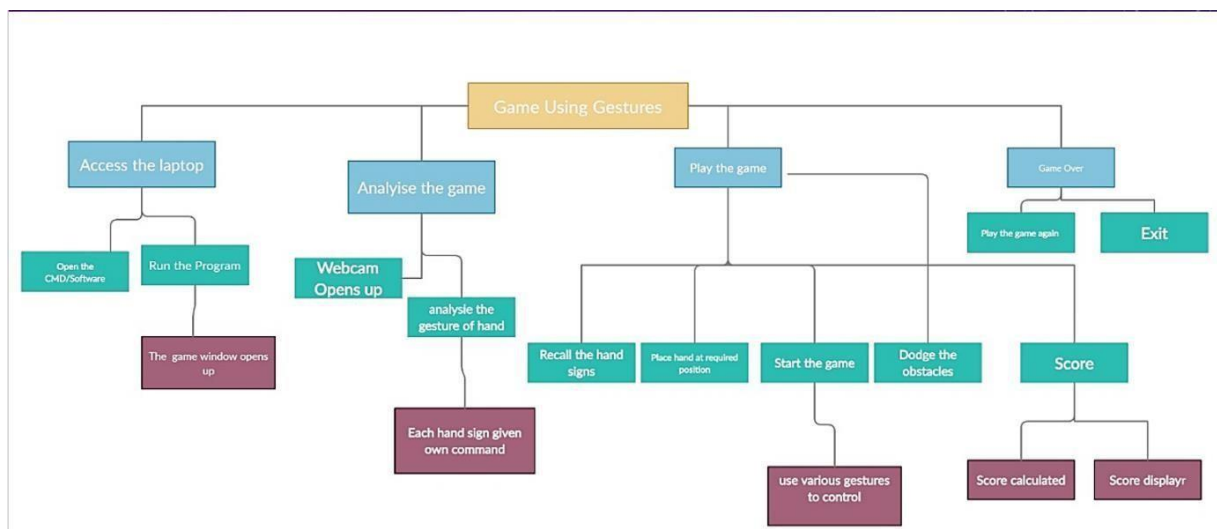


Proposed Methodology (Framework):

Proposed Work:

The main domain of the project lies in developing a game with the application of gesture recognition system. The usage of hand gestures to promote virtual activity as one does in real world, results in the main advantage that the game can be played in a virtual space with enhanced interaction much better than conventional peripherals.

Method and approaches:



When the user runs the program the game in command prompt window opens up and accesses the webcam of the user. Once the game starts, the player needs only to move his hand to make his game character move and dodge the obstacles and score points.

If the user fails to dodge any obstacle the timer stops and displays the time and total score with a message “GAME OVER”. The user is at his will to begin the game again or to quit the game.

Our Contribution:-

The proposed project has a promising future of the forth coming pro- digital era as currently the game focuses on breaking the norms of current gaming industries by hand gesture recognition system. The method chosen i.e. hand gesture recognition would provide better indulging gaming due to better physical enhancement and a more realistic interaction between the user and the interface. The project requires no large space for playing and proves its adaptability and is highly user friendly nature. Thus, the game can even be played in a virtual space by the player. Due to the involvement of physical activities the user will have better health and will not lose his physique even if the user is playing in the long run.

Comparison with existing models/methods

Technology used

Tools:-

- **PyCharm python IDE** – This IDE is chosen over the rest because it is cross-platform and for accessing smart built in developer tools, scientific tools and customizability.
- **Webcam drivers** – It is used to recognize the webcam associated with that device and for proper functioning of the webcam.

Programming Information:-

We will be using Python language and Python libraries and some API's for coding of the project. Python is easy to understand and is best for programming of large projects. Some of the libraries and API's we are going to include in our projects are:

- **Tensorflow:**

TensorFlow is a Python library for fast numerical computing created and released by Google. It is a foundation library that can be used to create Deep Learning models directly or by using wrapper libraries that simplify the process built on top of TensorFlow. It was created and is maintained by Google and released under the Apache 2.0 open source license. The API is nominally for the Python programming language, although there is access to the underlying C++ API.

- **OpenCv:**

The given library is used to access the webcam when the code is run for gesture recognition.

- **Multiprocessing:**

Multiprocessing is a package that supports spawning processes using an API similar to the threading module. The multiprocessing package offers 13 both local and remote concurrency, effectively sidestepping the Global Interpreter Lock by using sub processes instead of threads.

