IR SENSOR BASED WHEELCHAIR SYSTEM USING RASPBERRY PI FOR CHARCOT-MARIE-TOOTH

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ABSTRACT: The work depends on the development of a wheelchair that can be a fully automatic navigation system. It provides flexible operation to choose different modalities to command the wheel chair, this method is very useful to a people who can affected for charcot-marie-tooth disease. Patients can command the wheelchair based on their eye blinks, eye movement. The wheelchair can operate like an auto-guided vehicle, following IR sensor way. The digital commends from the IR sensor is moved to raspberry pi. It provides commands to be sent to the wheelchair. Several experiments are used in this technique to introduce an effective wheelchair for disabled persons.

KEYWORDS: IR sensor, Raspberry pi 2 model B+, Temperature sensor, Heart beat sensor, Ultrasonic sensor and Robotic wheelchair.

INTRODUCTION

One of the difficulties found by people with disabilities is related only on assistance. They people must need wheelchair .the patient their intact manipulation ability, to use a joystick. The system fully depends on the eye blink electric wheelchair. . As per requirement of the disabilities systems are available in market such as voice control or joystick control system. Sometime totally affected paralysis person like (charcot-marie-tooth) may be have very difficult to use that type of systems. . Here the Eye blink control system provide the independence to make their life easy and more convenient. However, many people with disabilities and who people can affect from a charcot-marrie-tooth disease do not have this manipulation ability so they must need a wheelchair. Automatic wheelchair systems can implement advices that allow them to move a patients from one place to another place. The head movement based system has much limitation so when the user can not able to access the system physically. When the voice recognition system is working properly move towards left, right, and stop, but noisy environment distracts the system command, system cannot respond properly.Smart wheelchairs studies since beginning of 1980s, with several developments in different countries, with wheelchair being commanded by eye blinks, eye movement position. IR sensor used to capture the blink position, so the system used save the huge amount of energy or external man power. .when the blink exceeds a threshold value the particular digital signal passes through a raspberry pi system. Stop the position of wheelchair using ultrasonic sensor for a particular range between obstacle and wheelchair must be stop. Used blink position on a panel on board to choose among different high level movement commands such as forward, left, right and stop an eye tracking interface.Appropriate image processing technique open CV open computer vision) library used for eye blink detection. To sense obstacles and have a LINE following algorithm for motor driving through doors and between the rooms.IR sensor sensing the eye blink position and captured the image in real time and analysis the image as input to set the commands to interface the motor driver IC passed through sending the commands to GPIO pins .In this Raspberry pi board is used to perform the control of the complete system operation.
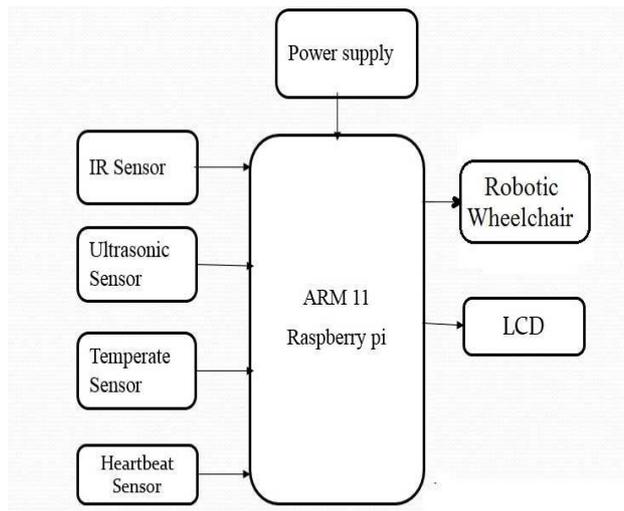
Figure 1) Block Diagram Of Eye Controlled Wheelchair
Using Raspberry pi

The motor driver is used to perform the different moving operation. And several application and line following algorithms are used to find out accurate blink location detection and tracking of that. The Raspberry pi acquired the data should analyse it and performing their operation. Raspberry pi send the signal to motorfor driving circuit based on the position of the eye blink. This will decide to perform operation on motor like run the motor in forward, left, right and stop position. If sensor gets the obstacle very close to the wheelchair, it will send the command to the raspberry pi and raspberry pi sends the signal to motor driving circuit to stop the motor.

