Eye Control System Based on Hough Transform Algorithm

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor of Engineering

in

Computer Science

by

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2017-2018

CERTIFICATE

This is to certify that the project Synopsis entitled ***"Eye Control System Based on Hough Transform Algorithm"*** is a bonafide work of ***"Anindita Chowdhury (15102067), Anamika Sonavane (15102018), Vibha Gaikwad (16202014)"*** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of ***Bachelor of Engineering*** in ***Computer Science.***

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Abstract

These days the lifestyle and living of the world has changed a lot, Technology plays a very important part in ones life. Thus,this paper proposes an eye control system employing eye gaze tracking techniques that might be helpful for those limb disabled people with healthy eyes. We design a motion function as well as an efficiently blink detection function. With these functions, users can select any button, link or can move the mouse anywhere on the screen, with their eyes only, through a conventional camera mounted on top of the computer or laptop. Digital Image Processing here will be used to process the image, with the help of hough transform algorithm, which will initially help us capture the image of eye, process the images into templates and creating a database which will be further used to compare with the real time images.

Introduction

More than 1 billion people in the world have some form of disability. This corresponds to about 15% of the world's population.Census 2001 has revealed that over 21 million people in India are suffering from one or the other kind of disability. This is equivalent to 2.1% of the population.Now in this population some are limb-disabled. Although this number is very small, but it matters to those who can not enjoy the digital world.

Due to their limb handicap, such vast amount of people cannot enjoy the convenience and entertainment of the ever advancing computer technology. A person's eyes convey a great deal of information with regards to the meaning behind certain facial expressions. Also, the direction in which an individual is looking shows where his or her attention is focused. By tracking the position of the iris, useful interfaces can be developed that allow the user to control and manipulate devices in a more natural manner. So, this paper has purpose of meeting the specific needs of these limb disabled people.

Objectives

Objectives of this project are:

- To design a system that controls mouse actions using Eye-Tracking.
- To design an effective system that enables limb-disabled people with healthy eyes to use computer.
- To eliminate use of any external Head-Mounted Eye Tracker and replace it with a normal camera.

Literature Review

Eye-tracking experiments have an early history. One of the earliest eye-trackers was designed by Edmund Huey (Huey, 1908) which just consisted of a contact lens like device with a hole for the pupil.

Generally, eye tracking measures the eyeball position and determines gaze direction of a person, and the movements of the eye can be tracked using different technologies. It can be categorized into four categories: infrared-oculography (IROG), scleral search coil method (SSC), electrooculography (EOG), and video-oculography (VOG). Currently, most of the eye tracking researches for HCI are based on VOG, because the VOG technique has minimized the invasiveness to user in some degree.

Eye-tracking has found its applications in many projects. In 2006 a group of Taiwanese engineers developed a "Powered Wheelchair controlled by Eye-Tracking system". In 2016 conducted a comparative study of user experience in online-social media branding web pages using eye-tracker.

Problem Definition

This project uses eye gaze position and eye-state (starring or blinking) for enabling virtual mouse, so as to make it possible for limb-disabled people to experience the digital world. The camera will capture image frames of eye pupil as input. After the eye is detected it will be processed for calibration. Processing should include conversion to gray-scale followed by canny-edge detection , which will be used to detect pupil center using Hough transform algorithm.

The user can gaze any where on the screen and for selecting a link / clicking a button, the user must blink. If the blink duration exceeds 2 seconds, the it will be considered as a click, otherwise not. Instead of using additional head mounted eye-tracker , the laptop camera will be used. If the camera is inefficient, then external camera, connected to the computer via USB cable or bluetooth should be used.

Design

Hardware Requirements

- Camera
- Computer

Software Components

- Hough transform algorithm,
- The Purkinje image detection method,
- The blink detection method, and
- The coordinates transform and calibration method.

