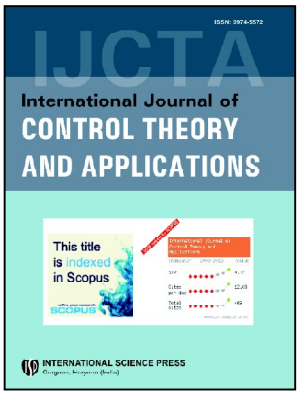

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The Free-Wheelers with Internet of Things

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Abstract: This paper presents an eye based electronic wheel chair with INTERNET OF THINGS. Raspberry pi is used as a Microcomputer interfaced with several sensors like camera, ultrasonic. A camera was attached to the wheel chair. The direction of the wheel chair depends on the rotation of the eye pupil. Haar cascade algorithm is used for camera to detect the exact eye pupil. By using the co-ordinates of edges i.e., if the distance between the center point and eye circle point is maximum then the chair moves to right, if it is minimum chair moves to left and if there is no movement in the pupil then it moves forward. The digital image signal is send to Raspberry pi. The GSM module will push the data to the cloud. From this data the care taker can handle the patient from time to time. The route used by the user is saved in the cloud using GSM module. As it is automated the care taker can be able to control the chair and thus can help his patient reach the destination.

Keywords: camera, Image processing, Open cv library, Raspberry pi 3 with customized OS and python as programming, wheel chair with driving motors, ultrasonic sensors, Internet of things (INTERNET OF THINGS) technology, GSM/ GPS module, pupil detection.

1. INTRODUCTION

The camera is placed at a certain suitable distance from the eye which captures the image (detection of face and eye). The image thus captured is followed by Detection of pupil and center point of the detected Pupil. In order to detect the Eye pupil and its center point there are so many techniques available. In this proposed model we used Haar cascade where features detection algorithm is used now by using the coordinates of edges, exact pupil of the detected eye is located. If the eye center point and pupil center point is maximum then the chair moves to right. If it is minimum, chair moves to left and if there is no movement in the pupil considering as middle position it move forward. Digital image processed output signal is send to raspberry pi, used for driving motors of electronic wheel chair [3]. The additional Ultrasonic sensors that we are providing are used to detect any sudden obstacles or moving objects, So when obstacle is detected without patient's notice there will be a necessity to stop the chair in motion. If such case occurs the Ultrasonic sensor sends the data to Raspberry Pi and it will

alert the motor to get stop. The proposed system is effective from the existing system since the advance technology (INTERNET OF THINGS) that is included, provides additional benefits and ease of operation for the person using the chair. The GSM/GPS module will push the data of the moment, to cloud based on time interval. The direction confirmation will be based on the blink of the eye. When pupil is looking left system will ask for confirmation to move left, the relevant latitude and longitude coordinates information will updated to cloud through GSM/GPS module. This cloud data will provide us the following information [1, 2]: If the patient is lost in his path this provided information in cloud will helpful in finding the location; if the care taker want to know the information about his/her patient this location will help him in finding the way to his/her patient. If the destinations are regular visit locations then this cloud information will give the suggestions for the regular visited destinations. The patient or care taker can be able to handle the system and guide the destination, it will warn or advice the path direction as automated. The route used by the user is saved in cloud. This route map, drive the chair automatically when the user takes the same path. It is always a challenge at the slopes and heights, so the system itself analyses those complications and asks in a smart way,by reducing the speed or by applying break. As it is automated the care taker can be able to control the chair and thus can help his patient reach his destination safely.

2. LITERATURE SURVEY

There are previous works carried out on eye pupil movement based electric wheel chair. And they helped us to get idea on our present prototype. One of the past project by Ankur Thakkar who created a glove based wheel chair in which finger movements of handicapped person is used for the movements of wheel chair in desired direction. He wanted to take the idea forward by making the system completely isolated from the person physically, and extend the usability of the system to a person suffering from quadriplegia.

Scientist Stephen W. Hawking is perhaps the most well-known victim of major paralysis. So an extended design of eye-controlled wheelchair was proposed and being implemented on various fields. The problem issued is, under the absence of care taker there is a possibility of the person losing his path. So as a solution to this an idea of automatically updating their present location and set a desired path to reach their actual location has inspired us to develop an eye-controlled electric wheelchair with INTERNET OF THINGS at an affordable cost.

