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Implementation of Adaptive Motion Controlled Wheel Chair

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Abstract

Individuals who are physically disabled face everyday obstacles resulting from birth defects, mishaps, or diseases. Our research intends to create a wheelchair specifically designed to enable people who are unable to manage other body parts to communicate by moving their heads. Our solution, an intelligent head-motion wheelchair, combines wireless communication, obstacle detection, and an Internet of Things alarm system. Head motions are recognized and stored by the system, which establishes a "neutral position" as the common reference. In the control mode, the wheelchair is propelled by DC motors that interpret head motions that are sensed. Interestingly, when the head returns to its neutral position, the wheelchair stays still, guaranteeing control and safety at all times. the creation and use of a wheelchair alert system that makes use of the Blynk IoT platform, an accelerometer sensor, and a Node MCU microcontroller. By quickly alerting caretakers through the Blynk mobile app when the wheelchair tilts or falls, the technology seeks to improve user safety. Using the accelerometer sensor, the Node MCU continuously checks the wheelchair's alignment. If there are any rapid changes that could indicate falls or tilts, it notifies the Blynk app over Wi-Fi. On their iPhones, caregivers get real-time alerts that facilitate prompt care.

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Introduction

Head motion-controlled wheelchairs are made possible by the integration of complex sensors, motor control systems, and microcontrollers. These wheelchairs employ sophisticated sensors, like accelerometers and gyroscopes, to recognize and record the minute motions of the user's head in real time. The wheelchair's central processing unit,a microcontroller or processor, processes these sensor inputs and converts head movements into exact commands for the wheelchair's motor control system.[2]

Paraplegics find it difficult to grip objects or become independent in their movements because of their limited hand movements. Th0ey are still able to control their head movements, though. As such, a head-motion controlled wheelchair provides them with a means of transportation. Users can direct the wheelchair to move in the desired direction by tilting their heads to the left, right, or ahead. In an effort to demonstrate the benefits of head-motion control over traditional electric wheelchairs, this study presents a novel method for creating a head-motion controlled wheelchair on a smaller scale.[1]

The creators of [2] created a wheelchair equipped with ultrasonic sensors, a gyroscope, and a voice recognition module. Using a Google spoken search and a microphone for input for identification, the wheelchair is based on spoken gestures. Through the use of a Bluetooth module, a handset establishes a connection, and mobility is managed by a smartphone application. A twin H-bridge motor driver IC is utilized to control the motor in response to signals from the

Bluetooth module. The wheelchair's laws are controlled by speech gestures, which rely on the Arduino Uno. Obstacles are detected using an ultrasonic sensor. The user can give vocal orders to move the model in the following directions: right, left, forward, backward, and stop.

A wheelchair using gesture motion was modeled in [4] by J. W. Machangpa and T. S. Chingtham, with the accelerometer kept in place on the user's head. The microprocessor and accelerometer are used in the controller function. Rather to delivering real-time raw navigation output, the suggested navigation approach uses an accelerometer and a pre-defined threshold voltage for motion instruction. In,[5] the authors operated and controlled an intelligent wheelchair by sensing tongue movements using a command signal, an enlarged magnet, and magnetic detectors. The tongue must be broken for the newly implemented navigation technique to work. Ferromagnetic device insertion should be discontinued, and the magnetic tracer should be removed if the person has magnetic resonance imaging (MRI).

The design and implementation of an automated wheelchair that responds to head motions is the main topic of this essay. Utilizing head movements has the advantage of promoting wireless technology, which can help improve wheelchair performance by extending their transmission range. The accelerometer detector functions to display the head's position as a motion is being developed. These use radio frequency to adopt position during data transmission. Motor drivers in the receiving unit change the voltage to what the wheels need. Radio frequency is used to facilitate data transfer between these. Microcontrollers will be used throughout the entire process, and in the end, the wheelchair will enable physically challenged individuals to live independently without the need for personal support.

