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A Vision-Based Iot Control System For Assisting Physically Disabled Persons Through Eye Gesture Recognition

C. JOTHI [1], R. SRIRANJANI[2], R. PAVITHRA [3], K. SUBASH [4], S. VISHAL[5]
1,2 ASSISTANT PROFESSOR, 3,4,5 UG SCHOLAR
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING,
MUTHAYAMMAL ENGINEERING COLLEGE, TAMILNADU, INDIA

ABSTRACT

This project is designed to help physically challenged people move independently and control basic home appliances without using their hands. The system allows users to control an electronic wheelchair and household devices using simple eye-blink gestures. It is mainly useful for people who have difficulty using their hands or speaking. An infrared (IR) sensor is fixed on a pair of eyeglasses to detect the user's eye blinks. These eye-blink signals are sent to an Arduino microcontroller, which understands the blink patterns as commands. Based on the command, the wheelchair moves forward, backward, left, or right. This makes movement easy and safe without the need for physical effort or help from others. Along with wheelchair control, the project also includes IoT-based home automation. Using the same eye-blink method, users can switch ON or OFF household appliances like lights and fans. This helps the user stay independent inside the home environment. The system uses low-cost components such as Arduino, IR sensors, and simple wearable devices, making it affordable and easy to use. The project shows that eye-blink detection is a simple, reliable, and non-invasive method for assistive control. Overall, this project improves mobility, comfort, and independence for physically challenged individuals.

KEYWORDS: Eye-blink detection, Assistive technology, electronic wheelchair, Arduino, IoT, IR sensor Smart home automation, physically challenged support, Human–machine interface

1. INTRODUCTION

A Vision-Based IoT Control System for Assisting Physically Disabled Persons Through Eye Gesture Recognition is designed to assist physically challenged and paralyzed individuals by enabling independent mobility through simple eye blink movements. This system uses an eye blink sensor to detect intentional blinking patterns, which are processed by an Arduino microcontroller to control the direction and movement of the wheelchair. By eliminating the need for manual controls or complex interfaces, the proposed system provides a cost-effective, user-friendly, and reliable solution for people with severe motor disabilities. The project aims to enhance mobility, self-confidence, and quality of life by integrating embedded systems and assistive technology into a practical real-world application. The proposed system integrates an eye blink sensor, Arduino microcontroller, motor driver, and DC motors to achieve accurate and safe wheelchair movement. Specific blink patterns are predefined to represent commands such as forward, left, right, and stop, ensuring reliable control with minimal effort from the user. Safety and ease of use are key considerations in the design, making the system suitable for continuous daily operation. By utilizing low-power embedded components and simple control logic, the wheelchair operates efficiently while remaining affordable. This project demonstrates how assistive technology can bridge the gap between human intent and machine response, offering a practical solution for individuals with limited physical abilities. This presents an effective and affordable assistive solution for individuals with severe physical disabilities. By converting eye blink movements into control commands, the system enables independent and dignified mobility while reducing dependency on others. This project highlights the practical application of embedded systems in healthcare and demonstrates how technology can be used to improve the quality of life for differently abled people.

2.LITERATURE SURVEY

2.1 AUTOMATIC WHEELCHAIR WITH ESSENTIAL APPLICATIONS

This work presents the development of a robotic wheelchair that can be commanded by users. It provides flexibility to choose different modalities to command the wheelchair, in addition to be suitable for people with different levels of disabilities like partially paralyzed, by birth disabilities, accidental injuries etc. Users can command and control the wheelchair based on their head movements. Also, the user can control some home appliances. As a trial, we work on the lighting system in a room that is ON and OFF mechanism of a light. The wheelchair can also operate like an auto-guided vehicle, with the help of obstacle sensors, which detects the obstacles in front of it, and it either stops or takes deviation. A main door detection section is provided with a magnetic sensor in the wheelchair and a magnet fixed at the main door for safety and then the wheelchair stops. A security as well as a safety alarm is provided in the device, which beeps when the device may hit somewhere or an emergency situation occurs. Head movements are used for both moving the device and for controlling directions of the device. This device is capable of lighting the room by eye movements.