3. SYSTEM MODEL

The Free-wheeler is completely an independent System and its entire internal modules works independently with each other. In this proposed model we are interfacing different components namely ultrasonic sensor, camera, GSM/GPS module and motors to the Raspberry Pi, where the entire functionality will takes place. Camera used to detect the face and the pupil in it, with the help of Haar cascading the pupil and its center point will be detected. Based on the movement of the eye pupil Detected by the camera which is interfaced to the Raspberry pi, the interfaced motor movement will be controlled. Ultrasonic sensor interfaced to Pi in order to make the wheel chair stop if any obstacle detected without user notice. GSM/GPS module is placed in the system and interfaced to the Raspberry Pi in order to keep the collected to the cloud. Based on the cloud data the caretaker can able to monitor the movement of the patient and able to track his location and there is a possibility for guiding the wheel chair to reach the destination [4].

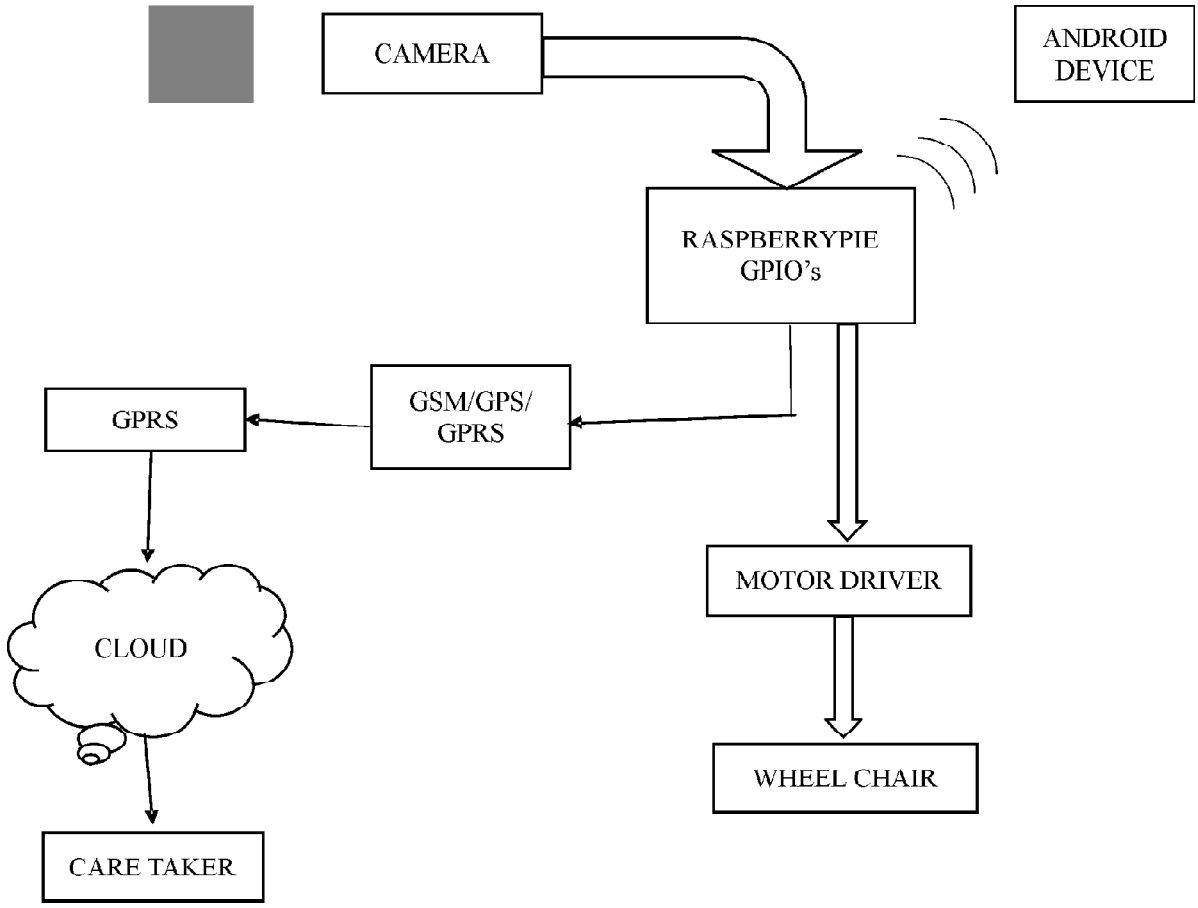


Figure 1: Functionality of the system

4. METHODOLOGY

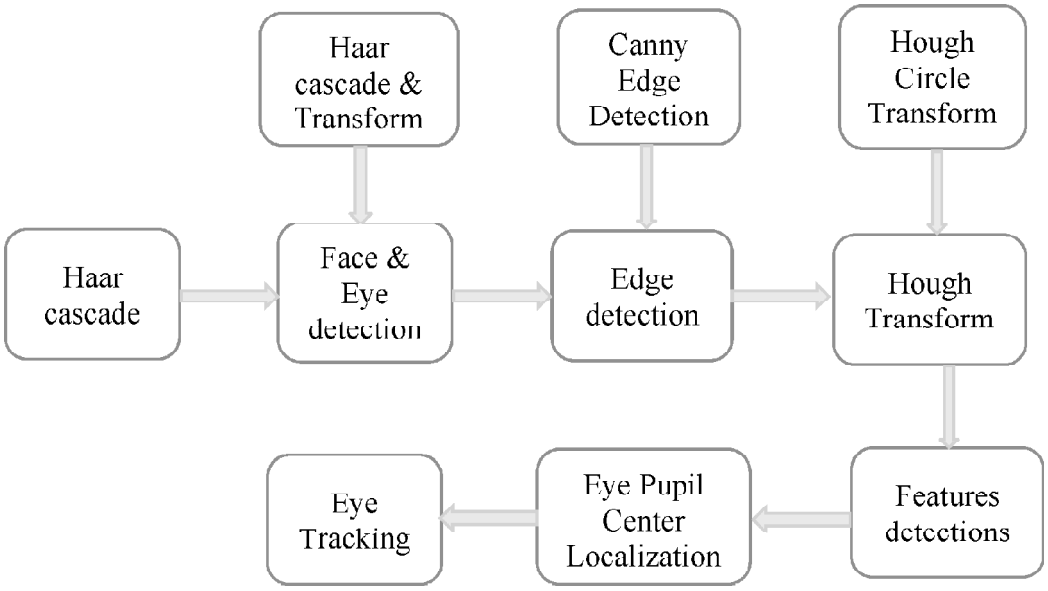


Figure 2: Process of face and eye detection

Camera and Open CV Mechanism

- Camera is placed in front of the eye
- Eye detection using Haar Classifier
- Edges detection using canny edge detection technique
- Hough transform is used to identify pupil in region of interest that is Eye
- Eye pupil is identified
- Depending on the position, direction like left, right are acknowledged using eye blink Depending on the voice notification

(A) Face Detection and Eye Detection

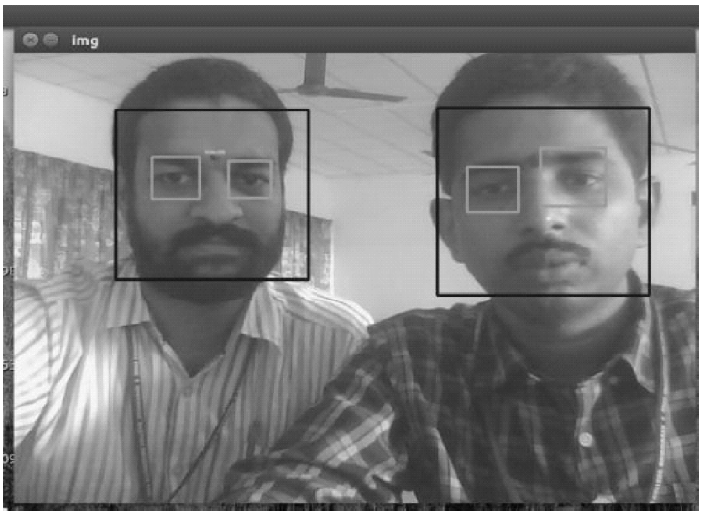
Camera which is interfaced to the Raspberry Pi board will start capturing the Face and detect the eye ball with the Haar cascade. After Detecting the Eye ball we need to find out the corners and center point of the eye. With the help of edge detection we can find out the left and right corners of the eye and the average between those two points will define its center point.

