A

PROJECT REPORT

ON

Eyeball Controlled Wheelchair

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For Partial Fulfillment of the Requirement for Bachelor of Technology in Information Technology

Guided by

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November, 2018

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AY, 2018-19, Semester I

CERTIFICATE

This is to certify that project work entitled **Eyeball Controlled Wheelchair** has been successfully carried out by **Ashesh Sheth (15IT016), Megharth Lakhataria (15IT038), Neel Patel (15IT058), Jaynil Patel (15IT070)** for the subject of **IT441- Minor Project- I** during the academic year 2018-19, Semester-I for the partial fulfilment of Bachelor of Technology in Information Technology. The work carried out during the semester is satisfactory.

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ACKNOWLEDGEMENTS

This minor project I would not have been possible without the help of many people. Hereafter, we would like to thank them for their help, support, and/or advice they have given us while working on the project.

First, we would like to thank our minor project-I supervisor, Prof. Vatsal Shah for his guidance, help, and the many discussion sessions that gave us courage and enthusiasm to design and build this application.

Finally, I would like to thank Birla Vishvakarma Mahavidyalaya Engineering College, for giving us the opportunity to work on this project.

ABSTRACT

This project includes the electronic wheelchair that is implemented for the disabled person who cannot walk. The purpose of this eyeball-controlled wheelchair is to eliminate the assistance required for the disabled person. In this system we are controlling the wheelchair by eye movements and central switch. A good resolution camera is mounted on wheelchair in front of the person, for capturing the image of eye and tracking the position of eye pupil by using any image processing techniques using OpenCV platform. According to eye pupil position of disabled person, motor will be moved in required direction such as left, right, backward and forward. It is mounted in front of wheelchair for safety to detect static obstacle or mobile barriers and to stop the wheelchair movement automatically. This is independent and cost-effective wheelchair system. A Raspberry Pi board is used to control whole system.

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Chapter 1: Introduction

1.1 Aim of the Project

- In 21st century the number of the people infected with paralysis are increasing at a very high level. Also, due to various new diseases the loco-motive organs of patient stop working. So, they are forced to use wheelchair to move. While, they use conventional manual powered wheelchair it becomes difficult for them to travel for longer time. Disable patients depends on other to help them to move on wheelchair. So, the main aim of our project to automate the wheelchair. This will reduce the burden on the patient to manually handle the wheelchair. In most of the cases of paralysis the patient can operate their eyes. So, our project aims to control the wheelchair using the pupils of the patient using computer vision.

1.2 Project Scope

- This project will detect the patients eye using a webcam mounted on a headrest and analyse the movement of the pupils. The movements will be analysed by the image processing toolkit of OpenCV. According to the analysis of the movement certain actions will be performed as follows. If the pupils move left the wheelchair will move left turn and if pupils move right wheelchair will move right. The direction of the pupil will guide the wheelchair.

1.3 Project Objective

- The idea is to create a generalized tool that can be seamlessly combined with other system like electric wheelchair, movable patient bed, eye-controlled alerting mechanism for disabled people etc. The main objective here is to capture live image and also establish the system that can recognize pupil movement in live image. Thus, we can summarize that our main objective to develop a “vision-based wheelchair system”.

1.4 Project Modules

- ➢ Eye-tracking Module
- ➢ Image Processing Module
- ➢ Controller Module
- ➢ Assembly Module

1.5 Project basic requirements

Software Requirements

- Operating System: Linux
- Back End: Image Processing Toolkit, OpenCV Library

Hardware Requirements

- Pi
- Web-Cam
- Electric Motors

Chapter 2: Literature Survey Report

2.1 Definition:

Eyeball controlled wheelchair

2.2 Introduction:

In 21st century the number of the people infected with paralysis are increasing at a very high level. Also, due to various new diseases the locomotive organs of patient stop working. So, they are forced to use wheelchair to move. While, they use conventional manual powered wheelchair it becomes difficult for them to travel for longer time. Disable patients depends on other to help them to move on wheelchair. So, the main aim of our project to automate the wheelchair. This will reduce the burden on the patient to manually handle the wheelchair. In most of the cases of paralysis the patient can operate their eyes. So, our project aims to control the wheelchair using the pupils of the patient using computer vision.