.2.2 ROBOTIC WHEELCHAIR USING EYE BLINK SENSORS AND ACCELEROMETER PROVIDED WITH HOME APPLIANCE CONTROL

According to a new report prepared jointly by the World Health Organization and the World Bank, 15 percent of the world ‘s population is disabled. The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled and mentally handicapped people. Driving a wheelchair is a tedious task for severely handicapped persons, unless they use the tongue to control the joystick. Simultaneously blind and paraplegic people deal with two problems, which creates uneasy situation for them, i.e. locomotion and localization.

Different systems are being developed to overcome the problems described above, allowing the end-user to perform safe movements and accomplish some daily life important tasks. Our Robotic wheelchair user’s eye blink and head tilt movement to steer the wheelchair. In addition, we can give more independence to the disabled person by using the same head-tilt movement to communicate with the devices in a room for example: a fan. This communication is done using a RF transmitter and receiver. Using this, the person can control various devices easily.

2.3 ROBOTIC WHEELCHAIR CONTROLLED BY EYE BLINK AND FACE ORIENTATION

This paper describes and evaluates intelligent robotic wheelchair mainly for quadriplegic patients. Each year huge number of people suffers with a spinal cord injury and approximately half of these injuries result in quadriplegia. The loss of personal mobility is one of the major life changes brought on by quadriplegia, mobility becomes a lifelong struggle. Quadriplegics rely on power wheelchairs for mobility, but the hands-free controller systems currently available are obtrusive and expensive. The objective of this project was to design a power wheelchair with a novel control system for quadriplegics with Face Orientations and eye blink. USB camera and eye blink sensor was fixed in front of user’s face. Face area was detected based on AdaBoost learning algorithm. Then facial landmarks were detected using Flandmark Detector. Finally, face orientations were classified by the normalized distance difference in horizontal and vertical axes between eyes, nose and mouth. Face orientation, which is used for commands electric wheelchair, consists of frontal, right, left, up and down, the eye blink count used to start and stop function. In addition, we can give more independence to the disabled person by using this to communicate with the devices in a room for example a fan.

3. EXISTING SYSTEM

In conventional mobility solutions, manual wheelchairs are the most widely used devices for assisting individuals with physical disabilities. However, the operation of manual wheelchairs involves significant physical effort and upper-body strength. Many users, especially those with severe mobility impairments, neurological conditions, or muscle weakness, find it extremely difficult to propel a manual wheelchair independently. As a result, the efficiency and usability of traditional manual wheelchairs are considerably limited. For non-abled or partially disabled individuals, manual operation becomes even more challenging because it demands continuous hand movement and coordination. Users with conditions such as hemiparesis, spinal injuries, muscular dystrophy, or paralysis are unable to exert the repetitive force required to move the wheelchair. Due to these limitations, they often depend entirely on caregivers or family members for mobility. This lack of independence affects their confidence, quality of life, and ability to perform routine activities without external support.

Another major drawback of the existing manual wheelchair system is its low operational efficiency. The user must constantly use their hands to generate movement, which leads to fatigue and makes long-distance travel difficult. Most importantly, manual wheelchairs are not suitable for individuals with hemiparesis, where one side of the body is partially paralyzed. These patients are unable to use both hands effectively to control the wheelchair, making manual propulsion nearly impossible. As a result, they become dependent on another person for even basic movement, which restricts their freedom and mobility.

Overall, the existing manual wheelchair system does not sufficiently address the requirements of people with severe physical disabilities. It lacks independence, convenience, adaptability, and modern assistive technology.

4. PROPOSED SYSTEM

The proposed system introduces an intelligent, vision-based IoT-enabled wheelchair that utilizes eye gestures as the primary mode of control. Unlike traditional manual or joystick- operated wheelchairs, this system is specifically designed to support users who have limited hand mobility, cognitive disabilities, or neurological impairments. The system aims to provide a more convenient, hands-free, and highly adaptive mobility solution that enhances independence and improves overall productivity in daily activities. To achieve this, the wheelchair is equipped with an eye-gesture recognition module that uses infrared (IR) sensors mounted on a lightweight pair of eyeglasses. These IR sensors continuously detect the user's eye-blink patterns and fine eye movements, which act as input signals for the system. Coil-based signal processing is incorporated to ensure greater signal stability and accurate tracking of small eye movements. This enhanced stability allows for precise interpretation of user commands, overcoming issues commonly faced in vision-based control systems. In addition to enhanced mobility, the system integrates IoT functionality to enable users to control home appliances like fans, lights, or televisions using eye gestures. This dual-purpose design creates a comprehensive assistive environment where users can navigate their wheelchair and interact with their living space without physical effort. Such an approach is especially beneficial for individuals who struggle with hand coordination or have limited physical strength.

