DESIGN AND DEVELOPMENT OF A HEAD, BLUETOOTH AND VOICE CONTROLLED WHEELCHAIR

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ABSTRACT

This project presents an innovative approach to wheelchair mobility through the design and development of a head, Bluetooth, and voice-controlled wheelchair. This system aims to empower individuals with limited hand dexterity or those who find traditional joystick controls challenging to navigate comfortably.

The proposed solution includes a specialized head-mounted device, Bluetooth connectivity, and a voice recognition system equipped with advanced sensors to detect head gestures and spoken commands. These inputs are translated into precise controls, enabling the user to navigate the wheelchair's direction and speed effectively. By leveraging advanced technology, the project emphasizes the design of the head control system, seamless Bluetooth integration, the development of robust voice-command algorithms, and the implementation of a user-friendly wireless communication system.

The anticipated outcome is a highly functional and intuitive wheelchair system that significantly enhances mobility and independence for individuals with disabilities. This innovative solution has the potential to improve the quality of life for many by providing a more accessible and efficient means of wheelchair control, thus promoting greater autonomy

INTRODUCTION

In recent years, technological advancements have significantly improved the quality of life for individuals with disabilities. One such innovation is the head, Bluetooth, and voice- controlled wheelchair. This cutting-edge technology empowers users with limited hand dexterity or those who find traditional joystick controls challenging.

The core components of this system include a specialized head-mounted device, Bluetooth module, and voice recognition system equipped with advanced sensors. These sensors, such as gyroscopes and microphones, accurately capture head movements and voice commands. The collected data is then processed by a sophisticated control algorithm to extract relevant information and generate precise commands for the wheelchair's motors. The algorithm translates head gestures and spoken instructions into specific actions, such as forward, backward, left, right, and stop.

To ensure seamless communication between the control system and the wheelchair, a robust wireless communication system is implemented. This system transmits control signals from the head-mounted device and voice module to the wheelchair's control unit, By providing greater control and flexibility, this technology can significantly enhance the quality of life for individuals with disabilities. It offers a more intuitive and efficient means of wheelchair control, empowering users to navigate their surroundings with greater ease and independence.