2.3 Main body:

There were many previous works carried out on electric wheelchairs. A few of them helped us get ideas for our current prototype. In [1] Karthikeyan K C et.al, proposes an optical-type eye tracking system to control powered wheelchair. User’s eye movement is translated to screen position using the optical type eye tracking system movement. The method allows the user to look around freely while the wheelchair navigates automatically to the desired goal point. Another control method of a robot is by means of an electric wheelchair, dedicated to severely disabled persons, equipped with a low-cost web camera, using only eye movements and gaze direction.

2.4 Denouement:

Thus, by referring the following citations we came to conclusion that it is possible to design an efficient solution which can help paralytic patients to move.

Chapter 3: System Analysis and Design

3.1 Comparison of Existing Applications with your Project

- The patient will able control the wheelchair using gazing of the eyes
- Main advantage is that the disable patient will able to move the wheelchair independently in their own respective direction.
- It is cost effective as Pi is very low priced.

3.2 Project Feasibility Study

Technical feasibility

- This hardware will give live gazing of the eye pupil and provide instant outcome. Also, it can be easily interfaced with the other application such as eye-controlled alerting mechanism for disabled ones.

Economic feasibility

- As the only required hardware is a low-resolution webcam and Pi. Wheelchair can be manufactured at a very low cost and it does not require any maintenance further after the development of the wheelchair.
- Patient can buy the wheelchair at low rate. As the main hardware is webcam and Pi, whenever wheelchair stops working due to some reasons, the only thing to replace is webcam or Pi.
- As, the Image Processing Toolkit is open source the overall economic feasibility of the project increases.

Operational feasibility

- Implementing our project is very feasible as it very friendly, what it requires from patient is to rotate the pupils of eye.
- It is feasible for our project to maintain the software as it is open source.