- **Cv2:**

OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.

- **Nes py:**

nes-py is an NES emulator and OpenAI Gym interface for MacOS, Linux, and Windows based on the SimpleNES emulator.

Proposed Work:-

Paper Title	Gesture Recognition using Microsoft Kinect
Year of publishing	2014
Author names	K. K. Biswas
Objective	A method to recognize human gestures using a Kinect depth camera.
Technique used	<ul style="list-style-type: none">• The depth sensor consists of an infrared laser projector combined with a monochrome CMOS sensor• The depth map is visualized here using colour gradients from white (near) to blue (far) FEATURE EXTRACTION <ul style="list-style-type: none">• CLAP: Clapping• CALL: Hand gesture to call someone• GREET: Greeting with folded hands • WAVE: Waving hand• NO: Shaking head sideways – “NO”• YES: Tilting head up and down – “YES”• CLASP: Hands clasped behind head• REST: Chin resting on Hand Pre – processing <ul style="list-style-type: none">A. Isolate the human making the gestures from the background scene. This is done by background subtraction from the depth image of the scene. This was done by using auto thresholdingB. Features from ROI A region of interest (ROI) is created by placing a 14x14 grid on the extracted foreground. The gesture is parameterized using depth variation and motion information content of each cell of the grid.C. Training and Testing Each frame of the video was represented by a row of the matrix. The columns represent the feature points

Paper Title	Vision-Based Hand Gesture Recognition and Applications
Year of publishing	2015
Author names	
Objective	<ul style="list-style-type: none"> • The main objective faced by a vision based hand gesture recognition system include recognition in complex background, in dynamic background, in presence of multiple gestures in the background, under variable lighting condition, under different viewpoints etc
Technique used	<p>Vision-based hand gesture recognition methods can be classified into two categories:</p> <ul style="list-style-type: none"> • Machine Learning based approaches: For a dynamic gesture, by treating it as the output of a stochastic process, the hand gesture recognition can be addressed based on statistical modelling, such as PCA, HMMs • The second category is Rule based approaches: Rule based approaches consist of a set of pre-encoded rules between feature inputs, which are applicable for both dynamic gestures and static gestures. <p>Hand Detection</p> <p>Gesture Recognition</p> <p>Performance Comparison</p> <ul style="list-style-type: none"> • compare the mean accuracy and mean running time between FEMD based hand gesture recognition system and Shape Context shape matching algorithm <p>Applications</p> <ul style="list-style-type: none"> • Sudoku game: The user selects a square by hovering his hand over it and pushes once. He/she then commands a number to be filled into the square by performing the corresponding hand gesture

Paper Title	Design and implementation of a flexible hand gesture command interface for games based on computer vision
Year of publishing	2017
Author names	Aashni P Haria , Archanasri Subramanian , Nivedhitha Asokkumar, Shristi Poddar, Jyothi S Nayak
Objective	<p>1,The main objective can successfully replace such devices (e.g. keyboard or mouse) needed for interacting with a personal computer</p> <p>2. Maintain real time performance and a more intuitive and natural interaction between the user and the computer</p>
Technique used	<p>1. Segmentation: they consider the difference in colour of the palm region due to the presence of a red colour decoration on the fingertips and on the middle of the palm of the Bharatanatyam dancer. In order to deal with is, they used texture based segmentation as a basic segmentation technique to differentiate the hand from the background instead of using skin colour segmentation which would not detect the red colour areas as a part of the hand</p> <p>2. Feature Point Extraction: After the hand region is obtained, the next step is to extract the contour of the hand. This method brings down the computational costs. the biggest contour was chosen as the contour of the hand palm after which the contour was simplified using polygonal approximation. The hand contour was obtained using the graham scan algorithm and to compute the convex hull of the hand.</p> <p>3.Detection Module: Our main intention is to recognize static and dynamic hand gestures with the support of a depth camera. A large number of methods have been utilized for pre-processing the image which includes algorithms and techniques for noise removal, edge detection, smoothening followed by different segmentation techniques for boundary extraction i.e separating the foreground from the background.</p> <p>Tests and Results</p> <ul style="list-style-type: none"> • The first priority was to verify the posture analysis and recognition strategy