Existing system

This[1] design and implementation of an automated wheelchair that responds to head motions is the main topic of this essay. Utilizing head movements has the advantage of promoting wireless technology, which can help improve wheelchair performance by extending their transmission range. The accelerometer detector functions to display the head's position as a motion is being developed. These use radio frequency to adopt position during data transmission. Motor drivers in the receiving unit change the voltage to what the wheels need. Radio frequency is used to facilitate data transfer between these. Microcontrollers will be used throughout the entire process, and in the end, the wheelchair will enable physically challenged individuals to live independently without the need for personal support.

Data that has been demodulated and sent to the microcontroller's receiver in accordance with the installed software is received by the receiver module. Its greatest operating range without an antenna is three meters. The range can be increased to a hundred meters by using the antenna with a little connecting wire. The user's mobile number needs to be entered into the source system in order to receive an SMS from the SIM card that the GSM module has utilized. The position will be sent via SMS from the GSM to the mobile device, together with the Google map coordinates—that is, latitude and longitude—which are shown. The device holder and mobile device communicate via our GSM module and SIM card.

The major drawback is it lacking of any Emergency safety. Using Arduino Uno instead of ESP32 may limit IoT applications due to lack of built-in Wi-Fi and Bluetooth, constrained processing power, and limited connectivity options. Uno's restricted I/O pins and absence of advanced protocols make it less suitable for projects requiring extensive wireless communication and complex data processing, often necessitating additional hardware or compromising functionality. Compared to the ESP32's capabilities, Uno may consume more power and struggle with tasks demanding higher computational resources.

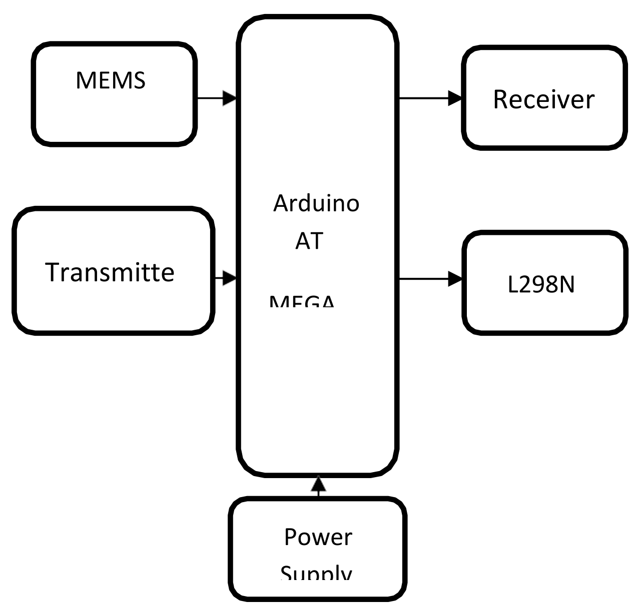

Fig. 1: Block Diagram of Head Motion Wheel Chair [1]

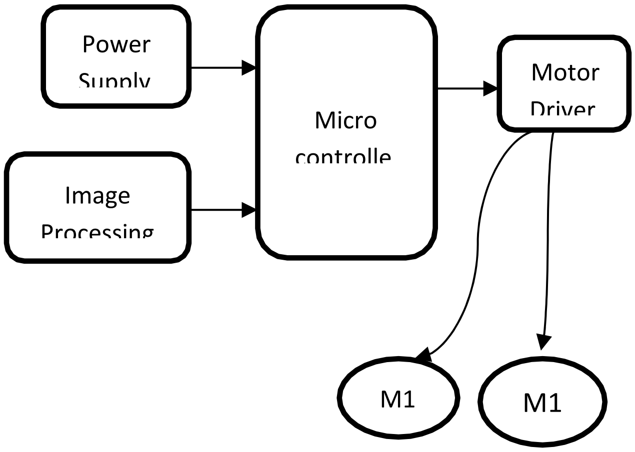

Fig. 2: Block Diagram of Eye Motion Controlled [3]

Eye tracking technology [3] may not always interpret eye movements accurately, leading to potential navigation errors and safety concerns. Continuously controlling the wheelchair with eye movements can tire users quickly, especially for those with limited eye control or stamina. Factors like varying lighting conditions and reflective surfaces can interfere with eye tracking sensors, affecting the system's reliability and performance in real-world environments.

