Project Synopsis

Project Reference Number: 46S_BE_4565

Title of the project: OCULAR BASED WHEELCHAIR ACTUATOR SYSTEM FOR AMYOTROPIC LATERAL SCLEROSIS(ALS) IMPAIRED PATIENTS

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Keywords: Visually Impaired, Smart Wheelchair, IR Sensor, Raspberry Pi, Camera, GPS Module, Accelerometer, DC Motors and Wi-fi.

Introduction / background:

People's quality of life is drastically impacted by the motor impairments caused by illnesses like Amyotrophic Lateral Sclerosis (ALS). Thanks to advancements in electric wheelchair design, persons with motor disabilities have learnt to live with their limited autonomy for years. To use and operate an electric wheelchair, however, typically takes a lot of ability. In addition, some people with motor disabilities are unable to manually operate an electric wheelchair (even with a joystick) because they are physically incapable of controlling their hand movement (such as persons with ALS). Researchers have looked into a variety of interfacing technologies, including speech recognition, head arrays, eye tracking, brain-computer interfaces (BCIs) based on Electroencephalography (EEG), Electro-oculography (EOG) systems, and Sip-and Puff (SnP) switches, to enable a user to control a wheelchair safely and easily. Each technology has restrictions, though, which make it impossible to use in daily life.

People with ALS gradually lose their ability to move around and may become totally dependent on carers or confined to their beds without the proper mobility aids. They gradually lose muscle power and frequently develop reaching and grasping issues that make using driving mechanisms, such as a joystick, challenging. Additionally, they have a very limited vocabulary. These physiological restrictions merely mean that people with ALS are unable to use the speech, head movements, and hand- or chin operated joysticks that are now used as interfaces for electric wheelchairs.

There is no need for physical interaction when using eye trackers to move the mouse cursor on a computer screen. Additionally, the majority of ALS patients maintain normal vision control and are able to move their eyes with ease. The wheelchair may be turned or moved towards a target location using a control system that can identify where the user is looking.

Objectives:

- To develop a system which is universal accessible , economically affordable system.
- The main objective of this project is camera is used to control the movement of wheelchair by using visual commands and accelerometer for hand gesture which helps the patients to move in desired direction.
- The use of IR sensor helps in detecting obstacles.
- The approach is interdisciplinary making use of IoT and Machine Learning.

Methodology:

Materials

- HARDWARE REQUIREMENTS:
  - RASPBERRY PI
  - ACCELEROMETER SENSOR
  - CAMERA
  - IR SENSOR
  - GPS MODULE
  - POWER SUPPLY
  - DC MOTOR
- SOFTWARE REQUIREMENTS:
  - PYTHON IDE
  - RAPBERRY PI OS
  - OpenCV

Methods

Here we will use Hand Gesture and visual Controlled both to control the Wheelchair. In order to detect movement in any of the three axis directions, a sensor called an accelerometer is used. In this project, the X and Y axis were taken into consideration for the direction. The input from the sensor is provided to the encoder, which encodes the data and transmits it wirelessly through the transmitter. The data is then received at the receiver end, where the sensor data is decoded before being provided to the microcontroller. The microprocessor delivers the signal to relays in accordance with the information from the accelerometer to drive the wheelchair forward, backward, left, and right. Here IR sensor able to detect obstacles present in the way. GPS used to find the location, camera is used for visual commands. The camera will capture the eye movement of the person and sends the commands to the micro-controller. Here the OpenCV algorithm is used for eye-image capture and commands. Python programming is used with Raspberry Pi to control the projects.