3.3 Project Timeline chart

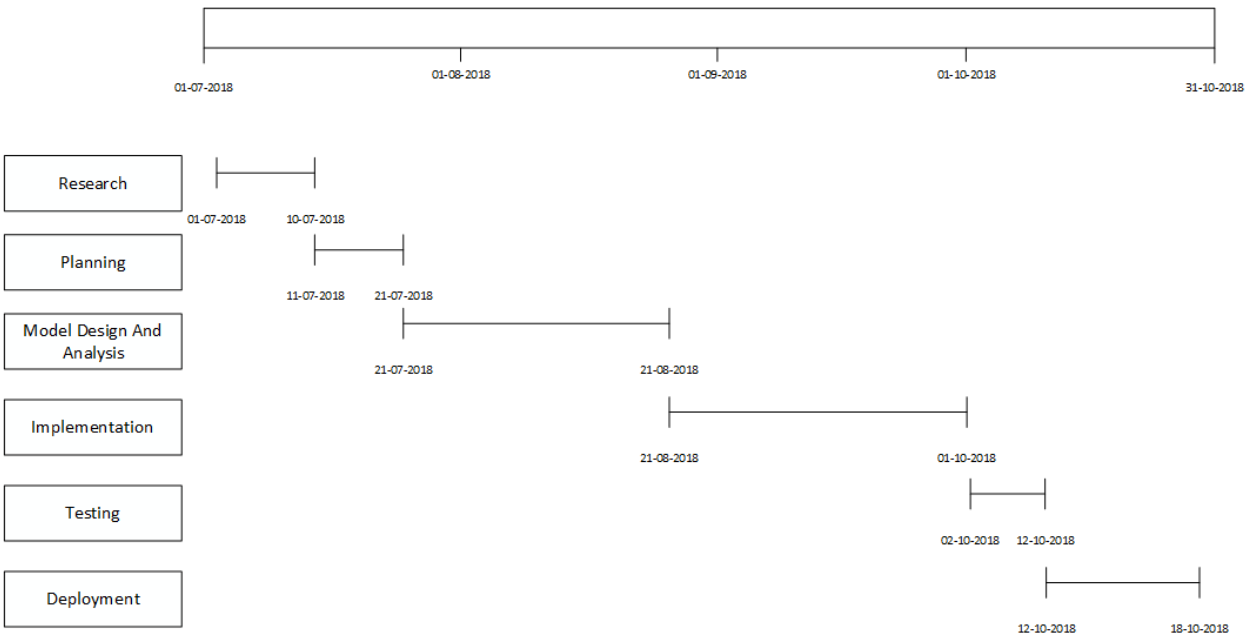

Figure 1: Project Timeline Chart

3.4 Detailed Modules Description

Image-processing Module:

➢ In this module, pupil will be identified using image processing. For this purpose, OpenCV will be used which is more precise and accurate for image processing of tracking application [3]. The designing steps are classified below

1) Image capturing: The image processing starts with the frame acquisition through a webcam that transferred data serially to OpenCV. An infinite triggering event for the camera is initiated for continuous stream of data whereas.

2) Feature Extraction: The stored RGB frame is then separated into its respective planes i.e. red, green and blue. Among the three planes, red plane was selected for the feature

extraction step because it had appropriate values of brightness, contrast and gamma pre-sets that resulted in a clear identification of pupil.

3) Sectionalisation: The logical manipulation will be applied on red plane image extracted from the feature extraction.

Eye-tracking Module:

- A trained machine learning model "Viola-Jones" will be used for detecting the real time capture images and videos. This model will extract the image from the processed image and compart it according to left or right.[4]
- The characteristics of Viola–Jones algorithm which make it a good and accurate detection algorithm fast and robust.
- The cascade object detector of OpenCV image processing toolkit will detect the eye pair.

Controller Module:

- This module will control the motion of wheelchair by sending the movement information to the motors. After detecting the eye movements, we can proceed to determining and sending serial signals to the Pi.
- After determining which direction, the wheel chair has to be moved in, the decision is transmitted to the Pi via the serial port. The only thing sent is a one-digit decision, saying right, left or straight movement.

Assembly Module:

- It will contain the assembly of motors with wheelchair and also with the Pi. This will enable the user to control the wheelchair using his/her pupil.

3.5 Architecture:

As shown in figure 1 the architecture the webcam is used to capture the image of the patient and pass it on to the OpenCV. Web-cam will run in infinite loop to continuously capture the image of the face. The OpenCV will pre-process the image and extract the eye movement according to the image extraction. The eye tracking signals will be sent to the Pi for movement of the rotors and motors. The Pi will work as a controller for the motors and the rotors connected to the Pi board. It will control the movement of the motor 1 and motor 2 connected to the motor driver in the Pi board. Thus, enabling the control of the wheelchair using eye pupil.

