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Eye-monitored wheel chair prototype

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ABSTRACT

According to a survey, there are 56,000 new people suffering from nervous disorder every year. The great scientist late Stephen Hawking was also suffering from quadriplegia. Our aim is to make lives of the people suffering from the quadriplegia simpler so they do not need to depend on anyone. We have made an Eye Monitored Wheel Chair System which allows movement of wheelchair depending on the eye movements of the person sitting on it. In quadriplegia, all the four limbs of the person are affected and the person can only move their eyes and partially tilt the head. We have created a prototype in which a patient sitting on the wheel chair is able to move in a direction just by seeing in that direction. The camera will take a snapshot of the iris, which will be then processed by the MATLAB, It will then send the signal to the motors through the Microcontroller over the Serial Port to move in a particular direction. This Eye monitored wheel chair is cost-effective and economical to everyone.

Keywords: *Gaze estimation, Obstacle detection, Matlab, Microcontroller.*

1. INTRODUCTION

With the growing population, the number of persons who are paralyzed and are therefore dependent on others for self-mobility is growing. The development of the wheelchair for paralyzed people is surprisingly recent starting with the conventional manually powered wheelchairs and advancing to electrical wheelchairs. Conventional wheelchairs tend to focus exclusively on manual use which assumes that the users still be able to use their hands. Diseases or accidents injuring the nervous system frequently causes people to lose their ability to move their voluntary muscle. Since voluntary muscle is the main actuator enabling people to move their body, paralysis may cause a person not move their locomotor organs such as arm, leg, and others. Paralysis may be local, global, or follow specific patterns. Most paralysis is constant, however, there are other forms such as periodic paralysis (caused by genetic diseases), caused by various other factors.

Late Scientist Stephen W. Hawking is perhaps the most well-known victim of major paralysis – Hawking was diagnosed with incurable Amyotrophic Lateral Sclerosis (ALS) in 1962, thereafter using a wheelchair to move. As we know that for a fact that the people suffering from close to or complete paralysis usually can control their eye movements, so taking this as an inspiration we tried to develop an eye-controlled electric wheelchair prototype.

2. LITERATURE SURVEY

There were many pervious works carried out on electronic Wheelchairs. These are a few of them which helped us to get ideas for our current prototype.

In [1] "Touch screen based wheelchair system," This method is very much user free and requires very less muscle movement. Touch screen is used as input device and LCD displays the user's gesture correctly when recognized. An IR obstacle detection unit can be used which is fixed to the wheelchair to avoid possible accident. A resistive touch screen will be best suited for this application as it is low cost and has greater lifespan compared to other types of touch screens available. From the screen, user can either select a predefined path or can create their path in real-time. The drawback of this method is that, it is less accurate in the turning of wheelchair.

In [2] "Voice and Gesture Based Electric-Automatized Wheelchair Using ARM", this method is very greatly user free and comfortable for elders with limbs impairments. The benefit of this method is to people who are unable to perform simple movements with their hands. This technique uses language and hence cannot be considered universal. A voice recognition IC is interfaced with a microcontroller. This IC accepts the input from the user as voice commands which are then converted to digital signals that a microcontroller can process. It will produce the desired output which controls the wheelchair.

In [3] "Automatic Wheelchair Controlled using Hand gesture", an EMG Sensor, and guide Signal Separation" can be used in this method. A system is designed which uses an IR sensitive camera to identify the gesture shown by the user. The captured images of the gesture are given to the microprocessor which does further processing. The drawback of this method is that it cannot be used by the persons who are suffering from a nerve disorder, stoke etc.

3. PROPOSED METHOD

The purpose of this project is to develop a wheelchair prototype that will be controlled by the eyes of the person seated in the wheelchair. This allows people without the full use of their limbs the freedom to move about and provide a level of autonomy. The project consists of two main parts. The eye tracking module consisting of a camera that captures the image of eye ball. The setup is designed such that it causes minimum stress to the user. A webcam is fixed on to a spectacle like set up to capture the image. The orientation of the camera is such that it captures the movement of one eye and at the same time 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 processed. Once the image has been processed it moves onto the second part, the microcontroller which triggers the movement of the assembly.

A. Hardware configuration

Hardware configuration of the proposed eye monitored wheel chair is given in below fig1.