SYSTEM DESIGN MODEL

This system is based on the eye blinking IR Sensor, and all the module will work independent to each other. For the basic requirements of the any electronic system is Power supply. In this system there is mandatory to gives the proper power supply to individual components and the standard power supply should be used for Raspberry pi, IR sensor, ultrasonic sensor, temperature sensor, heartbeat sensor motors. The Figure 2 Represent the Overall Functionality Of the Novel Implemented System. The Raspberry pi board is the brain of the robot. In this proposed system model the module like ultrasonic sensor, heartbeat sensor, temperature sensor, IR sensor, dc motor, power circuit and the power supply. Then, the power supply is directly connected through the Raspberry pi board. In this system the Raspberry pi ARM11 processor is playing a main role of hardware part. A real time data acquisition and analyzing the signal Raspberry pi 2 model B board is very efficiently process the multiple image frames by frame. For capturing the eye blinking of the patient to normal IR Sensor PASCO CI-6628 is used in our system. By using this IR sensor will make the system cost effective and to reduce the processing time.
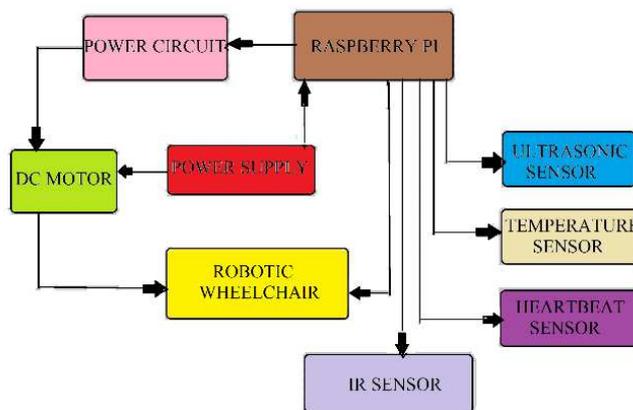

FIGURE 2) PROPOSED SYSTEM DESIGN MODEL.

The Raspberry pi 2 model B gives the commands to the motor driver circuit, which is enable the GPIO pins to perform operation. Such as move forward, left and right operation performed based on the eye blinking according to the threshold value. Sensors are also mounted on the head of the robotic wheelchair for detecting the obstacles, controlling the wheelchair, measuring the temperature, heartbeats of the patient. Ultrasonic sensor is used for detecting the obstacle or any object is moving in front of the robotic wheelchair. The ultrasonic sensor (HC-SR04) is directly connected to the Raspberry pi board, it acquired the data and measure the distance between wheelchair and obstacle. This system comes under the real time data acquisition, data processing and control system. The temperature sensor (LM35) is mounted on the raspberry pi board, which is used to measure the temperature of the patient body. Green rubber Heartbeat sensor is also mounted on the raspberry pi 2 model B, in which it is used to measure the pulse rate of the patient who are affected by CHARCOT-MARIE-TOOTH. For using Raspberry pi board, they have its own operating system (OS) is known as "Raspbian", which is Linux based operation system and also compatible with raspberry pi board. To detect the exact eye blinking according to the threshold value is very challenging. A new technique used for eye blink Detection and Controlling, which works based on the open computer vision (Open CV) library tool. Most ofcoding part done with the help of Open CV library, which is especially used in the raspberry pi board. To connect the raspberry pi board to desktop Putty software is used. Python language or embedded C is used for codding, which is user friendly and helpful to resolve the error efficiently. The Open CV (version 3.0.0) library with python is used in this system.

METHODOLOGY

The principle of this system is eye detection based on raspberry pi technology. A new algorithm introduced for detecting the eye by Image processing. In this technique used to find out the blinking of eye. During initial stage the system acquired the captured eye blinks by IR sensor. The figure 3 represents the complete methodology of proposed implementation.
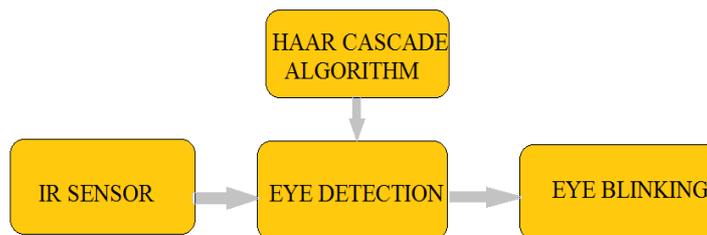

FIGURE 3 SYSTEM PROCESS DESIGN

Here, it will give the information of the system working. First, IR sensor is used to sense the eye blinks according to threshold value the robotic wheelchair will move towards the specific direction. For the eye detection Haar cascade algorithm is used. Then, according to the eye blinking, for a different threshold value direction will be vary. A minimum one blinking of eye the robotic wheelchair will move forward, for two blinking of eye it will move towards left side, for three blinking of eye it will move towards right side and if there any obstacle is present in front of the wheelchair the ultrasonic sensor is used to stop it robotic wheelchair movement. Once the power supply is switched on, the system will start working, and according to the command values system will work successfully.