One potential drawback Cost & Maintenance: Setting up and keeping up an eye motion control system that works well can be expensive, which may prevent certain people from having full access. To guarantee peak performance, the system might need routine calibration and maintenance, which would raise the overall cost and complexity.[3]

The[3] wheelchair system that is controlled by eye movement or blinking is introduced. Whether the surroundings is bright or dim, these systems are not entirely efficient. A wheelchair that is controlled by tongue movement has been proposed in.[6,7] The patient may find it uncomfortable to have their tongue perforated in order to inject magnetic materials into their mouth for this control interface. The wheelchairs that are brain-controlled (BCW) are described in.[8,9] Wheelchair navigation can be controlled by thought waves for those with motor impairments. The system's calibration is crucial, though, because different people's brain impulses behave differently. Given the drawbacks of the above mentioned methods, the wheelchair's most appropriate control interface for quadriplegic people is the control over head movement. Wheelchairs with head movement control have been created.[1,2,4] Head movement can be used to control the navigation on these wheelchairs. We have also created a head motion controlled wheelchair using our suggested approach, adding a few new capabilities that weren't in the earlier versions. The current wheelchairs come with a variety of navigation control methods, including joystick, voice, hand gesture, touch switch, eye movement, tongue movement, brain wave, head movement, and more. Of these methods, only patients with intact upper limbs (paraplegics) can use the joystick, hand gesture, touch switch, or other conventional control interfaces for navigation control. Additionally, quadriplegic individuals can benefit from alternative control interfaces such as speech, eye movement, tongue movement, brain wave, and head motion.

Proposed system

We propose a system an ESP32 microcontroller is used in the proposed head-motion controlled wheelchair system to process data and regulate wheelchair movements. The technology uses head gestures to analyze data from an ADXL345 accelerometer and steer the wheelchair in various directions. This user-friendly control system improves accessibility for people with restricted movement. In addition, an ultrasonic sensor is integrated to identify obstructions in the wheelchair's route, offering instantaneous feedback to the obstacle avoidance control system. This function makes navigating through different surroundings easier and improves user safety. In addition, a sophisticated alert system is put in place to identify any possible wheelchair tilting or falls in order to guarantee the safety of the user. When support and intervention are required, this method allows for fast notification to caregivers or users themselves.

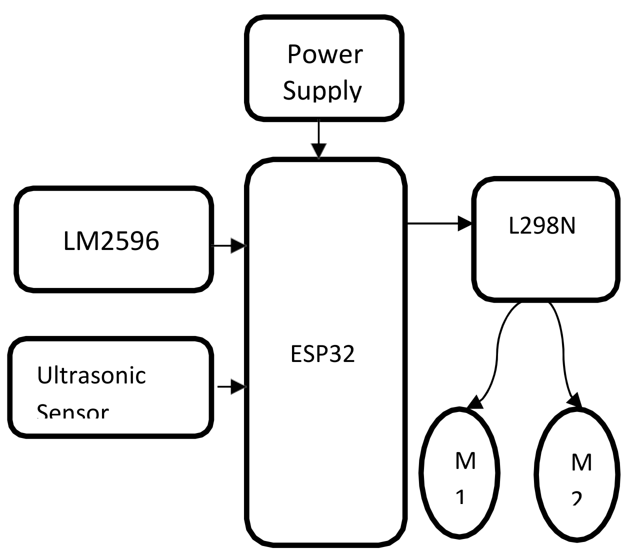

Fig. 3: Block Diagram of Proposed System Receiver

In conclusion, buzzer alarms installed in wheelchair substations can also be integrated with remote monitoring and control systems, allowing caregivers or users to receive real-time alerts and notifications about critical events or system malfunctions, even when they are not with the wheelchair. This creates a comprehensive and user-centric wheelchair system that prioritizes both mobility and safety for individuals with mobility impairments.

An ESP32 microcontroller integrated into the receiver module is in charge of wirelessly receiving accelerometer data sent by the transmitter module, which is also outfitted with an ESP32 microcontroller. Real-time data exchange is made possible by this communication, which takes place over a WiFi network that is set up between the two modules. An accelerometer on the transmitter module measures acceleration forces continually and converts them into digital data. This data is transferred to the receiver module via the WiFi connection after being formatted appropriately, such as JSON. The integrity and stability of the wireless link are carefully taken into account, guaranteeing dependable communication within the specified operating range of 10–30 meters.