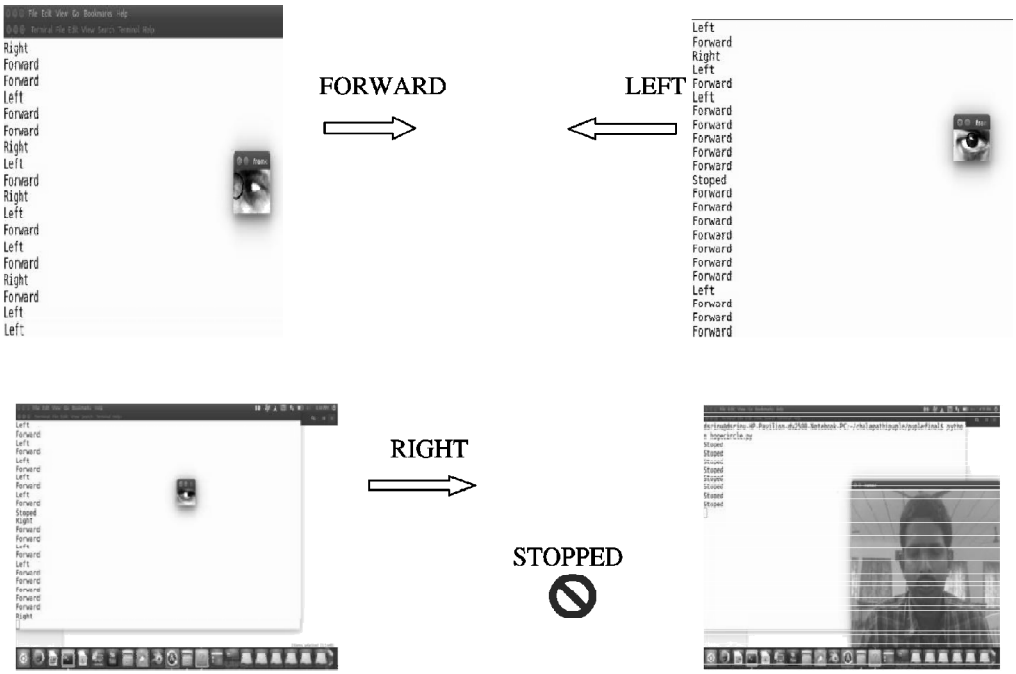
Edge Detection: We can determine the soft edges of the corner with the Help of canny Edge detection algorithm and corner edge detection algorithm. After determining the corner the center of the pupil is determined by finding out the mid-point of the two edges.

Hough Transformation: By using Hough transformation method we can draw the exact cycle of the eye. It detects the exact movement of the eye pupil and drawing the circle.