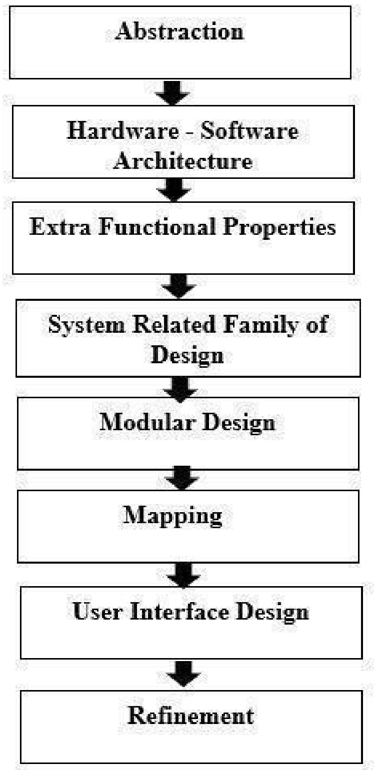
OBJECTIVE

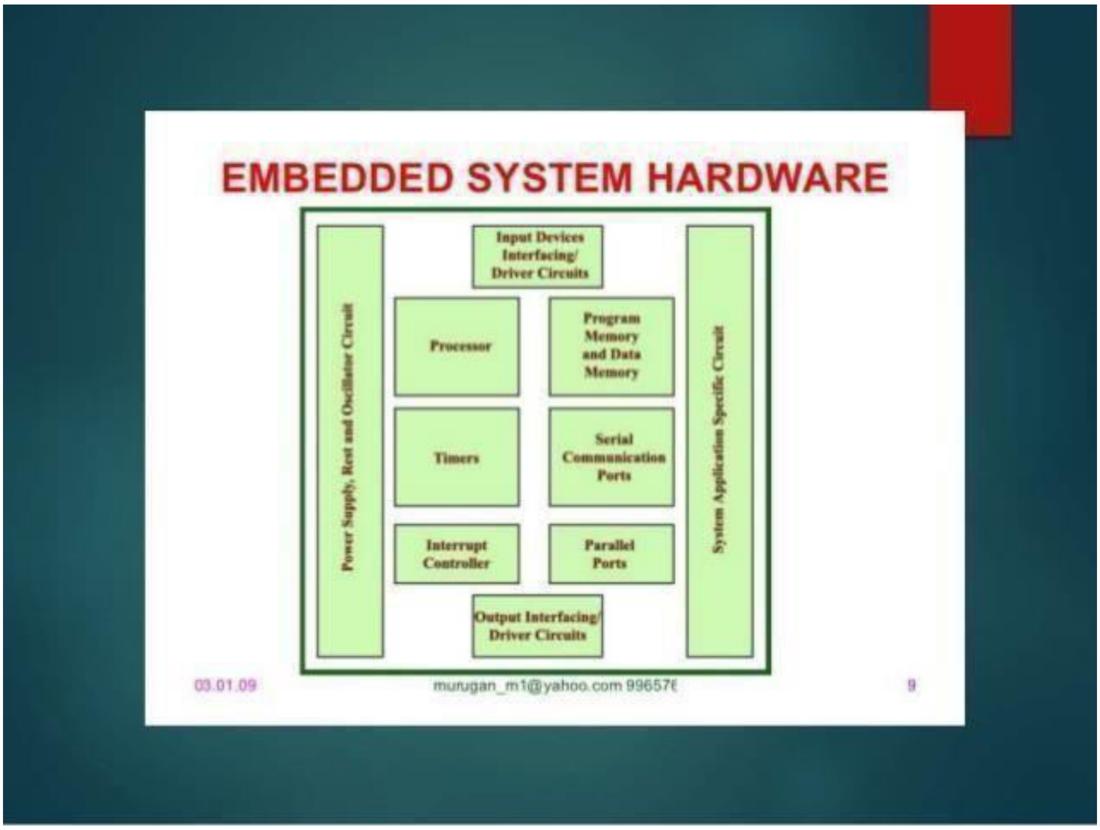
The objective of the Head, Bluetooth, and Voice-Controlled Wheelchair project is to enhance mobility solutions by integrating multiple control mechanisms to provide users with a more flexible, efficient, and accessible means of transportation. The primary aim is to develop a wheelchair that can be controlled using head movements, voice commands, and Bluetooth- enabled devices, thereby offering users multiple modes of operation based on their comfort and ability. This multi-modal control system is designed to assist individuals with varying levels of mobility impairment, making independent movement more feasible and convenient.

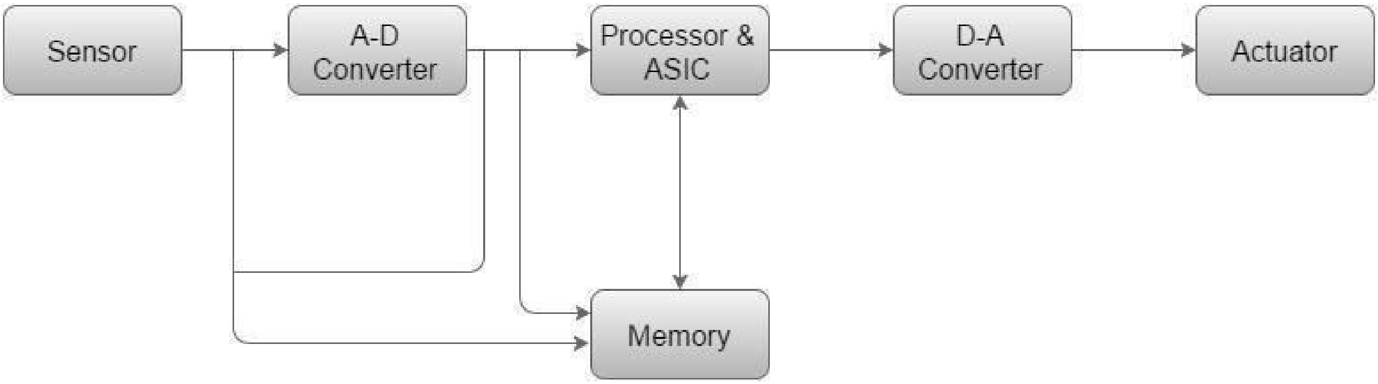
In addition to improving accessibility, the project seeks to enhance the responsiveness and accuracy of wheelchair