Modern technology is utilized in the creation of an advanced alarm system, which includes an Node MCU microcontroller that is seamlessly coupled with an accelerometer and the Blynk IoT platform. This system is intended to identify crucial events, including wheelchair user tilts or falls, and make sure caregivers receive timely notifications via email and instant messaging via the Blynk app. Hardware configuration involves the complex coupling of the accelerometer to the Node MCU in order to record dynamic motions and orientation deviations in real time. The ESP32 has been carefully tuned to create a strong internet connection.

Blynk is set up to send alerts via a variety of channels, including email notifications and push notifications on caregivers' mobile devices, in order to guarantee optimal reach and effectiveness. Moreover, the Blynk application's email dispatch feature ensures that caregivers receive alerts right away, improving their responsiveness in emergencysituations.

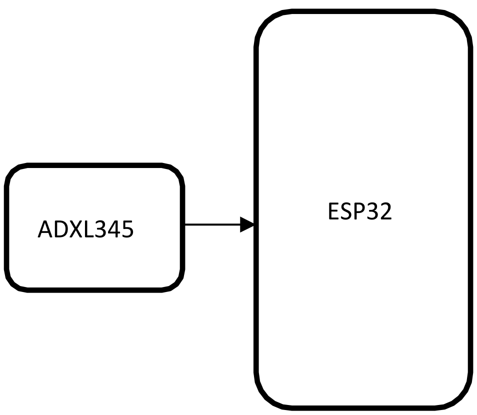

Fig. 4: Block Diagram of Proposed System Transmitter

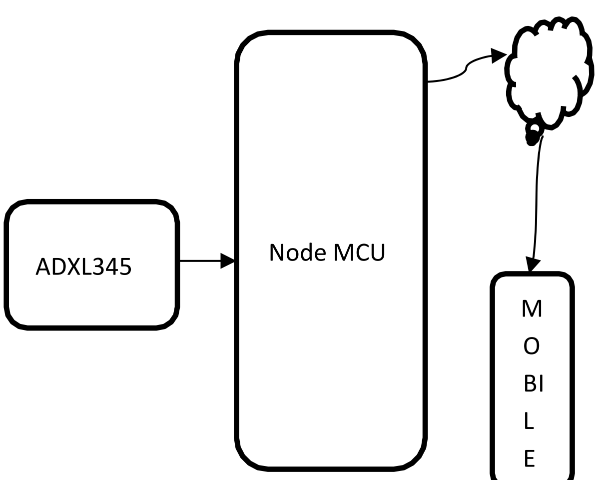

Fig. 5: Block Diagram of Alert System

Results

Fig. 6: Transmitter Module of Wheel Chair

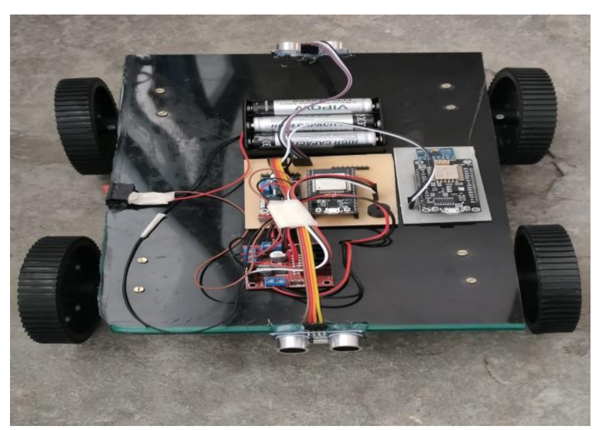

