# Wheel Chair Movement Automation using Patient Iris

**Chetan W. Rawarkar[1] D. S. Chandak[2]**
[1]Student [2]Assistant Professor
[1,2]Department of Electrical & Electronics Engineering
[1,2]Prof Ram Meghe College of Engineering and Management, Badnera Amravati India

*Abstract*— Statistics suggests that there are 11,000 new cases of Alzheimer's disease (AD) every year in United States of America. Great people like Stephen Hawking and Max Brito have been suffering from this crippling phenomenon. Our project is an attempt to make lives of the people suffering from this phenomenon simple and by simpler we mean self-reliant, which will thereby reinstate their confidence and their happiness. The idea is to create an Eye Monitored System which allows movement of the patient's wheelchair depending on the eye movements. We know that a person suffering from Alzheimer's disease or quadriplegia can partially move his eyes and tilt his head, thus presenting an opportunity for detecting those movements. We have created a device where a patient sitting on the Wheel Chair assembly looking directly at the camera, is able to move in a direction just by looking in that direction. The camera signals are monitored by a MATLAB script, to move in a particular direction. The system is cost effective and thus can be used by patients spread over a large economy range.

***Key words:*** Wheelchair, Automation, Iris, Alzheimer's Disease, Arduino

## I. INTRODUCTION

People who are unable to walk and are using wheel chairs exert great amounts of energy using physical strength to turn and steer the wheels. With eyesight being their guide, the disabled would save energy and could use their hands and arms for other activities. 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 paper will consist of three main parts. Our paper is an eye movement controlled wheelchair. A mounted camera database will track eye movement and control a wheelchair to go forward, left or right, stop or reverse. Blinks will control start/stopping. We have included sensors on the front of the wheelchair for collision detection. The most challenging aspects lied in finding a good way to calibrate the camera to a person's eyes without obscuring their vision, determining the eye's movement, and controlling the wheelchair's wheels for proper movement.[3]. The captured database images loaded on the system will take a USB output from the laptop and convert the signal into signals that will be sent to the wheelchair wheels for movement. Also, object detection sensors will be connected to our arduino to provide necessary feedback for proper operation of the wheelchair system. The final part of the project is the motor drivers to interface with the wheelchair itself. [4] There will be two motor drivers for each motor on the wheelchair both left and right. Each motor driver will consist of an h-bridge that will power the motor depending on the output of the arduino.[1].

## II. PROPOSED METHODOLOGY

Face image is given to MATLAB algorithm eliminate background identify only face. From face eyes are detected. Both eyes will be made separated as left eye and right eye scanning of the eye. Will be done to fix whether is closed or open. If it is closed system will send command to stop the chair, if eyes are open system will check the eye ball position whether it is left or right or in centre. If it is at left, left movement command will given to chair, if it is at centre forward movement command will be executed and it is in right then right movement command will be executed.

Based on a series of snapshots taken and thereafter processed, the motion of the user's eyes are detected, decision to move the Wheel Chair in a particular direction is take.[2] A description of the Algorithm is given in the software section of the report. Continuous snapshots stored in database every frame are taken and feature points extracted are saved i.e. we capture approximately 10 snapshot every process it. Based on the position of the feature points in previous snapshot and current snapshot, a movement is detected and this is communicated to the wheelchair. A decision based on the processing done by the MATLAB application is communicated and received by the load images. So, now we will have a look at the overall code structure of our algorithm and the logic behind the decision making.

## III. SIMULATION FLOW

There are multiple aspects to the software design of this project. Since majority of computational work is done in software, a lot of our time went in software design and testing. The MATLAB component is responsible for load the images, determining the movement of eyes,

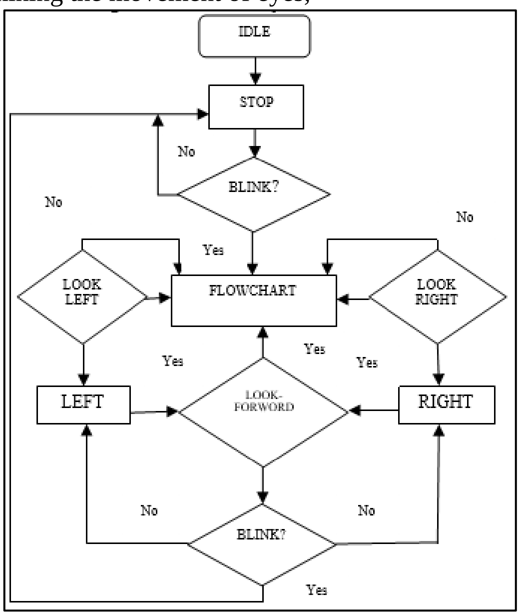


Fig. 1: Eye Tracking Algorithm Flow Chart

 

## IV. INPUT DATABASE FOR PROPOSED MODEL

Due to low processing speeds, practically processing every frame through MATLAB was not possible. Hence every 25th frame was worked upon. Every sample was converted then from RGB to gray scale which reduces the overall information associated with the image thus making image easier to extract and process [7]. Contrast limited adaptive histogram equalization (CLAHE) was also performed. It enhances small data regions so that the histogram of each output region approximately matches the specified histogram. The region of interest was also limited to capture only the eyes of the patient to avoid accidental noise capture. The requisite condition for our algorithm was to continuously analyze different captured video frames, based on which the motion of the robot was determined, the captured video was sampled every 25th sample [9]. The sampling rate was chosen in due consideration with the maximum image processing capacities of MATLAB and our hardware prototype in accordance with the algorithm implemented. Some of the vital functions of Image Processing Toolbox implemented in the algorithm are as mentioned.

