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EYE MOMENT BASED WHEEL CHAIR CONTROLLING

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ABSTRACT. A novel technique is implemented for the eye controlled based independent and cost effective system. The purpose of Eye movement based control electric wheelchair is to eliminate the necessity of the assistance required for the disabled person. And it provides great opportunity of the disabled to feel of independent accessible life. The implemented system will allow the disabled person to control the wheelchair without the assistance from other persons. In this system controlling of wheelchair carried out based on Eye movements. The sensor is mounted in front of the user, to monitor the Eye blink of the user and to decide the movement (either forward or backward). According to the position of the eye, wheelchair motor will be directed to move left, right and forward. In addition to this, for the safety purpose ultrasonic sensor is mounted in front of wheelchair to detect the obstacles and automatically stop the wheelchair movement. To make system cost effective for monitoring, a PIC controller board allowed accessing the system without displaying unit.

INTRODUCTION

The Wheelchair is dependent system used by elderly and physical disable persons. Here introducing the design implementation models of totally independent Eye control electric wheelchair. As per requirement of the disabilities deferent kind of automatic systems are available in market such as voice control or joystick control system. Sometime for totally paralysis person may be have very difficult to use that type of systems. Here the Eye control system provides the independence to make their life easy and more convenient. And also they save the huge amount of energy or external man power. Sensor is used captured the blink in real time and analysis the signal as input to set the commands for interface the motor driver IC through sending the commands to GPIO pins. The motor driver circuit is used to perform the different operationsuch as left, right, forward and stop. For the advance level of Image Processing open computer vision (OpenCV) library is used for Face and Eye detection. And several application and algorithms are used to find out accurate pupil location detection and tracking of that. One of them is Haar cascade like features detection algorithm used to detects single or multiple face and detection of both eye. To detecting the exact Eye pupil and locate its center point is ultimate goal of this system. For automatically find out Eye pupil and tracking eye pupil many computer vision library of Image processing are used like object detection, motion detection, Image color conversion, edge detection, pattern matching etc. For eye pupil tracking there are several number of other techniques available. But they have its own limitation. One of them ECG, EEG and EOG sensor based eye pupil detection technique is available, where voltage variation based output assumed to decide the location of pupil. But for different user, different output voltage will be generates, which will result faulty location of the eye pupil. The head movement based system have limitation, when user can not able to access the system physically. Moreover, voice activated power wheelchair which works properly, when user speak the command system works according to it like left, right, forward, back, stop. But a noisy environment distracts the system, and system cannot respond properly. And other infrared reflection based eye pupil detection system providing accurate detection of the eye pupil centre location, as well as system can track the eye movement. But the infrared radiations affected the eye and user may loss the eye visibility.

It is difficult for patients with severe physical disabilities to communicate with others, such as amyotrophic lateral sclerosis and serious paraplegia. Owingto the illness in which they lost their limb motor function and language function, they cannot move even their muscles except eye. In order to provide an efficient means of communication for those patients, in this paper we proposed a system that uses EOG-feature based methods and Learning Vector Quantization algorithm to recognize eye motions. According to the recognition results, we use API (application programming interface) to control cursor movements.

The recognition part consists of four steps. First, we measure EOG signals by every 1.8 seconds. Next, we make a judge whether eye motion subsists in the 1.8 seconds EOG data, if any, we extract the data of each motion from the 1.8 seconds EOG data. After that we use Fast Fourier Transform to obtain the frequency features of the extracted motion. Finally we use Learning Vector Quantization network and characteristics of EOG features at each motion to recognize eye motions. The LVQ network is trained beforehand. In this paper we recognized motions of rolling eye upward, rolling downward, rolling left, rolling right, blink and diagonal eye motions which contain rolling up-left, rolling up-right, rolling down-left, rolling downright (the angle of the diagonal motion is 45°) and blink string of three times motion. 8 directions motions correspond to 8 directions cursor movement in this system. We regard blink motion as invalid signal and define blink string motions as double click action. Using this system we have obtained a high recognition accuracy of eye motions(The average

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correct detection rate on each subject was 97.8%, 97.6% and 92.7%). This EOG Mouse interface would be used as a means of communication to help those patients as ALS.

SYSTEM DESIGN

The problem of the utmost importance of a proposed EBEWC system is the robustness against different user types, illumination changes, user's movement, vibration, and accuracy. In order to consider these as vehicle system, if the user changes, the system should be works without any input parameter changes. In accordance with EWC movement, illumination condition may change. Also, disturbances due to EWC vibration is potentially problem.

In the conventional EWC control system with human eyes only, camera is mounted on EWC. This may cause a vulnerable when EWC is vibrated. Also, when user moves their head, gaze estimation is difficult. Furthermore, illumination condition may change during EWC movement. The proposed EBEWC system utilizes IR camera which mounted on user's glass. This way will eliminate problems of illumination changes, user's movement, and EWC vibration. Furthermore, the pupil detection based on pupil knowledge will improve the robustness against different users.