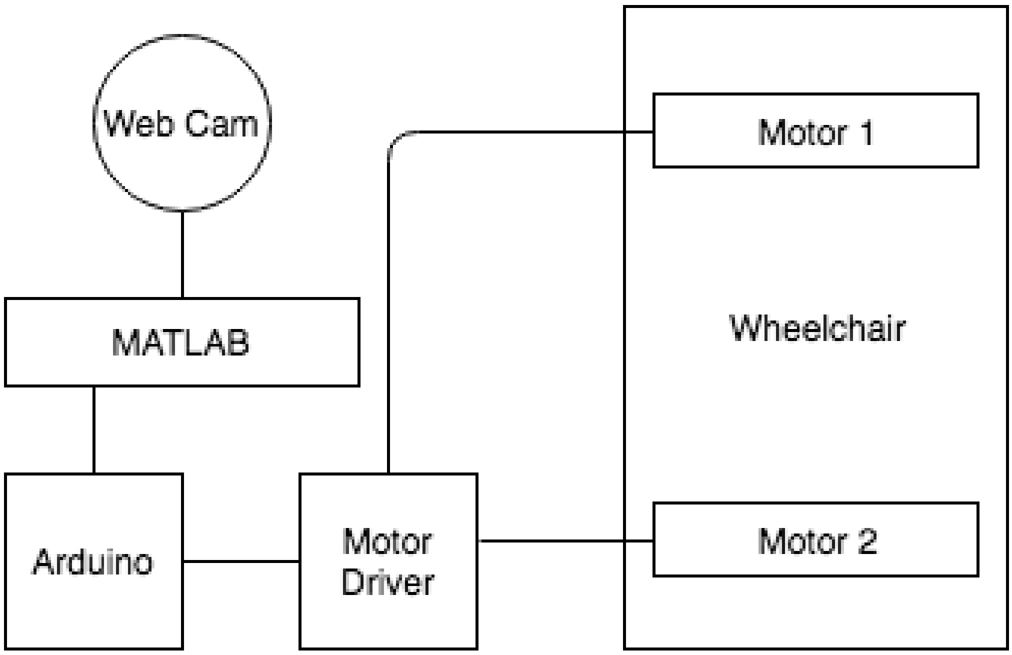

Figure 2 Architecture

3.6 Flowchart of working system:

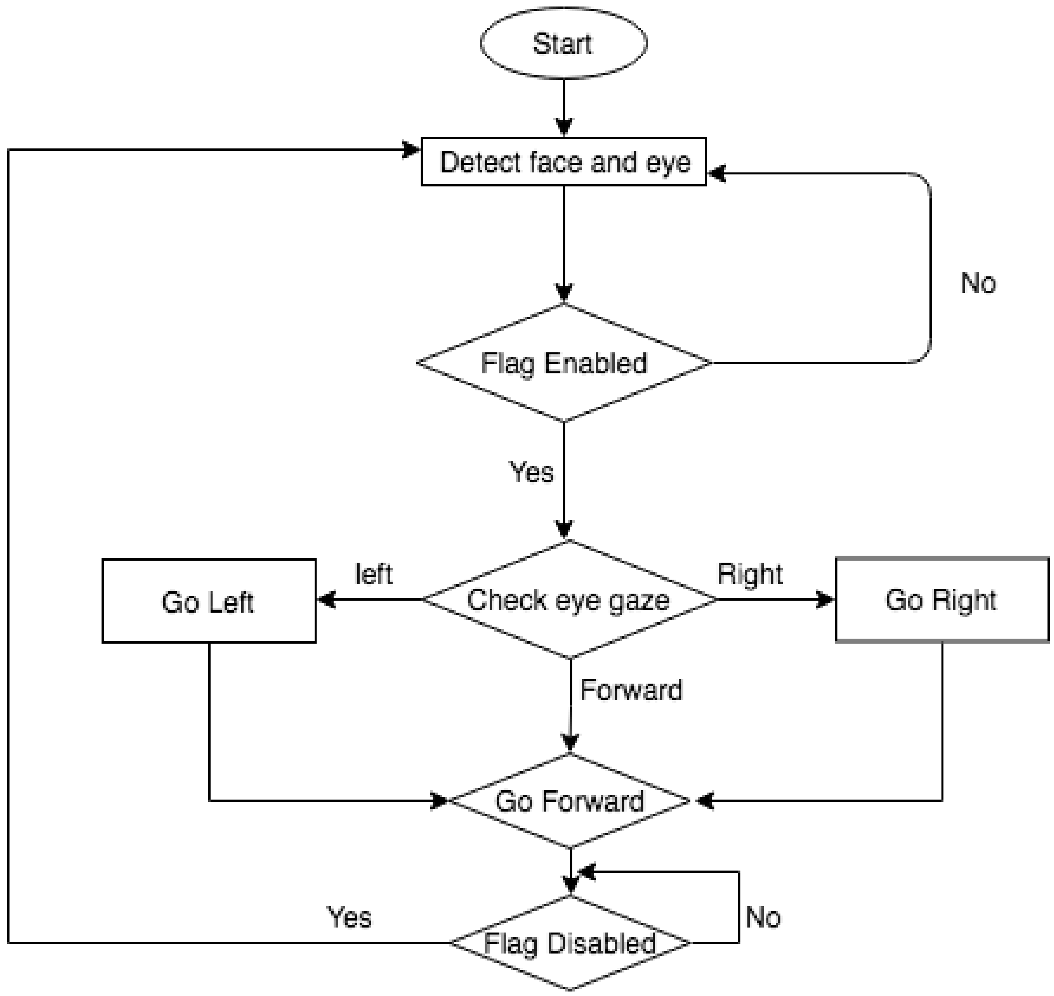

Figure 3 Flowchart

3.5 Project SRS

3.5.1 Use Case Diagrams

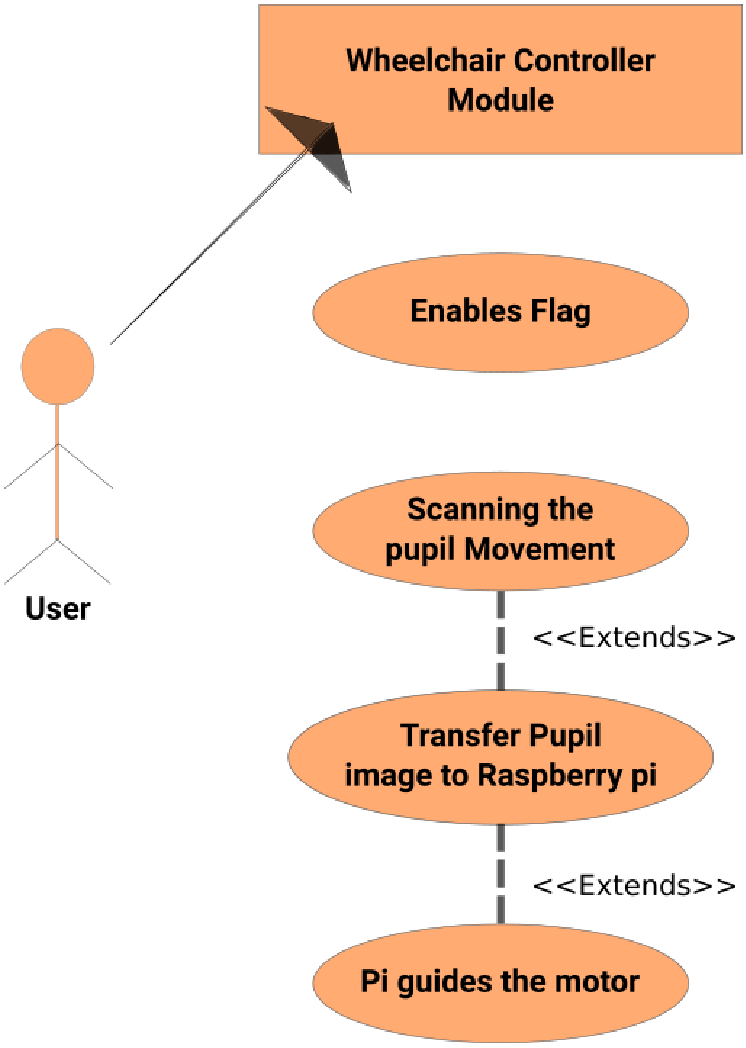

Figure 4 Use Case Diagram

3.5.2 Data Flow Diagram

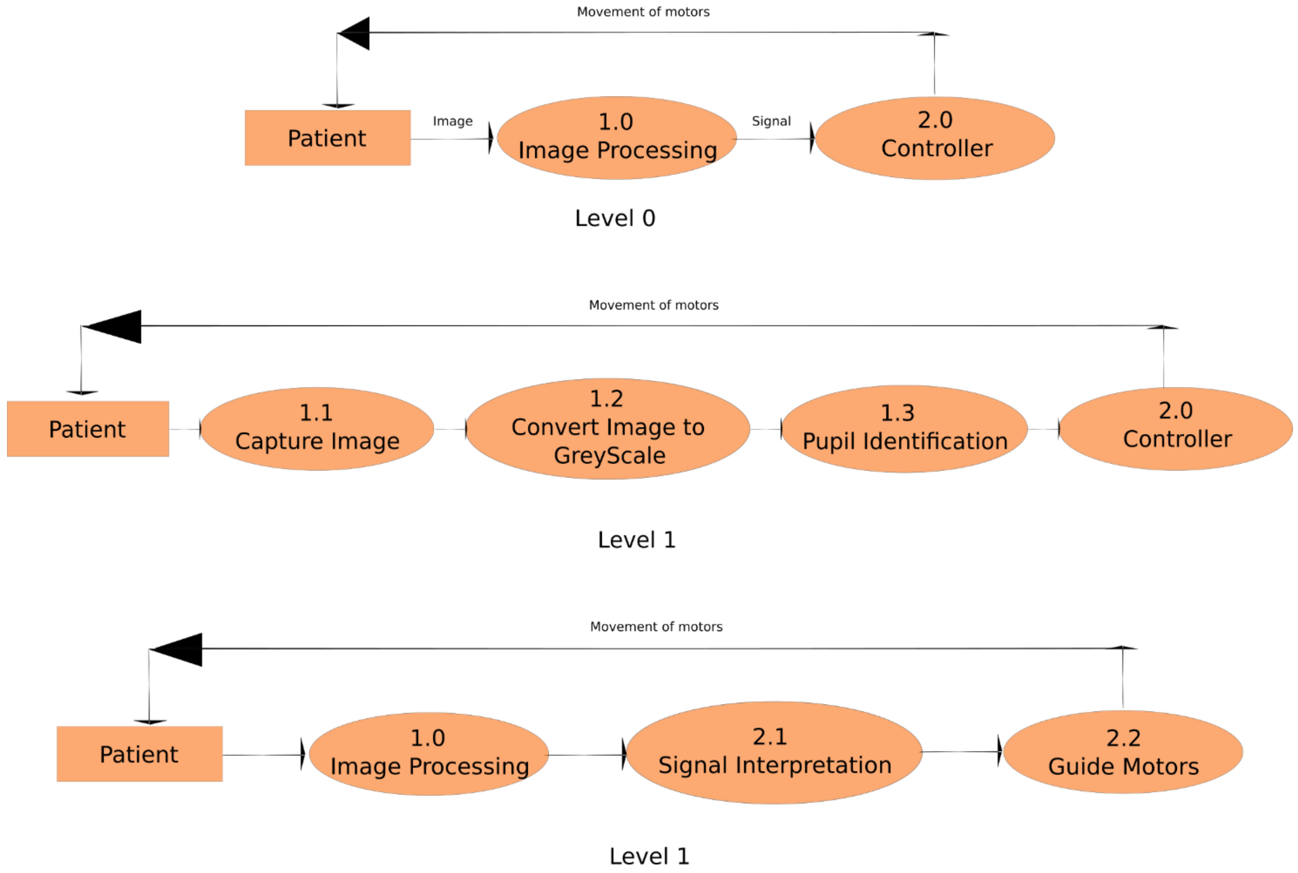

Figure 5 Data Flow Diagram

3.5.4 Activity Diagram

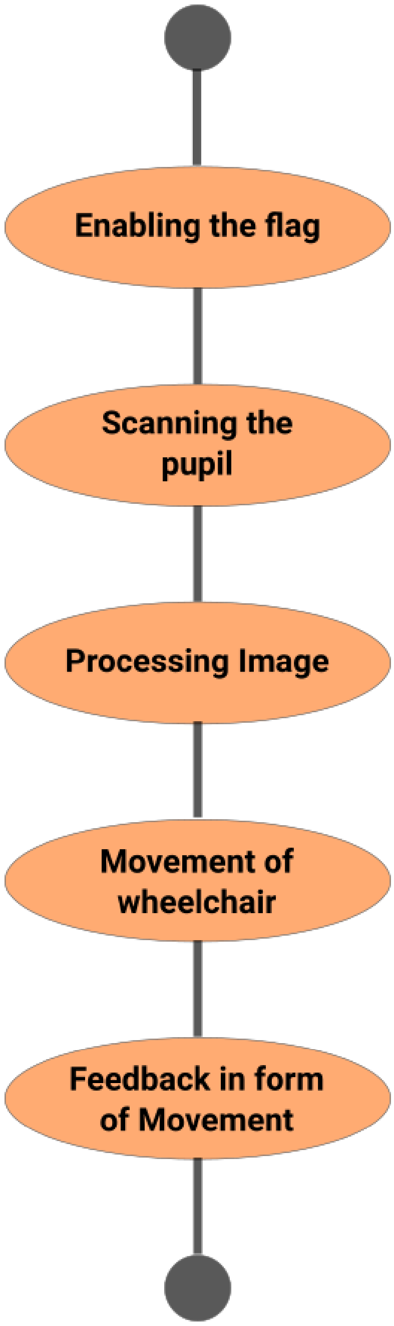

Figure 6 Activity Diagram

Chapter 4: Implementation and Testing

4.1 User Interface and Snapshots

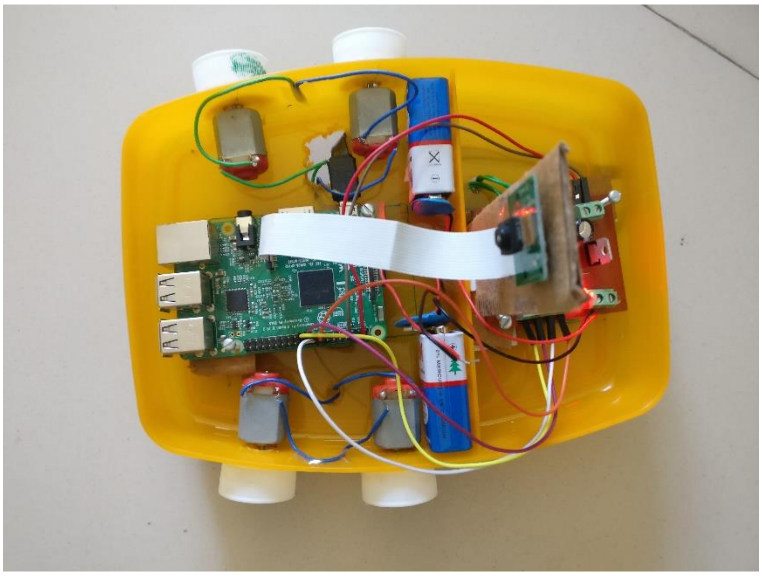

Figure 7 Top View

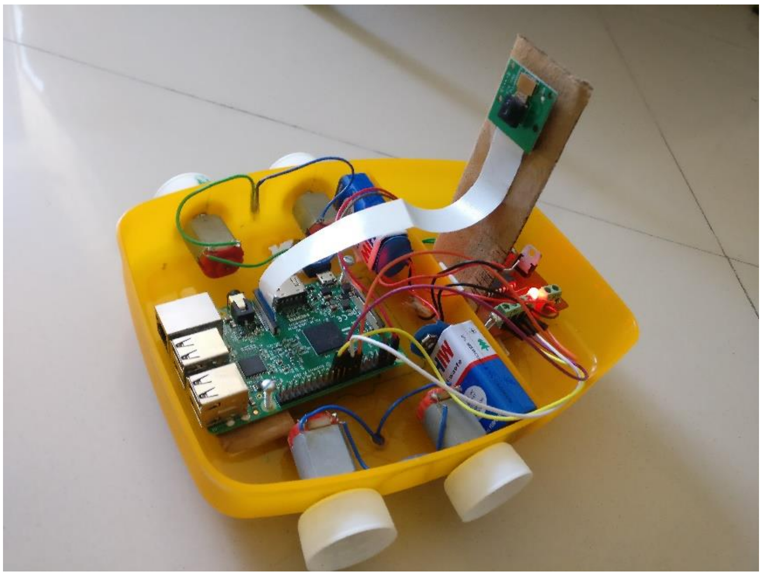

Figure 8 Side View