Now after detecting the eye movements, we have to come up with a decision algorithm that will help the controller to drive the motors accordingly:

- Valid Left: The decision to turn left will be considered as valid if the eye turns left and stays there for a cycle. This action will be detected as a left turn request. After that, the patient will turn right to again look forward. Thus, this signal should be considered as void.
- Valid Right: Similarly, the decision to turn right will be considered as valid if the eye turns right and stays there for a cycle. This action will be detected as a right turn request. After that, the patient will turn left to again look forward. Thus, this signal should be considered as void.
- Valid Straight: The signal to go straight is when a person looks left and right or right and then left. This will be detected as to go straight.

Below Figure represented the position of iris moves the wheel chair as per the direction of the iris represented.

Fig. 2: For Straight instruction the iris position is shown in figure.

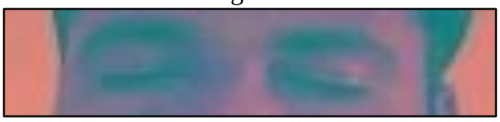

Fig. 3: For Stop instruction the iris position is shown in figure.

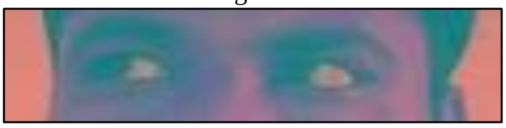

Fig. 4: For Right instruction the iris position is shown in figure.

Fig. 5: For Left instruction the iris position is shown in figure.

## V. TESTING STRATEGY

The UI of the system is designed in such a way that it is easier for the people to use. Also it has the facility for adjusting the threshold according to the eye size for capturing the pupil movement

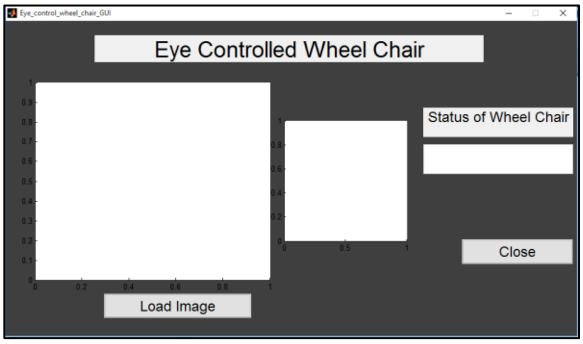


Fig. 6: Snapshot for GUI

## VI. RESULTS

The input and its corresponding images shown below are produced after using algorithm on input image for processing in MATLAB.

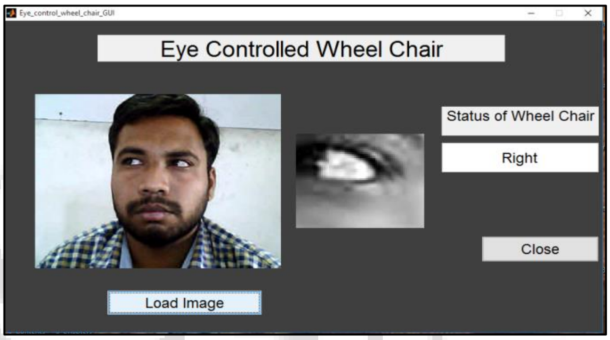


Fig. 7: Result of Right Movement.

The project performs satisfactory with performance accuracy of around 70-90%. The results after testing it for 100 to 200 attempts to move in a random direction were made by both us. The results were tabulated below [17].

Now, in this step we actually detect the eye movements. The idea is to compare the current position of the eye with the previous position. Thus, the difference in the coordinates will help us to predict the motion in the particular eye. But sometimes, it may be possible that only one of the either eye will be detected. In that case, we will give preference to the eye that is detected currently.

| Name of Image | Table Column Head | | |
|---|---|---|---|
| | No. of Images | Successful Attempts | Accuracy |
| Left | L1, L2, L3, L4, L5, L9 | 04 | 70% |
| Right | R1, R2, R5, R10, R12 | 03 | 60% |
| Streight | C2, C3, C4, C6, C7, C8 | 05 | 80% |
| Stop | CL2, CL3, CL4, CL5, CL6, CL7 | 04 | 70% |

Table 1: Accuracy Results

The system accuracy could have been improved for it was calibrated for the height and width of his eyes. Better lighting can improve the accuracy by providing brighter snapshots to process. The initial pre-processing contrast stretches the image around the mean, which helps in improving the accuracy by making the detection more accurate. Successful attempts were counted as all those attempts which resulted in movement of the wheel chair in the desired direction. For the system to be accurate, each time a system is configured for a person, alter the height and length of the specified eye so that the system recognizes the eye of the person with high precision.

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