IMPLEMENTATION AND SYSTEM DESIGN

The system implementation is working based on the real time data acquisition Operating System. The low power consumption Raspberry pi 2 model B advance board computer is used. Which provide well enough in/out pins, USB port, PWM, HDMI, UART and Ethernet adaptor port for connecting internet system devices via wired and wireless connection. Also, the Raspberry pi have a 512 MB of RAM. It will have up to 32 GB external memory and controlled based on ARM11 processor architecture. ARM11 processor is the CPU (Central Processing Unit) in the Raspberry pi board in which it has 700 MHz ARM1176JZF-S core.The IR sensor is mounted in front of user Eye. The IR sensor is mounted in front of the user Eye, IR sensor is interfaced to the control unit on the disabled person for sensing the IR signals transmitted by the eye blink.This data is conveyed to the control unit which moves the wheelchair as desired, either left, right or forward. In addition to this, for safety purpose ultrasonic sensor is mounted in front of wheelchair to detect the obstacles and automatically stop the

wheelchair movement.For controlling the dc motors driving IC, 12 Volt battery for power supply of motors is used.The motor driving circuit is connected with the Raspberry pi 2 model B, which is operates the entire system.
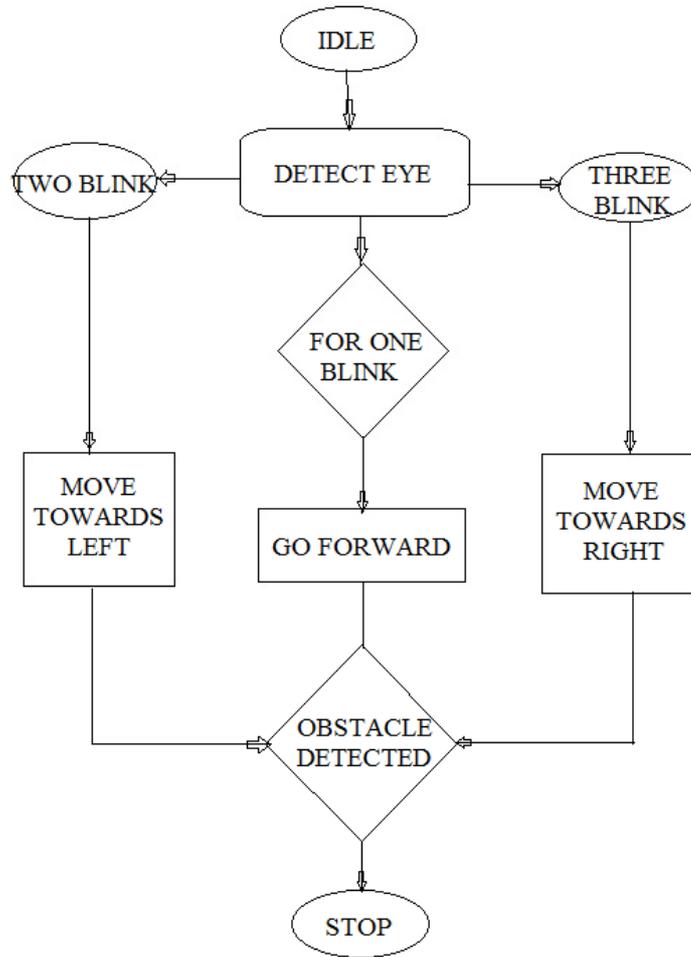

FIGURE 4) FLOW CHART OF WORKING SYSTEM

This systemgenerates the command signal to enable the GPIO pins and perform the Forward, Left, Right and Stop Operation.