Activity Diagram

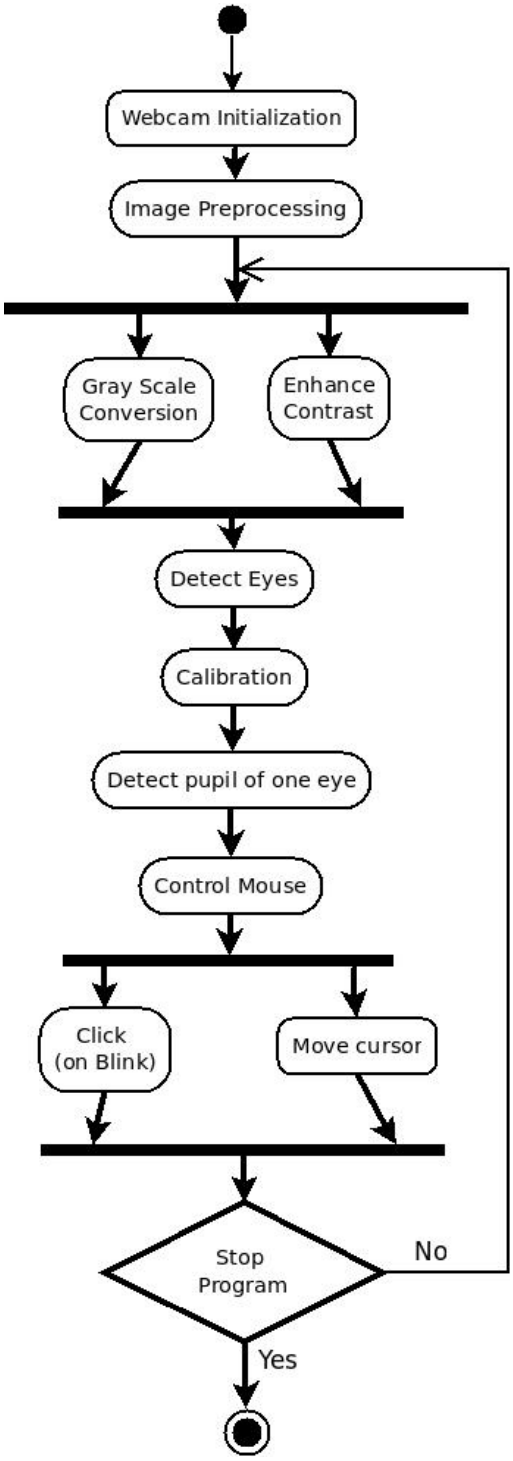

Figure 1: Activity diagram

Technology Stack

Following technologies are used currentl used in this project :

- **Windows Operating System, Windows 7 Professional**
- **Visual Studio 2015 Community version :** Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps and it supports 36 different programming languages, such as C++, Visual Basic .NET, C, Javascript, Python, Node.js and many more.
- **Open CV with C++ :** OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. OpenCV runs on the following desktop operating systems: Windows, Linux, macOS, FreeBSD, NetBSD, OpenBSD. OpenCV runs on the following mobile operating systems: Android, iOS, Maemo, BlackBerry 10.