Overall, the proposed system offers a safe, low-cost, and highly reliable solution for people with severe physical or cognitive disabilities. By combining eye-gesture recognition, IoT automation, and adjustable seating mechanisms, the system aims to restore independence, increase productivity, and significantly improve quality of life. This innovative approach demonstrates how assistive technology can evolve into a complete, user-friendly mobility and smart-home interaction platform.

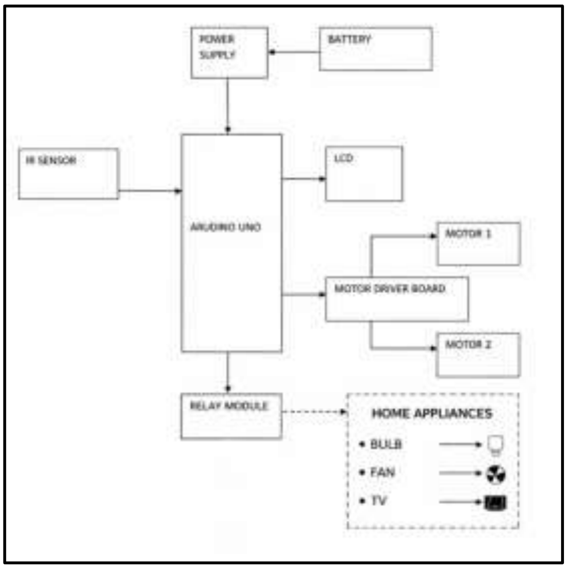


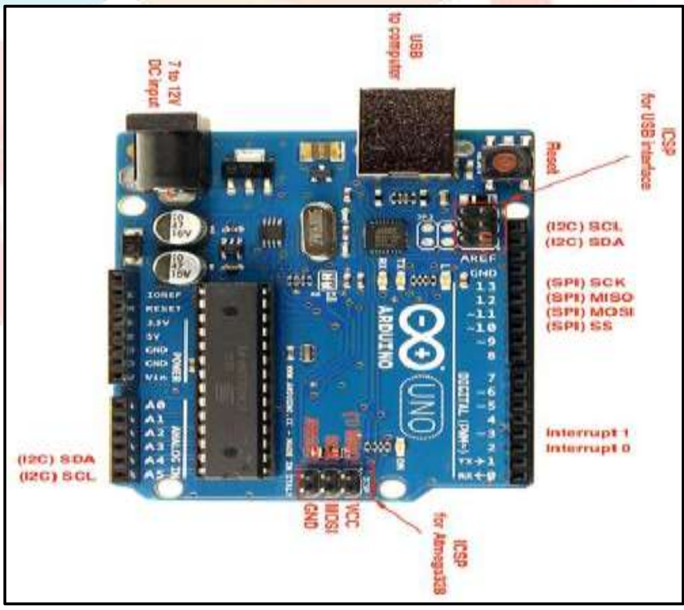
Fig: 1 Block Diagram

5.HARDWARE DESCRIPTION

5.1 POWER SUPPLY

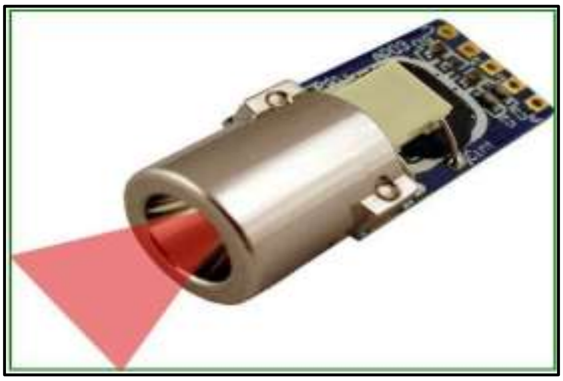
The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

5.2 ARDUINO UNO CONTROLLER



The Arduino Uno is a microcontroller board built around the ATmega328 chip. It has 14 digital input/output pins, of which 6 can be used for PWM output. It also has 6 analog input pins, a 16 MHz crystal oscillator, a USB port, a power input jack, an ICSP header, and a reset button. Everything required to run the microcontroller is built into the board. You can connect it to a computer via USB or power it using an AC-to-DC adapter or battery to start using it.