(B) Detection of Eye Pupil & Direction Determining

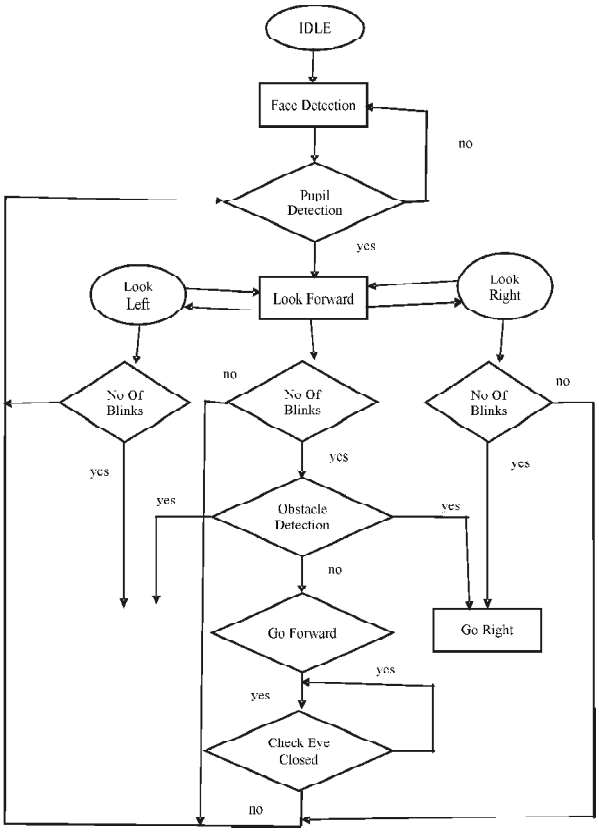
Here we will measure the eye circle center point and eye center point and the distance between them with the help of coordinate system logic. Based on the eye pupil movement the distance between them will change. If the Distance between them is minimum then it represents the movement as left. Similarly if it is maximum then it indicates the movement as right. and movement of the eye pupil is idle then it concludes the forward movement of the wheelchair. Apart from the above if no pupil is detected, and then the system will make the wheel chair to get stopped. The system will ask for the confirmation each time when the directions of the pupil get changed for particular time duration. All these commands will get action based on the confirmation from the patient based on the blinking of the eye, Likewise the commands will applied for the movement of the wheelchair in the respective direction [5].





The conversion of real image to grey and identifying the pupil by using coordinate systems is explained in the above figures.

Flowchart for system working



(C) Implementation of Internet of Things to the Proposed System

Internet of Things (IoT) simply means the inter-networking between the physical systems. In the proposed model we are introducing the concept of Internet of Things which enables the internetworking between the Wheel chair, patient and caretaker through cloud. We are connecting the proposed system with the GSM/GPS Module which continuously map the activity to the cloud with the coordinates by which the wheel chair location and its movement will be mapped in the cloud platform. The respective data will enable the wheel chair tracking and guidelines for it. With the collected data we will write some algorithm which will make the most visited paths as favorites or as default paths. When the system starts at the next time, it will ask user (patient) for confirmation to proceed in the previously most visited paths. If the user gives a sign of acceptance than without patient interference the system will move in that path with the GPS coordinates available in the cloud platform until the patient eye pupil is detected. If he wants to make the system to move in the other direction just by closing the eye for a particular duration than the running path will get interrupted and new execution of pupil detection will takes place. Similarly if the patient lost his path and worried with the above methodology the system can able to take the patient to the home with the available clouded data. Apart from this if the care taker wants to know the status or condition of the patient and where he was roaming and all this clouded data will enable the care taker to monitor patient activity. In the case of patient missing also the caretaker no need to worry. The care taker could able to know the location where the patient was and from the destination of the caretaker itself he could able to control the movement of the wheel chair and could able to suggest the desired destination to the system by means of the clouded data. This is how the proposed model will enable the feasibility and flexibility to the wheel chair [6, 7]. And there by the patient can perform his task by himself without any physical assistance and this Internet of Things will make the caretaker task simple and worriless.

Thus we get the required information from the image processing, and this information is given to the raspberry pi in order to drive the wheel chair. This system also uses ultrasonic sensor which gives the exact information about any obstacle without patient's notice making the system prone to accidents. Based on the ultrasonic data, raspberry pi make the system to apply Break. The entire information gets updated in cloud time to time which can be accessed anywhere, provides an ease for the care taker to have an eye on his respective patient [15].

5. CONCLUSION

As the synonym of the word "THE FREE WHEELER" is to be independent, our proposed project is to make the life of the physically handicapped people independent. The concept of eye based electronic wheel chair with INTERNET OF THINGS provides a good, safe and comfortable means of transport for physically disabled persons. This system is the extension for all the available previous designs of wheel chairs where we can enjoy additional benefits using INTERNET OF THINGS. The motion of the chair is continuously updated in to cloud using GSM/GPS technology which can be accessed anywhere, which used to guide the patient in his/her regular path and also helps the care taker to trace his/her patient.

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