The purpose of this project is to develop a wheelchair that will be controlled by the eyes of the person seated in the wheelchair. This will allow people without full use of their limbs the freedom to move about and provide a level of autonomy. The project will consist of three main parts. The eye tracking module consists of a camera that captures the image of eye ball. The setup is designed so as to cause minimum stress to the user. A webcam is fixed on to a spectacle like set up to capture the image. The camera is placed so as to capture the movement of one eye allowing clear vision to the other eye. The camera will take an image of the eyes that will be sent to the laptop where the images are being processed. Once the image has been processed it moves onto the second part, the microcontroller.

A functional block diagram of the system is given in fig. 1. The microcontroller is used to produce the logic signals to the H-bridge. The burner circuit of the microcontroller can be used if any editing of the microcontroller program is required. A microcontroller with the required number of input and output pins of PIC. The RF receiver is connected to the microcontroller. The microcontroller receives the serial data through the RF receiver. The input ports of the microcontroller are connected to the RF receiver and its output ports are connected to the logic input of the H-bridge to control the direction of rotation of the motor. 4 output ports are used to control two motors using their respective H-bridges. The PIC microcontroller converts the serial data received from the RF receiver to logic signals and these signals are given to the input port of the H-bridge. Ports RB4- RB7 are used to control the H-bridge.

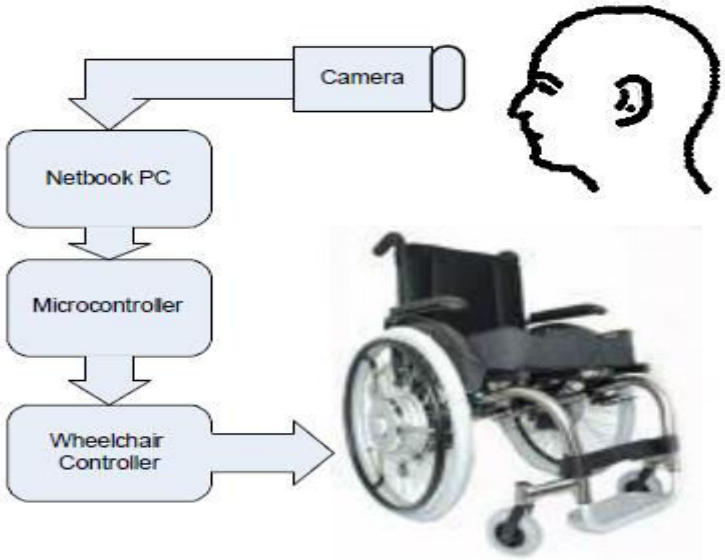

Fig.1. PIC Based Wheel Chair Controller

In order to control EWC using Netbook PC, custom micro controller circuit is used to modify standard control of Yamaha EWC. Default control of the EWC is made by joystick. Micro controller is replaced to the joystick. Command is delivered by Netbook PC, and then micro controller works to move EWC. USB interface on Netbook PC is used to connect with the other peripheral. The interface of the micro controller circuit is RS232. To connect between Netbook PC and the micro controller, USB to Serial converter is used. The micro controller is driven by the relay equipped with the EWC. Micro-controller connection is shown in Fig.3.

In order to estimate gaze, eye should be detected and tracked. Fig. 4 shows the process flow of eye detection and tracking. The proposed EBEWC system detect eye based on deformable template method [32]. This method

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matches between eye template and source images. We create eye template and apply Gaussian smoother. Deformable template method detects rough position of eye. Benefit of deformable template method is that it takes less time than classifier methods. Although this method is faster than the other classifier methods, the aforementioned robustness is not good enough.

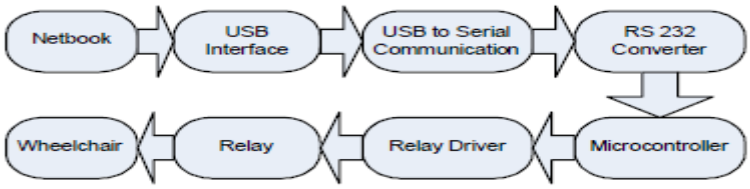

Fig.2. PIC connects to other peripheral through serial communication. Serial communication type should be converted to USB communication using USB to serial converter

In order to control EWC using Netbook PC, custom micro controller circuit is used to modify standard control of Yamaha EWC. Default control of the EWC is made by joystick. Micro controller is replaced to the joystick. Command is delivered by Netbook PC, and then micro controller works to move EWC. USB interface on Netbook PC is used to connect with the other peripheral. The interface of the micro controller circuit is RS232. To connect between Netbook PC and the micro controller, USB to Serial converter is used. The micro controller is driven by the relay equipped with the EWC. Micro-controller connection.