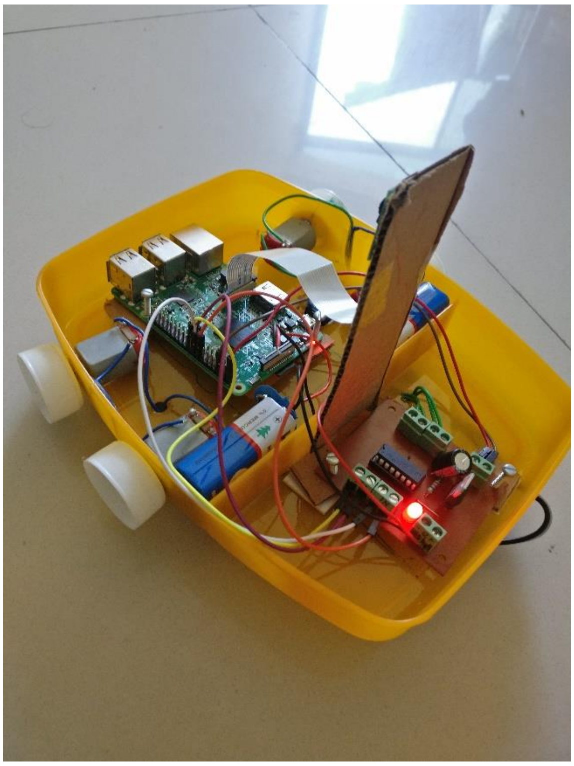

Figure 9 Front View

4.2 Testing using Use Cases

Test Case ID	Test Scenario	Test Steps	Expected Results	Actual Results
TU01	Check if eye closed, greater than 3 seconds	1. Uses looks at the camera 2. Checks the flag LED	Wheelchair starts forward movement and LED will be on.	As Expected
TU02	Check if wheelchair is working even if one is closed	1. Uses looks at the camera 2. Checks the flag LED	Wheelchair starts forward movement and LED will be on.	As Expected
TU03	Check the wheelchair movement if user looks right.	1. Left wheels moves forwards. 2. Right wheels moves backward.	Wheelchair turns right.	As expected