Fig. 7: Receiver Module of Wheel Chair

Fig.8: Prototype of Wheel Chair

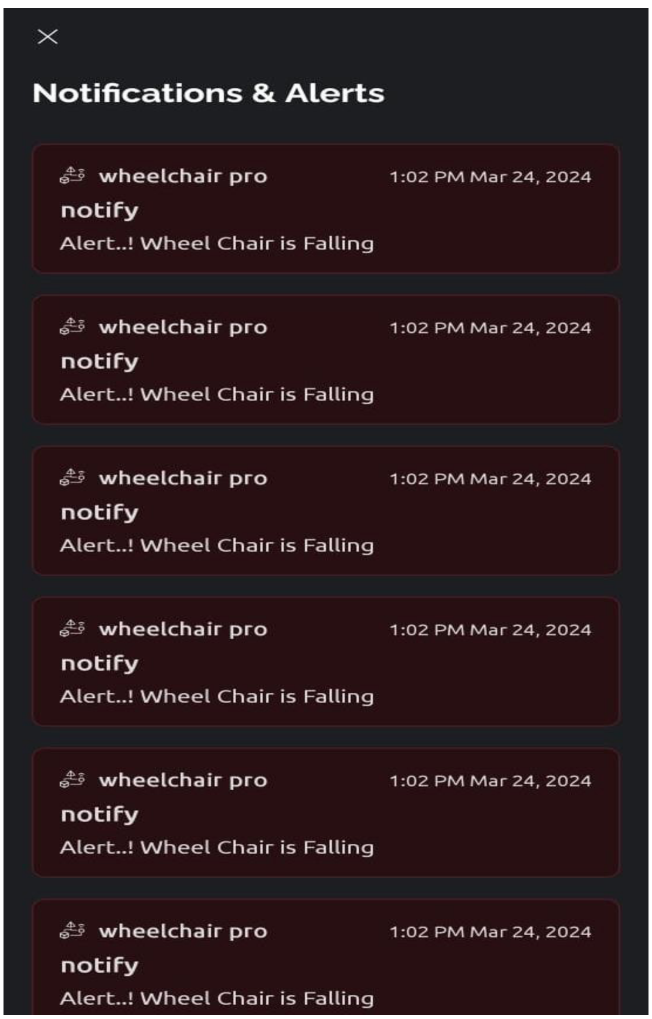

Fig. 9: Alert Message when Wheel Chair falls

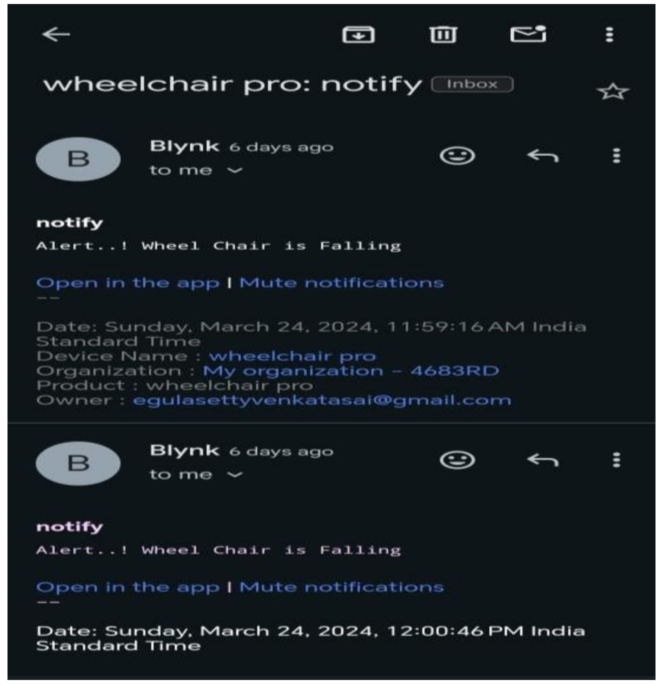

Fig.10: Alert Mails when Wheel Chair falls

Conclusion

In summary, the prototype has been created for individuals who are quadriplegic.other from their head, are incapable of moving any portion of their body. With this wheelchair, these people can easily move around both indoor and outdoor areas without help from others. Comparing the system to earlier versions, there are a number of extra benefits. It has the ability to identify obstacles in both front and rear directions. These days, the system uses a NodeMCU to notify family members in the event of an accident. Additionally, wifi has been used to establish the head motion detection circuit and the motor control circuit communicate wirelessly, negating the need for substantial wiring. By accurately identifying head movements, incorporating machine learning algorithms has the potential to improve wheelchair control in the future. Moreover, an Internet of Things-based health monitoringsystem might be included to keep an eye on paraplegic patients.

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