5.3 IR SENSOR

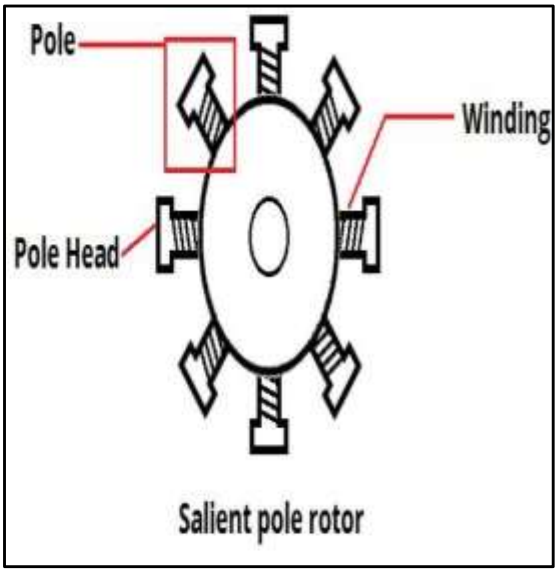


An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

5.4 LCD

LCD modules are widely used in many embedded projects due to their low cost, easy availability, and user-friendly interface. Most people have seen these displays in everyday items like calculators or PCs. The physical look and pin layout are already described above. Now, let's get a bit technical. A 16x2 LCD is named because it has 16 columns and 2 rows. There are several other models like 8x1, 8x2, 10x2, 16x1, etc., but the most commonly used one is the 16x2 LCD. This means it can display 32 characters in total. Each character is made up of 5x8 pixel dots. A single character with all its pixels is shown in the image below.

5.5 SALIENT-POLE ROTOR



WINDINGS: Windings are wires that are laid in coils, usually wrapped around a laminated soft iron magnetic core so as to form magnetic poles when energized with current. Electric machines come in two basic magnet field pole configurations: salient-pole machine and no salient-pole machine. In the salient-pole machine the pole's magnetic field is produced by a winding wound around the pole below the pole face. In the no salient-pole, or distributed field, or round-rotor, machine, the winding is distributed in pole face slots a shaded-pole motor has a winding around part of the pole that delays the phase of the magnetic field for that pole. Some motors have conductors which consist of thicker metal, such as bars or sheets of metal, usually copper, although sometimes aluminum is used.

These are usually powered by electromagnetic induction.

MOTOR SUPPLY: A DC motor is usually supplied through slip ring commutator as described above. AC motors' commutation can be either slipping ring commutator or externally commutated type, can be fixed- speed or variable-speed control type, and can be synchronous or asynchronous type. Universal motors can run on either AC or DC.

MOTOR CONTROL: Fixed-speed controlled AC motors are provided with direct-on-line or soft-start starters. Variable speed-controlled AC motors are provided with a range of different power inverter, variable-frequency drive or electronic commutator technologies. The term electronic commutator is usually associated with self-commutated brushless DC motor and switched reluctance motor applications.

6. CONCLUSION

In this system, we present a significant enhancement to the traditional wheelchair by integrating a motorized mechanism and enabling hands-free control through eye-blink detection. This innovation simplifies wheelchair operation for physically disabled and paralyzed individuals, providing them with a practical, user-friendly, and independent mobility solution. The primary objective of this project is to make a meaningful contribution to society by proposing a technology that has the potential to improve the quality of life for millions of people worldwide who struggle with basic mobility. By offering a reliable alternative to manual and joystick- based wheelchairs, the system demonstrates how technology can bridge gaps in accessibility and empower users with limited physical capabilities. Furthermore, the system lays a strong foundation for future enhancements, such as the development of a dedicated mobile application that would allow remote monitoring and seamless control of the wheelchair. The integration of IoT-based home automation further expands the system’s usability, enabling users to operate essential household appliances without physical effort. These additions would transform the wheelchair into a complete assistive ecosystem that supports mobility, safety, and convenience. Overall, the project successfully demonstrates that a vision-based, eye-gesture controlled system can serve as an effective, affordable, and scalable solution for improving independence and dignity for individuals with disabilities.

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