In the proposed EBEWC system, the well known Viola- Jones classifier in the OpenCV library [21] detects eye when the deformable template fails to detect eye position. The Viola- Jones classifier employs Adaboost at each node in the cascade to learn a high detection rate the cost of low rejection rate multi-tree classifier at each node of the cascade. The Viola- Jones function in OpenCV is used for the proposed EBEWC system. Before using the function, we should create XML file through learning processes. The training sample data (face or eye image) must be collected. There are two sample types: negative and positive samples. Negative sample corresponds to non-object images while positive sample corresponds to object image. After acquisition of image, OpenCV will search the face center location followed by search the eye center. By using combination between deformable eye template and the Viola- Jones method, eye location will be detected. Advantages of this proposed method is fast and robust against circumstances changes.

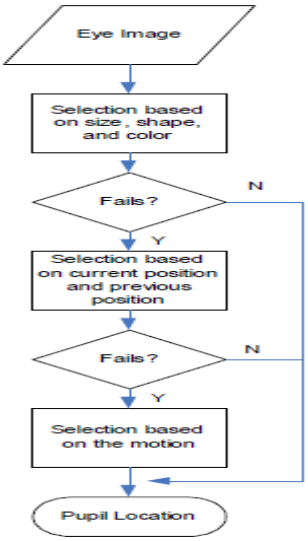

Fig.3. Flow chart for wheel chair movement

After the roughly eye position is founded, eye image is locked and tracked. Therefore, there is no need to detect eye any more. The detected eye position is not going to be changed because the camera is mounted on the glass. Eye gaze is estimated based on pupil center location. Because of this system rely on the pupil center location; pupil detection has to be done perfectly. Pupil is detected by using its knowledge. Process flow of the pupil detection is shown in Fig.3. Three types of knowledge are used. We use pupil size, shape, and color as the first knowledge. First, adaptive threshold method is applied for pupil detection. Threshold value T is determined by the average pixel value (mean) of eye image μ.

The eyeball is assumed to be a sphere with radius R. Although the typical eyeball shape is ellipsoid, sphere shape assumption does not affect to the pupil center location estimation so much that spheroid shape of assumption of eyes ball shape does not affect too much to the pupil center location estimation accuracy. The

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pupil is located at the front of eyeball. The distance from the center gaze to current gaze is assumed to be *r*. Gaze is defined as angle θ between normal gaze and r. The relation between *R*, *r* and θ is as follows,

$$r = R\sin\theta$$

$$\theta = \arcsin(\frac{r}{R})$$

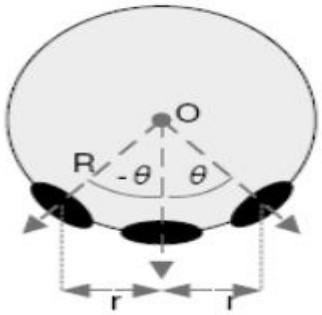
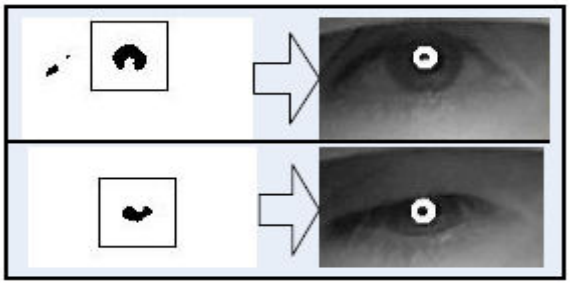
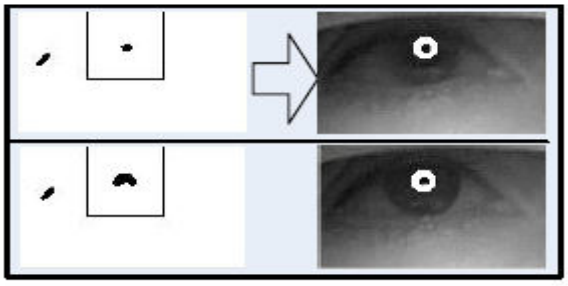


Fig.4. Eye moment



(a) Case 1, Pupil clearly appears



(b) Case 2, Pupil clearly appears with some defect by eyelids

CONCLUSION

The concept of the eye controlled wheelchair is not only represents the alternative resources but more important to help physically disabled persons to make their life independent. The aim of implementing an autonomous eye controlled wheelchair is to highlight the features of digital Image processing. There are some real time design constants measured like a system takes some time (4second) to execute the system for processing the video in Real time Environment. Therefore the system performs the Wheelchair movement operation with some delay time. It's very hard to track the Eye pupil in dark light places, so the system works perfect on environmental light and in a room light with fluorescent mercury vapor lights, which is low in infrared.

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