Eye Gaze System

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Abstract- Computer vision is playing vital role in visual interaction innovations with computers to ease out life. using deep learning and computer vision we can create IO devices that can work on gestures to ease our work. Eye movement can be used as a real-time input medium for human-computer communication, which is especially important for people with physical disability. In order to improve the eye tracking technique using computer vision in user-computer dialogue, a novel eye control system with integrating both mouse and keyboard functions can be created. This technology can be used to control computer system by providing way to move mouse pointer and and access keyboard using gestures for more ease. This paper proposes a a eye gaze tracking system that can be used to control mouse movements and keyboard control using human eye ball tracking using computer vision. It provides hand free control over a system That make user interaction with system more easy.

Keywords- computer vison, deep learning, eye gaze, CNN, Deep layer, Neural Network.

I. INTRODUCTION

Now a days personal computer systems are playing a vital role in our everyday lives. They are used in areas such as work, education and entertainment. Most of the Systems uses common method to use the personal computers mostly based on the input method via mouse and keyboard. Traditionally We use mouse and keyboard to interact with the computer. But for disabled peoples it is not easy to use this system, also for quick and smooth interactions with computers and to create hand free control or interaction with computers, we need to use eye gaze tracking system. Many disabled people have only the action that they can perform of their own free will is the blinking of their eyes. Because of this, many human interaction systems are developing based on eye gaze. By detecting eye position and tracking the iris movement of the eyeballs many useful interfaces can be developed. Due to the rapid development of technology, there is a great demand for Human- Computer Interaction. Many precious systems are being developed for people to make their life more easy.

This system captures the images and use them to track eyeball movements. To do that we need image processing, the input data is acquired first and then it is converted into digital form. In the digital image, various types of mathematical operations are applied to get a more enhanced image to perform the next operation. There are many systems and applications that are based on human eye tracking. Various kinds of human-computer interfaces exist that make use of human eye movements and eye blinking . Some interfaces make use of eye movement for controlling the mouse cursor. The movements of the eyes shall be detected using basic webcams with resolution enough to capture the slightest eyeball movements and no external devices will be necessary. The project aims at designing a Software that cab be easily installed into a Desktop or Laptop. the software shall make use of a webcam to capture real time images of the user and then process these images to detect the eye.

II. RELATED WORK

There are several methods to track the motion of the eyes. The most direct method is the fixation of a sensor to the eye. The fixation of small levers to the eyeball belongs to this category, but is not recommended because of high risk of injuries to the eyes.

1) Video-Based Eye Tracking:

The main task of a video based eye tracker is to analyze the direction of gaze from the image frame delivered by a video camera. All video-based eyetracking systems needs to detect the iris center in the camera's image frame. This is a task for image recognition, mainly edge detection, to predict and analyze the elliptical contour of the pupil. As the human cornea has a nearly perfect sphere shape, a glint stays in the same position for any direction of gaze while the pupil moves. There are some eye trackers which also track the rotational movement of the eye but such systems are not very common. One of the application for such eye . trackers is a head camera controlled by the eye movements using the motion stabilization softwares and hardwares of the eye to get a motion stabilized camera image.

2) electrooculography (EOG):

Another method is electrooculography (EOG) where sensors attached at the skin around the eyes measure an electric field. Originally, it was believed that the sensors measure the electric potential of the eye muscles. It turned out that it is the electric field of the eye which is an electric dipole. This method uses electro-magnetic sensitivity interferences. it works well as the technology is advanced and being used by a long time. The main feature of the system is that it can detect the eye movements even when the eye is closed.

EOG method explained above are obtrusive and are not suited for interaction. The so preferred method for eye-gaze interaction is video. The core part of this method is a video camera connected to a computer for real-time video frames processing. The image processing takes the each picture frame delivered from the camera and detects the eye and the pupil to calculate the gaze's direction. The main advantage of video-based eye tracking system is the unobtrusiveness.

III. SURVEY OF PREVIOUS WORK

Sr. no	Real-time working	Accuracy	Speed	Ref.
1.	yes	less	less	[6]
2.	yes	less	less	[2]
3.	no	high	less	[5]
4.	yes	less	less	[8]

By reference to the above-mentioned attributes, we can conclude that previous systems have some drawbacks. To overcome some of these drawbacks we created a new system. Some of the previous systems are based on the internet so for operating them you must have a network connected to them.

Other drawbacks of previous systems :

- The previous systems are big in size and costly.
- Sensor based systems can be risky to use.