Paper Title	Interaction with Virtual Game through Hand Gesture Recognition
Year of publishing	2019
Author names	<u>Siddharth S. Rautaray</u> ; <u>Anupam Agrawal</u>
Objective	Ease the game development so that developers can easily use it to produce educational computer games for end-users.
Technique used	<ol style="list-style-type: none"> 1. Hand Gesture Vocabulary <ul style="list-style-type: none"> • Our framework targets to be used to produce the educational computer games with hand gesture interaction for preschool children. Hence we first need to define a hand gesture vocabulary for this purpose. • We establish a hand gesture vocabulary closely related to preschool children education, so that children can answer simple questions using these hand gestures 2. Framework Overview <ul style="list-style-type: none"> • Design a game authoring tool named authoring GUI in which the game script and game component are created. 3. Hand Gesture Recognition <ul style="list-style-type: none"> • The recognition component is responsible for gaining images from camera, segmenting hand gestures from images, and finally recognizing hand gestures. • Segmentation • Hand Gesture Feature Extraction • Recognition 4. Experiments on Recognition Rate <ul style="list-style-type: none"> • Experiments to test our hand gesture recognition rate for five types of hand gestures. For each type of gestures we do 50 times to recognize them to find the average recognition rate.

Paper Title	Human Computer Interaction using Hand Gestures and Voice
Year of publishing	2019
Author names	<u>Prajakta Dhamanskar , Aniket C Poojari ;Harshita S Sarwade; Renita R D'silva</u>
Objective	<p>1. It eliminates motion blur and is able to detect gestures like clicking and also hand tracking</p> <p>2. A voice module is integrated to receive voice commands from the user and perform it. This enables intuitive HCI and interactive motion gaming.</p>
Technique used	<p>1.Speech to Text conversion: In the voice part a speech to text conversion library is used to convert the spoken commands of the user to text.</p> <p>2.Command Check: The text received is then analysed to perform a specific task. User can switch easily between the two parts.</p> <p>3.) Deep Learning object detection: A model is used to give the exact bounding box of the hand in the image.</p> <p>4) Skin colour Thresholding: This converts the skin colour part of the bounding box which contains the hand into white and the rest into black.</p> <p>3) Contour extraction and polygon approximation: Helps in finding the maximum area contour which is the hand.</p> <p>4) Convex hull and convexity defects extraction: Helps in finding the fingertips in the image.</p> <p>5).Experiment and results</p> <ul style="list-style-type: none"> • It can be used on a real robot on which we can set up the operations to be performed upon recognizing the commands. • these object detectors can be used in autonomous driving research to detect vehicles, street signs and also pedestrians. This survey provides a broad introduction to the field of hand posture and gesture recognition as a mechanism of interaction with computers

References:-

- [1]. S. Belongie, J. Malik, and J. Puzicha. Shape matching and object recognition using shape contexts. IEEE Trans. on PAMI, 2002.
- [2]. M. Bray, E. Koller-Meier, and L. V. Gool. Smart particle filtering for 3d hand tracking, Sixth IEEE International Conf. 2004
- [3]. Choi, Yoo-Joo., Lee, Je-Sung, Cho. We-Duke. A Robust Hand Recognition in Varying Illumination. Advances in HCI, Shane Pinder(Ed.), 2006.
- [4]. Le T N, Cong D T, Ba T N, et al. Contour Based Hand Gesture Recognition Using Depth Data. International Conference on Signal Processing, Image Processing and Pattern Recognition, 2013.
- [5]. Kang S K, Mi Y N, Rhee P K. Colour Based Hand and Finger Detection Technology for User Interaction. International Conference on Convergence and Hybrid Information Technology. IEEE, 2008.
- [6]. Human Computer Interaction using Hand Gestures and Voice
IEEE , 2019
- [7]. Interaction with virtual game through hand gesture recognition
IEEE ,2019
- [8]. Ananya Choudhury, Anjan Kumar Talukdar, Kandarpa Kumar Sarma | A Review on Vision-Based Hand Gesture Recognition and Applications | IGI Global PA August 2015 | IEEE, 2019
- [9]. Jing-Hao Sun, Ting-Ting Ji, Shu-Bin Zhang, Jia-Kui Yang, Guang-Rong Ji | Research on the Hand Gesture Recognition Based on Deep Learning | 2018 12th International Symposium on Antennas, Propagation and EM Theory (ISAPE) | IEEE, 2018
- [10]. Zhi-hua Chen, Jung-Tae Kim, Jianning Liang, Jing Zhang, Yu-Bo Yuan | Real-Time Hand Gesture Recognition Using Finger Segmentation | 21st International Conference on Pattern Recognition (ICPR '12) | 25 Jun 2014