control by employing advanced sensor-based technologies.
Head control system utilizes motion sensors to detect directional tilts, while the voice recognition system processes spoken commands for movement control. These features work alongside a Bluetooth interface that allows users to control the wheelchair remotely via a Smartphone or tablet, ensuring a reliable alternative for navigation. The wheelchair is also designed to operate efficiently in different environments, providing smooth navigation and stability on various surfaces.
The paper also aims to improve user safety and comfort through real-time feedback systems and obstacle detection. By integrating smart sensors, the wheelchair can alert users to potential obstacles, preventing accidents and ensuring a secure riding experience. Furthermore, real-time tracking and monitoring capabilities can assist caregivers or healthcare providers in keeping track of the user's movement and well-being.
By combining automation with user-centric design, this project aims to empower individuals with mobility challenges by providing a smarter, more intuitive, and reliable wheelchair system. Ultimately, the goal is to enhance independence, improve daily mobility, and contribute to a more inclusive and technologically advanced assistive device ecosystem.

Embedded system process steps

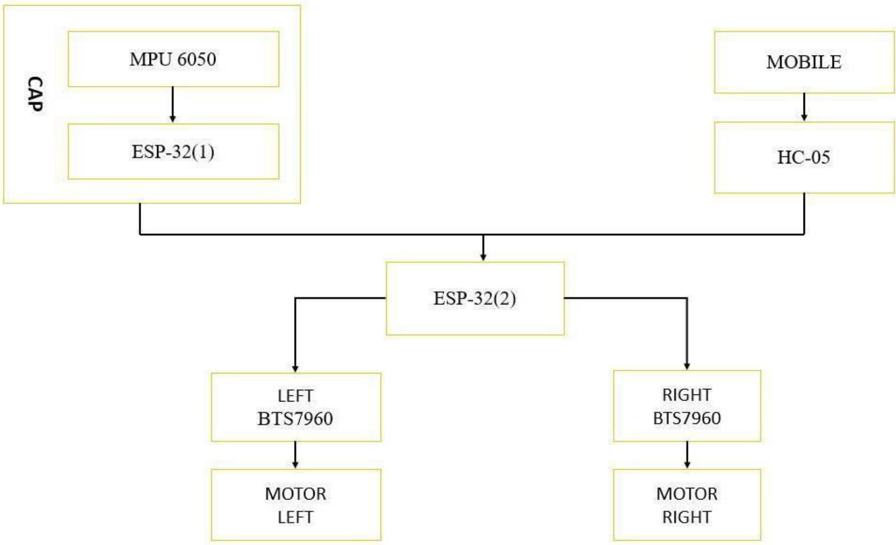






Basic Embedded Structure

WORKING AND ITS COMPONENTS



Block Diagram OF Head, Bluetooth And Voice Controlled Wheelchair

This block diagram represents a system that controls a motorized device using an ESP32 microcontroller, an MPU6050 sensor, and Bluetooth communication. Here's a breakdown of the components and their interactions:
Components:

Cap Unit:

The system consists of a cap unit, which houses an MPU6050 sensor and an ESP32 (1) microcontroller. The MPU6050 is a motion sensor that detects head movements such as tilting and rotation. This sensor data is processed by ESP32 (1) and transmitted wirelessly using ESP-NOW, a low-latency communication protocol, to the main control unit.

Mobile Communication:

On the other side, there is a mobile communication module that allows users to control the system using a mobile device. The mobile phone connects to an HC-05 Bluetooth module, which is linked to ESP32 (2). This provides an additional means of control, allowing commands to be sent via a smartphone.

Main Control Unit:

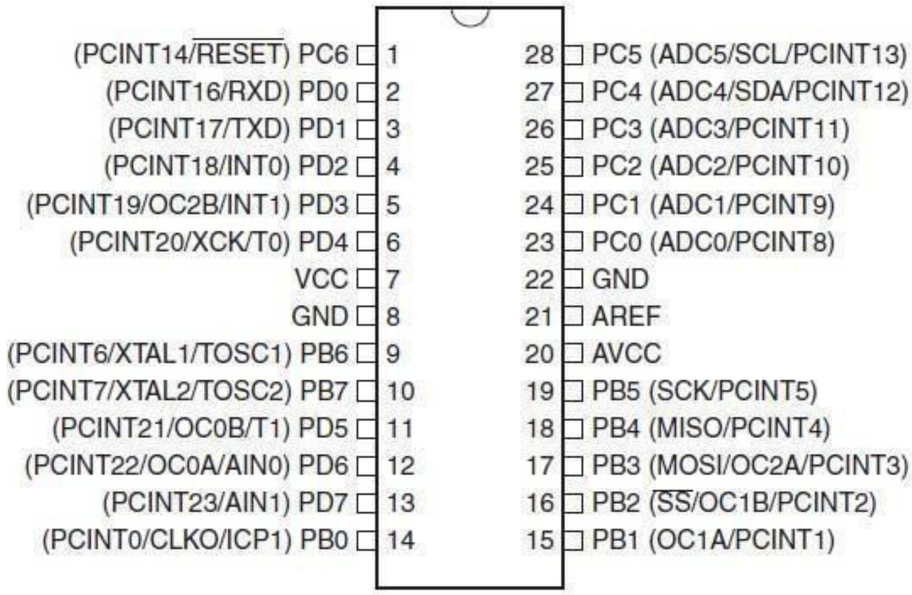
The main control unit, ESP32 (2), serves as the central processor. It receives motion data from ESP32 (1) through ESP-NOW and command signals from the mobile via Bluetooth. Based on these inputs, ESP32 (2) processes the data and determines the necessary motor actions. It then sends control signals to two BTS7960 motor drivers, which control the left and right motors.

Motor Control:

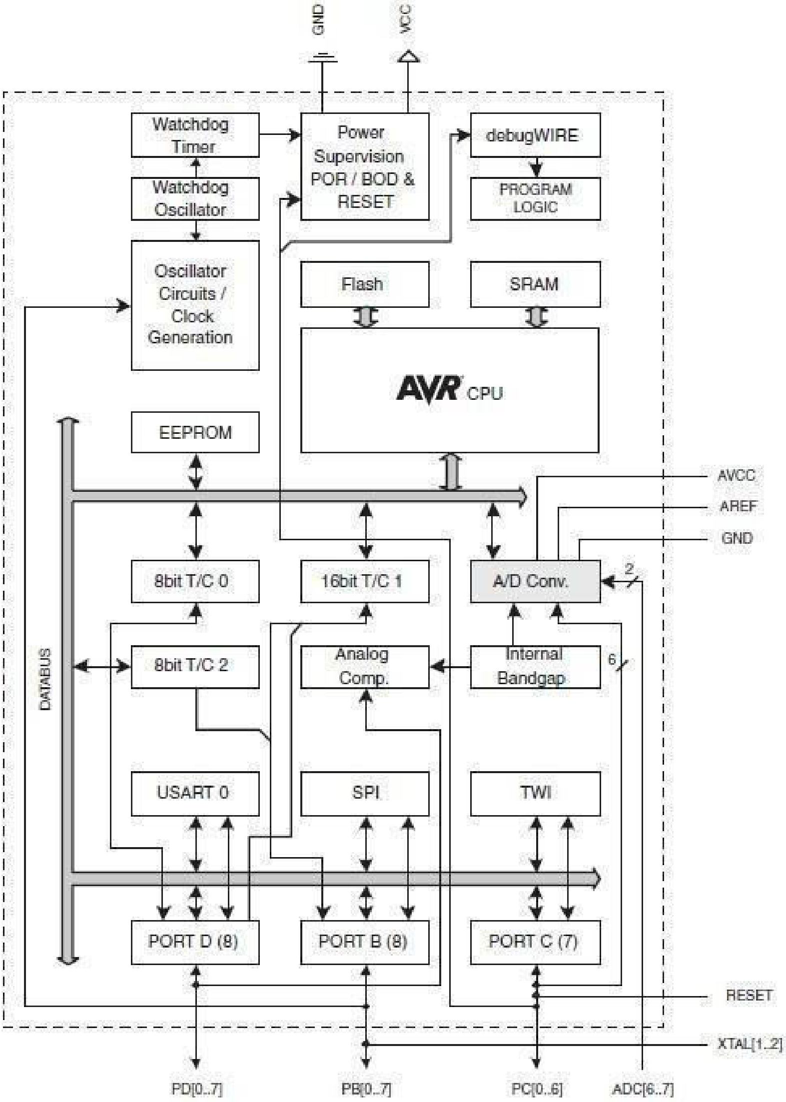
The motor drivers receive signals from ESP32 (2) and adjust the movement accordingly. The left motor is controlled by one BTS7960 module, while the right motor is managed by another. This setup allows the system to execute movements such as forward, backward, left, and right turns based on the user's head movements or mobile commands.