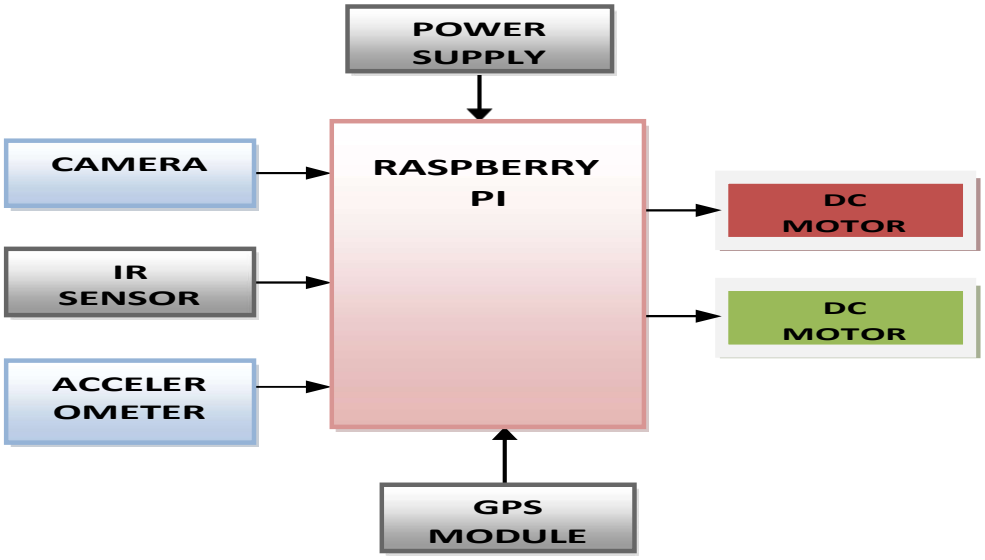


Fig: Block diagram

Algorithm for Eye detection-Various face detection algorithms are there but the Viola-Jones Algorithm is the oldest method that is also used today , OpenCV-Python is a library of Python bindings designed to solve computer vision problems is used .In this project we are using OpenCv for recognition of eyeball moment , so that the wheelchair moves in a particular direction. Dlib HoG Face Detection .HOG is basically a feature descriptor that is performed both for image processing and computer vision techniques .OpenCV is a video and image processing library and it is used for image and video analysis, like facial detection, license plate reading, photo editing, advanced robotic vision, and many more. The Dlib library contains our implementation of 'deep metric learning' which is used to construct our face embeddings used for the actual recognition process. The face recognition library is super easy to work with and we will be using this in our code. First, remember to install Dlib library before you install face recognition.

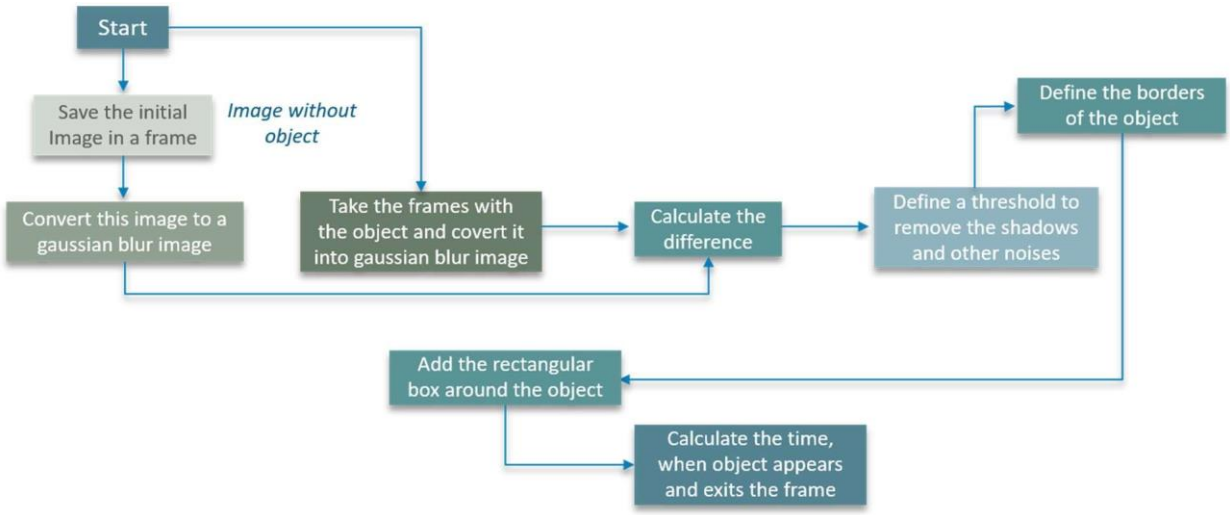
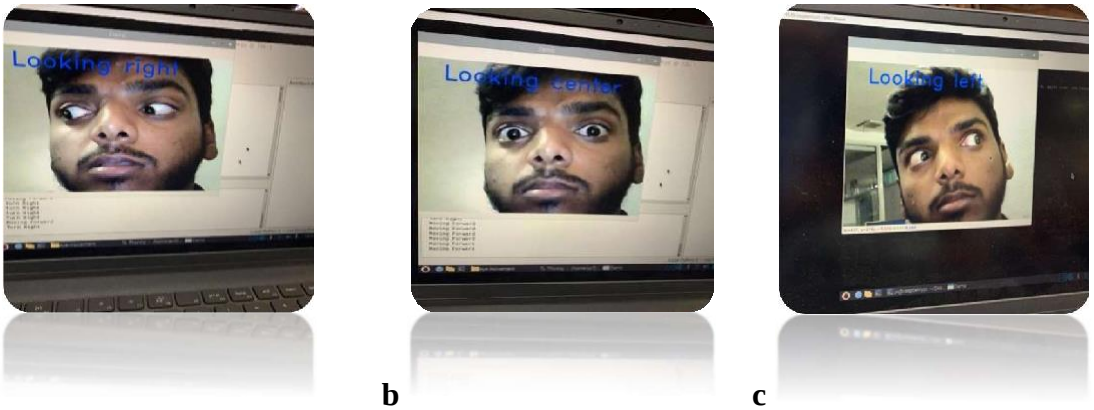