RASPBERRY PI OS INSTALLATION

A very basic step is followed to install its own operating system in micro SD card (memory card). To boots a raspbian file win32 diskimager software used. While putting a bootable memory device on Raspberry pi 2 model B board, then it can access the Raspbian operating system directly without rebooting.

SYSTEM ALGORITHM

In this system open computer vision (Open CV) free access library algorithm used for image processing. The Open CV library plays a very important role. A novel algorithm used for system execution and perform the operation.

EYE DETECTION

For the eye detection the Open CV library can be used.

A very first Haar Cascade algorithm is used for both Face and Eye detection individually.

RESULT

The system acquired the resulted data of wheelchair movement according to the eye blinking by using the IR sensor based on the threshold value signal send to the motor driving circuit. There the system used temperature sensor, heartbeat sensor and ultrasonic sensor. The temperature sensor is used to measure the temperature of the patient body. The heartbeat sensor for pulse rate measurement, and successfully measured the heartbeat of the patient body.
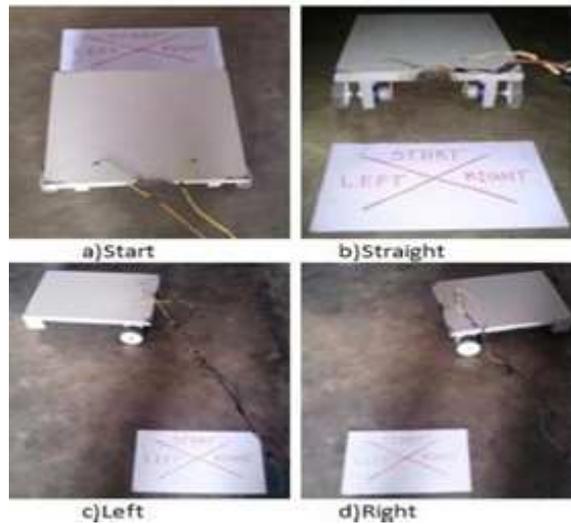

FIGURE 5) WHEELCHAIR PROTOTYPE MODEL

The ultrasonic sensor for obstacle detection. And successfully measure the distance between the wheelchair and obstacle. When the object is detected in front of wheelchair and cross the minimum distance threshold value, emergency brakes will be applied to stop the wheelchair movement.

CONCLUSION

This concept of eye blink controlled wheelchair movement is not only Shows the alternative resources but more important to help physically disabled persons to make independent accessible life without any assistance need. The main aim of implementing an IR sensor based eye controlled wheelchair movement is to highlight the features of digital Image processing in the embedded systems. There are some real time design constant measured like a system takes some time of seconds for eye blink to execute the system for processing the wheelchair eye movement in Real time Environment. Therefore this system performs the Wheelchair eye movement operation with some delay time of blink movement. It's very hard to track the Eye blink in dark light places, so this system works on an environmental light and in a room light with fluorescent mercury vapour lamps, which is low in infrared.

REFERENCES

[1] Implementation of Wheelchair Controller using Eyeball Movement for Paralytic People, A. kamaraj, April -2013.
[2] Peng Zhang, Momoyo Ito, Shin-ichi Ito, Minoru Fukumi, "Implementation of EOG mouse using Learning Vector Quantization and EOG-feature based methods", *IEEE Conference on Systems, Process & Control (ICSPC)*, dec.-2013,
[3] Implementation of Wheelchair Controller using Eyeball Movement for Paralytic People, A.kamaraj, April -2013.
[4] Eye Controlled Wheel Chair Using EOG, Alex Dev, Horizon C Chacko and Roshan Varghese, *International Conference on Computing and Control Engineering (ICCCE 2012),* 12 & 13 April, 2012.
[5] Eye Controlled Wheelchair, SandeshPai, SagarAyare, RomilKapadia, and October-2012. "Iris Movement Tracking by Morphological Operations for Direction Control", YashPathak, Samir Akhare, and Vishal Lambe. September 2012.
[6] C. D. la Cruz, T. F. Bastos-Filho, and R. Carelli, "Adaptive motion control law of a robotic wheelchair," *Control Eng. Practice*, vol. 19, pp. 113–125, 2011.
[7] G. Pires, U. Nunes, andM.Castelo-Branco, "Statistical spatial filtering for a P300-based BCI: Tests in able-bodied, and patients with cerebral palsy and amyotrophic lateral sclerosis," *J. Neurosci. Methods*, vol.195, pp. 270–281, 2011.