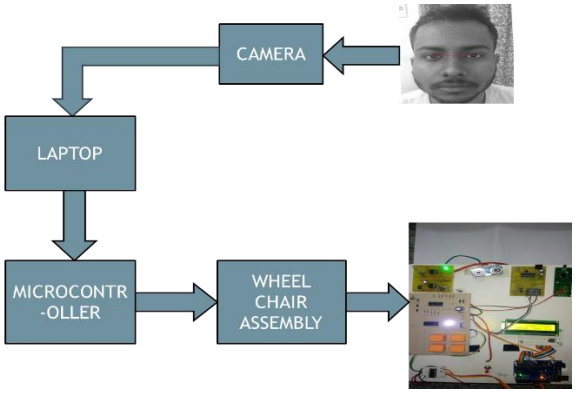

Figure 1. Hardware Configuration

A functional block diagram of the system is given in fig 2. 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 and asynchronous serial communication is selected. 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 89C51 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.

B. Gaze Estimation

In order to estimate gaze, the eye should be detected and tracked. Fig 3. Shows the process flow of eye detection and tracking. The proposed EBEWC system detect eye based on deformable template method [4].This method matches between eye template and source images. We create eye template and apply Gaussian smoother. We then employed deformable template method which detects

rough positions of an eye. The benefit of using this 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.

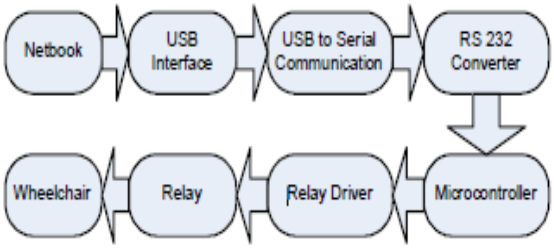

Figure 2. Functional block diagram

Microcontroller 89C51 connects to other peripheral through serial communication. Serial communication type should be converted to USB communication using USB to serial converter.

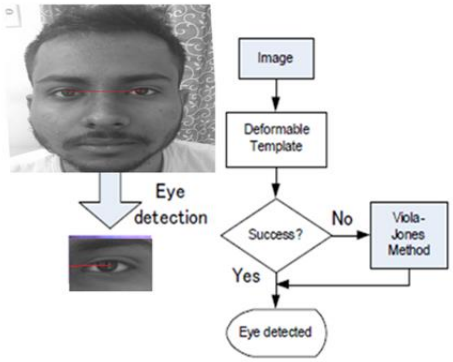

Figure 3. Flow diagram of eye detection

In the proposed EBEWC system, the well-known Viola- Jones classifier in the Open CV library [12] detects eye when the deformable template fails to detect eye position.

C. Obstacle detection

The IR sensor is placed at the front end of the wheelchair prototype. This is used to provide information on obstacles in the direction of the wheelchair. It consists of transmitting and receiving section. If any obstacle in the direction of a wheelchair, it will send 5V supply to the controller, then the wheelchair is stopped. Else 0V supply is given to the controller.

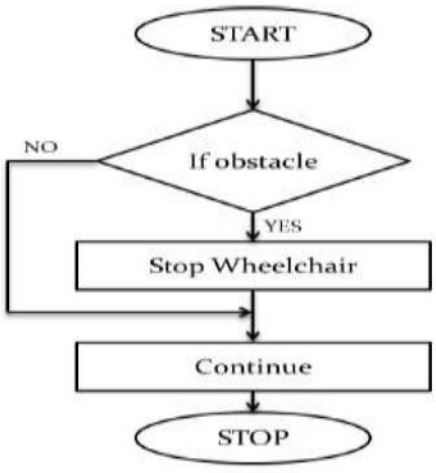

Fig 4. Flow chart of the obstacle sensor

4. CONCLUSION

Specific features of the proposed EBEWC system are:

- It allows user movement: User can move using the proposed EBEWC system in any directions in the allowable distance of which the camera mounted on the glass acquires user's face,
- It does not require any calibration process before using the proposed EBEWC system,
- It is robust against immunization changes, additive noises, vibrations to the EWC, user nationality (different color of the eye as well as skin, size, and shape of the eye), eyelid influence, and shade and shadow,

- Pupil center detection accuracy for the acceptable angle range is almost 0.2 degree,
- Even if pupil center is not detected when user close eye, gaze location is estimated with the knowledge of previously detected pupil center location.

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