IV. PROPOSED SYSTEM

The system consists of following modules:

1. CNN Algorithm:

A convolutional neural network is a feed-forward neural network used to analyse visual images by processing image data with grid structure. It is also known as a ConvNet. A convolutional neural network is used to detect and classify one or many objects from an image. In CNN, every image is represented in the form of an array of pixel values as shown in fig.
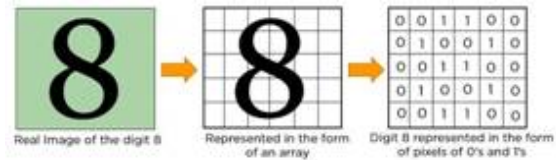
A computer analyse an image as an array of numbers. The matrix on the right contains numbers between 0 and 255, each of which corresponds to the pixel brightness in the Image.

CNN is designed to automatically and adaptively learn spatial hierarchies of features through backpropagation by using multiple building blocks of layers, such as convolution layers, pooling layers, and fully connected layers. CNN is a mathematical constructed in such way that it has typically three types of layers (or building blocks): convolution, pooling, and fully connected layers. The first two, convolution and pooling layers, perform feature extraction, whereas the third, a fully connected layer, maps the extracted features into final output, such as classification. A convolution layer plays a important role in CNN, which is composed of a stack of mathematical operations, such as convolution, a specialized type of linear operation. In digital images, pixel values are stored in a two-dimensional (2D) array, i.e., an array of numbers (Fig. 1), and a small grid of parameters called kernel, an optimizable feature extractor, is applied at each image position, which makes CNNs highly efficient for image processing, since a feature may occur anywhere in the image.

Convolutional neural networks are composed of multiple layers of artificial neurons that are mathematical functions which calculates the weighted sum of multiple inputs and outputs an activation value.
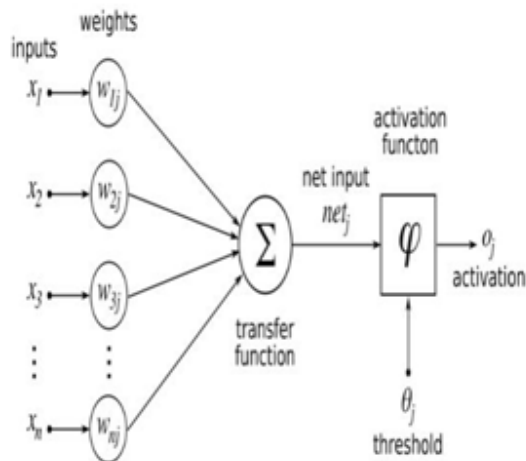
The structure of an artificial neuron, the basic component of artificial neural networks
(source: Wikipedia)

The behavior of every neuron is defined by its weights. When it is fed with the pixel values from image frame, the artificial neurons of a CNN pick out various visual features.

When you input an image into a ConvNet, each of its layers generates several activation maps. Activation maps highlight the relevant features of the image. Every neurons takes a patch of pixels as input, multiplies their color values by its weights, sums them up, and then runs them through the activation function.

The first neural layer of the CNN usually detects basic features such as horizontal, vertical, and diagonal edges. The output comes from the first layer is fed as input of the next layer, which extracts more complex features, such as corners and combinations of edges. As you move deeper into the convolutional neural network, the layers start detecting higher-level features such as objects, faces, and more.

2. TensorFlow:

TensorFlow is an open-source end-to-end platform for creating simple and complex Machine Learning applications. It is a symbolic math library that uses dataflow and differentiable programming to perform various tasks focused on creating, training and inference of deep neural networks. It allows to create machine learning applications using various tools, libraries, and community resources. TensorFlow enables you to build dataflow graphs and structures to define how data moves through a graph by taking inputs as a multi-dimensional array called Tensor. Tensorflow allows to construct a flowchart of operations that can be performed on these inputs, which goes at one end and comes

at the other end as output. It is called Tensorflow because it takes input as a multi-dimensional array, also known as tensors. You can construct a sort of flowchart of operations (called a Graph) that you want to perform on that input. The input goes in at one end, and then it flows through this system of multiple operations and comes out the other end as output.

This is why it is called TensorFlow because the tensor goes in it flows through a list of operations, and then it comes out the other side.

3. Problem description:

Create a eye gaze tracking system that can be used to track movements of human eye using computer vision and predict and move mouse cursor of computer system according to those movements also identify the gestures to do actions accordingly.

V. OPENCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications. 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.

VI. CONCLUSION

Eye tracking and head movement detection are considered effective and reliable human-computer interaction and communication alternative methods. Hence, they have been the subject of many research works. Many approaches for implementing these technologies have been reported in the literature. This paper investigated existing methods and presented a state-of-art survey on eye tracking and head movement detection.

Many applications can benefit from utilizing effective eye tracking and/or head movement detection methods.

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