Fig: How OpenCV Works



a b c

Fig: Eye-Gaze Detection (a)Looking-Right (b)Looing-Center (c)Looking-Left

Results and Conclusions:

Visual-based wheelchair control systems use cameras or other visual sensors to track the user's head or eye movements and translate those movements into commands that control the wheelchair's movement. This type of system can be particularly useful for individuals with ALS, who may have limited or no control over their limbs, but still have some ability to move their eyes or head. The camera captures images of the user's face and uses algorithms to track the movement of the user's head or eyes. This movement is then translated into commands that control the wheelchair's movement, such as turning left or right, or moving forward or backward. Ultimately, the goal of a final prototype of a wheelchair is to provide individuals with limited mobility with a safe, comfortable, and reliable means of mobility that allows them to maintain their independence and improve their quality of life.

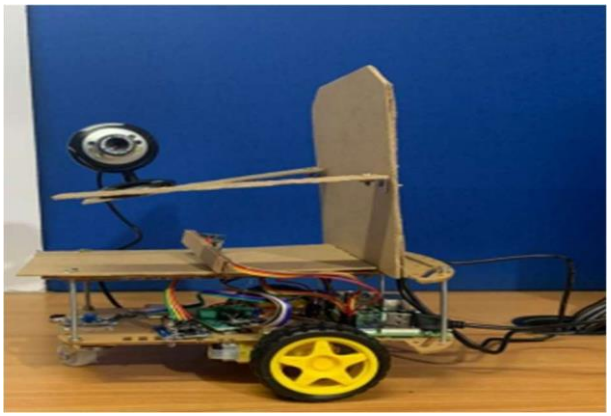


Fig: Final wheelchair prototype

Scope for future work:

This project conducts a thorough review of the different approaches and models. This system uses upgraded gesture technology built with wearable, affordable and portable components. Acceleration data is used to identify the hand motion. Motion commands are given to move the wheelchair forward and backward. Natural interaction between the elderly, disabled, and handicapped people. User independence as well as the psychological benefits of independence. The wheelchair user has the freedom and ability to turn in the desired direction with just a slight hand twist. The accelerometer is very sensitive, therefore training is required before usage. Voice commands for wheelchair control Improvements can be achieved by using speech sensors and various body motions, such as leg or head movement. In order to develop

and further validate the process in the future, they will concentrate on addressing flaws in their work and conducting more trials. In future, this project aims at improving the cost efficiency by introducing solar panels for charging the wheelchair. Introducing a mechanism of elevating and lowering of wheelchair could also be a future addition. Future enhancements might also include reading minds of patients for the movement of wheelchair using Artificial Intelligence and Machine Learning.