Proposed System Architecture/Working

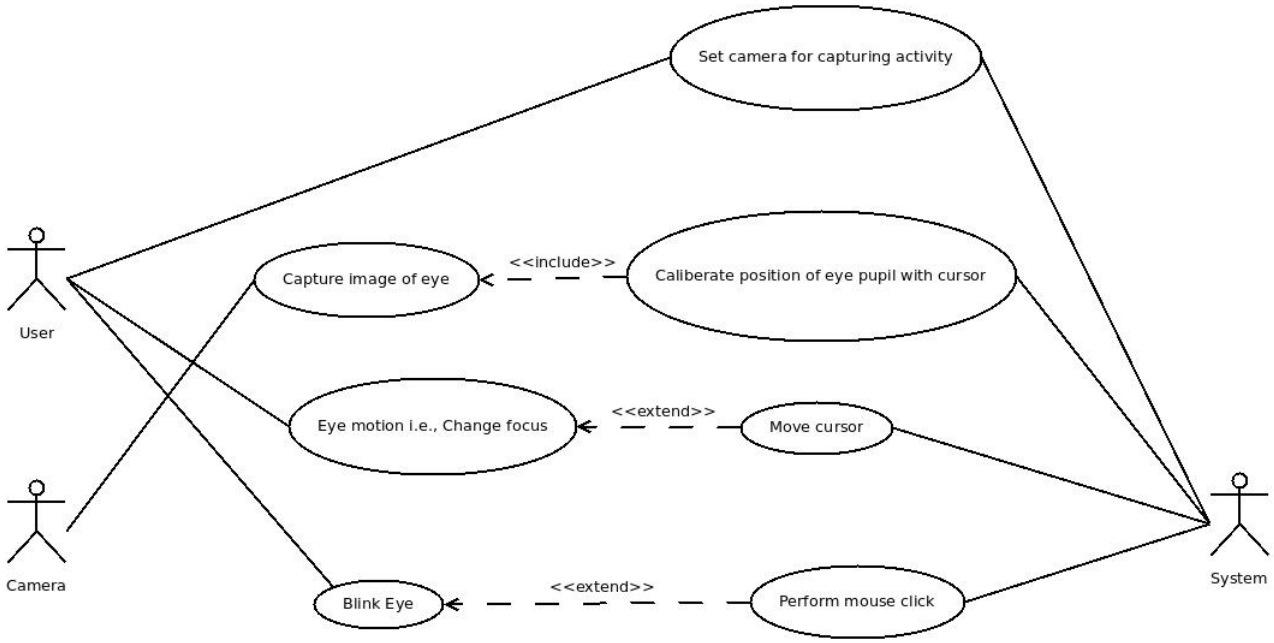

Figure 2: Use case diagram

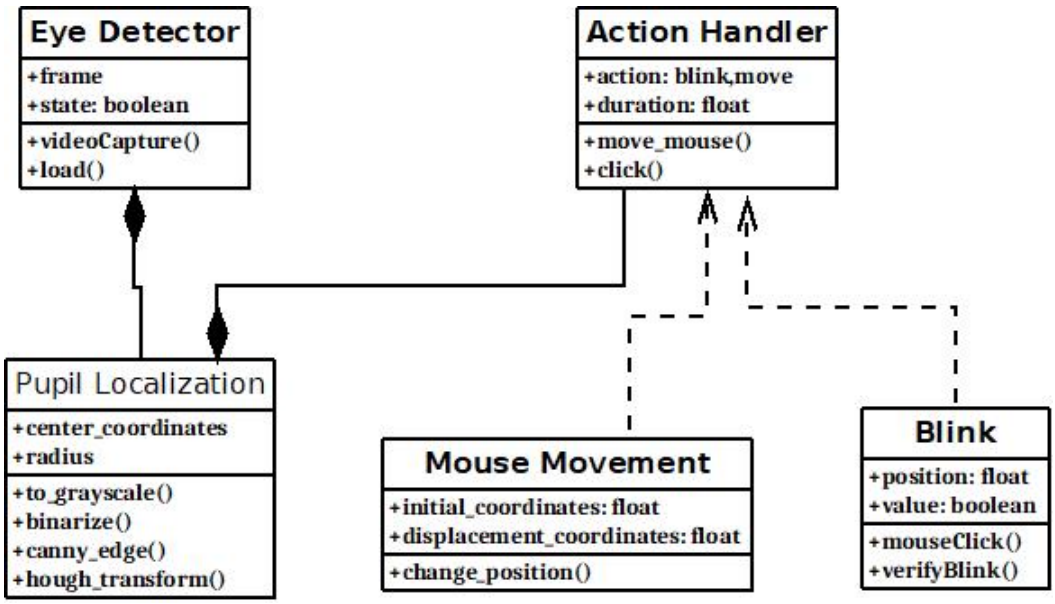

Figure 3: Class diagram

Dependencies

- The distance between the person and the camera should be as less as possible
- Camera resolution should be of the best quality.

References

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[4] “DESIGN AND IMPLEMENTATION OF A HUMAN COMPUTER INTERFACE TRACKING SYSTEM BASED ON MULTIPLE EYE FEATURES” , http://www.jatit.org/volumes/research-papers/Vol9No2/8Vol9No2.pdf

[5] “Eye Control System Base on Ameliorated Hough Transform Algorithm” , https://ieeexplore.ieee.org/document/6516004/, September 9, 2013

Planning

- Weeks 1-2 : To develop a window containing 4 buttons, where each button corresponds to a particular operation.
- Weeks 3-4 : Deciding upon the 4 functionalities and integrating them with the buttons
- Weeks 4-6 : To implement blink detection and mouse click
- Weeks 7-10 : Tansforming the computer application into mobile application with the use of VR gear