TU04	Check the wheelchair movement if user looks left.	1. Left wheels moves backward. 2. Right wheels moves forward.	Wheelchair turns left.	As Expected
TU05	Check if eye closed, greater than 3 seconds	1. Uses looks at the camera 2. Checks the flag LED	Wheelchair stops movement and LED will be off.	As Expected

Table 1: Test Cases

Chapter 5: Conclusion and Future Work

5.1 Conclusion

The main objective of the project is to develop a Eyeball Controlled Wheelchair System. We had taken a wide range of literature review in order to achieve all the tasks, where we came to know about some of the products that are existing in the market. We made a detailed research in that path to cover the loopholes that existing systems are facing and to eradicate them in our application. In the process of research, we came to know about the latest technologies and different algorithms.
As a result, the product has been successfully developed in terms of extendibility, portability, and maintainability and tested in order to meet all requirements.

5.2 Future Work

With the knowledge We have gained by developing this system. We are confident that in the future We can make the application more effectively by adding these services.

- Streamline circuits
- Integrate voice commands
- Make whole system more power efficient
- Enable speed control
- Enable backward motion
- Drowsiness detection

Chapter 6: References

6.1 References:

[1] Gunda Gautam, Gunda Sumanth, Karthikeyan K C, Shyam Sundar, D.Venkataraman, "Eye Movement Based Electronic Wheel Chair For Physically Challenged Persons", International Journal of Scientific & technology research, 2014, Volume 3, Issue 2, ISSN 2277-8616.

[2] Deepmala Kurrey, Rahul Gedam "A review on eye ball detection based wheelchair control using OpenCV and Arduino Platform for a Physically Disabled Person"

[3] https://www.pyimagesearch.com/2018/07/23/simple-object-tracking-with-opencv/

[4] https://docs.opencv.org/3.3.0/d7/d8b/tutorial_py_face_detection.html