Working Principle:

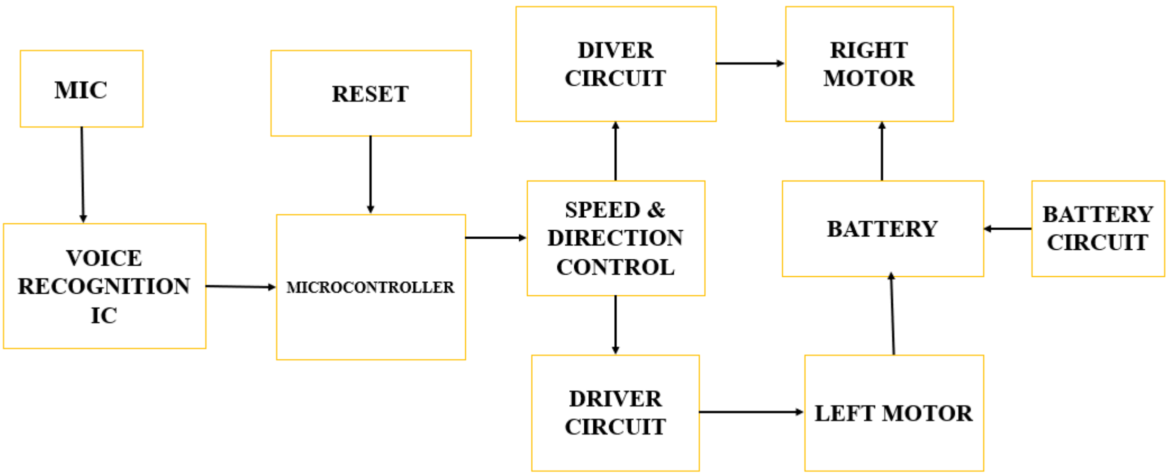
- The user wears a cap equipped with an MPU6050 sensor and ESP32 (1).
- The MPU6050 detects head movements (tilt, rotation, etc.).
- ESP32 (1) sends the processed motion data to ESP32 (2) using ESP-NOW.
- The user can also send commands via a mobile device, which communicates through Bluetooth (HC-05).
- ESP32 (2) processes the received signals and controls the BTS7960 motor drivers.
- The motor drivers adjust the speed and direction of the left and right motors, enabling movement.



Pin Configuration of Atmega328



Arduino Block Diagram



Block Diagram Of Voice Control Module Using Command Working

RESULTS

Implementing a Bluetooth and voice-controlled wheelchair system enhances mobility and independence for users with disabilities. The wheelchair is equipped with a microcontroller, such as the ESP32, which processes commands received via Bluetooth or voice input. A smartphone or dedicated voice module interprets voice commands and transmits control signals to the ESP32, directing the wheelchair's movement. The system integrates motor drivers to regulate speed and direction, ensuring smooth navigation based on user input.

Result Of A Head, Bluetooth And Voice Controlled Wheelchair

The Bluetooth module enables wireless communication between the wheelchair and a mobile app, allowing users to control movement through a touchscreen interface or predefined voice commands. The voice recognition system processes spoken instructions, converting them into movement commands for the wheelchair motors. The ESP32 manages communication, processes data, and executes motor control operations, providing a seamless user experience.

Result Of A Head Motion Control With Cap

In the internet-enabled version, the wheelchair can be integrated with cloud platforms for remote monitoring and diagnostics. The ESP32 connects to WiFi, enabling real-time tracking of the wheelchair's status and location. Users or caregivers can access data via a web interface or mobile app, receiving alerts in case of low battery, obstacles detected, or emergency situations. By leveraging platforms like AWS, Firebase, or a custom server, the system ensures accessibility, safety, and reliability, offering enhanced functionality beyond basic mobility control.

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