# IOT ENABLED WHEEL CHAIR WITH OBSTACLE DETECTION AND CONTINUOUS HEALTH MONITORING

[1]V.K.S.Koteswara Rao,[2]V.Jitendra,[3]T.Sirisha,[4]T.Akash Kumar,[5]P.Anitha,[6]Dr B.Siva Prasad

[1,2,3,4] B. Tech student Department of ECE, NSRIT, Vizag, AP, India

[5]Assistant Professor, Department of ECE, NSRIT, Vizag, AP, India

[6]Professor, Head of Department of ECE, NSRIT, Vizag, AP, India

**ABSTRACT:** The goal of this project is to improve mobility and freedom for those with physical disabilities or limited mobility by designing and developing an Arduino-controlled smart wheelchair that is Internet of Things enabled. To develop a clever and intuitive mobility aid, the system combines a number of technologies, such as motor drivers, sensors, Bluetooth or Wi-Fi modules, and Arduino Uno. Users or caregivers can control movement remotely by using a web interface or smartphone application to operate the wheelchair wirelessly.The system has obstacle detection sensors in addition to directional control to guarantee safe navigation and avoid collisions. IoT technology integration allows for real-time tracking, health monitoring (using sensors to measure body temperature or heart rate), and emergency notifications. Processing is done on all control and sensor data.

**KEYWORDS:** Bluetooth module, Arduino Uno, smart wheelchair, IoT-enabled, obstacle detection, sensor integration, remote control, mobility aid, tracking in real time, monitoring of health, server in the cloud, Wi-Fi module, assistive technologies, Self-navigating.

## LITERATURE OF SURVEY

### 2.1. Introduction to Robotic Wheelchairs

Robotic wheelchairs have evolved from manually operated devices to intelligent systems that integrate sensors, robotics, and automation to aid users with mobility impairments. These smart wheelchairs enhance the user experience by providing more autonomy, safety, and comfort. • Kang et al. (2015) designed a robotic wheelchair that uses sensors for navigation. Their approach integrates path planning and obstacle avoidance to create an autonomous system that can respond to changes in the environment (Kang, Y., & Ryu, J. 2015, "Development of a smart wheelchair system based on integrated wireless and sensor networks").

### 2.2. Bluetooth Integration for Communication

Bluetooth technology is widely used to enable wireless communication in robotic systems, providing a seamless interface between the user and the wheelchair's control system. Gao et al. (2012) presented a Bluetooth-based remote control system for a wheelchair. The system allowed a user to control the wheelchair from a distance using Bluetooth-enabled devices, such as smartphones or custom Bluetooth remotes (Gao, X., Li, Y., & Li, F. 2012, "Bluetooth-based wheelchair control system"). With the increasing demand for smart

assistive technologies, many researchers and developers have worked on enhancing the functionality and usability of wheelchairs using microcontrollers, sensors, and wireless communication modules. Below is a review of various relevant works and technologies that have contributed to the evolution of smart wheelchair systems, especially those involving Bluetooth control, Arduino microcontrollers, and IoT integration.

### 2.3. Bluetooth-Controlled Wheelchair Systems

Bluetooth-based wheelchair control systems have been widely explored for their cost-effectiveness, ease of use, and short-range wireless capabilities. In a study by S. Choudhary et al. (2018), a Bluetooth module (HC05) was interfaced with an Arduino Uno to control the movement of a basic motorized wheelchair using an Android smartphone. Their results showed that Bluetooth control offers reliable connectivity for indoor use and can be easily implemented in embedded systems without high power consumption. Similarly, M. Shalini and team (2019) developed a system that uses a mobile application created with MIT App Inventor to send directional commands to a wheelchair via Bluetooth. Their system provided basic forward, reverse, left, and right control, and was appreciated for its simplicity and affordability for everyday users. IoT Enabled Wheel-chair With Obstacle Detection And Continuous Health 6

## INTRODUCTION

One essential component of human independence and well-being is mobility. However, it might be difficult for those with age-related impairments, injuries, or physical disabilities to move freely and independently. Wheelchairs are essential for facilitating mobility in these situations. Both manual and electric wheelchairs offer basic assistance, but they might not be able to meet the needs of users who need sophisticated control features, remote operation, or improved safety measures. In order to increase usefulness, safety, and user autonomy, IoT-enabled smart wheelchairs are being investigated and developed. These devices make use of contemporary embedded systems, sensors, and wireless technologies. Connecting items to the internet to facilitate data interchange and remote control is known as the Internet of Things (IoT), a quickly expanding field. Integrating IoT with assistive devices like wheelchairs opens up a wide range of possibilities from remote movement control to health monitoring, obstacle avoidance, and real-time location tracking. These features not only empower users with greater control over their environment but also allow caregivers and medical professionals to monitor the user's status remotely. With the increasing accessibility of microcontrollers such as Arduino, building customizable and affordable smart wheelchairs is now more feasible than ever. The goal of this project is to create and deploy an Arduino Uno microcontroller-controlled wheelchair with Internet of Things capabilities. Depending on the design option, the wheelchair can be controlled wirelessly via Bluetooth or Wi-Fi networking via an IoT dashboard or smartphone app. The system's usefulness in medical contexts can also be increased by adding optional capabilities like temperature sensing, heart rate monitoring, and emergency warnings.The Arduino acts as the system's main controller, processing sensor data and control commands. A directional command (forward, backward, left, or right) sent by the user through the mobile application is processed by the Arduino,

which then relays control instructions to the motor driver, which turns on the DC motors mounted on the wheels. The wheelchair can operate safely even in busy or unfamiliar situations thanks to the addition of ultrasonic sensors, which allow the system to scan the environment for obstructions and automatically halt the wheelchair if something is detected nearby.

## METHODOLOGY:

By combining several smart technologies into a single assistive device, the Internet of Things-enabled wheelchair with obstacle detection and ongoing health monitoring is a cutting-edge mobility assistance intended to improve the safety and independence of people with physical limitations. The Arduino Uno, the main microcontroller for managing sensor data and managing the wheelchair's numerous operations, is at the heart of this project. By enabling remote control of the wheelchair via a wearable technology or mobile application, the Bluetooth module helps users or caregivers to effectively operate the wheelchair through short-range communication. By integrating IoT (Internet of Things) technology, the conventional wheelchair is transformed into a smart system that can communicate and analyze data in real-time, improving functionality and usability.

The project's main component is obstacle detection, which is accomplished by placing infrared proximity sensors or ultrasonic sensors strategically on the wheelchair to identify obstructions in the way. This helps to avoid collisions and allows for safe mobility in both indoor and outdoor settings. This ensures smooth and risk-free mobility, which is especially important for people with impaired vision or motor control. Wi-Fi modules add even more functionality to the wheelchair by connecting it to a cloud-based server and allowing for real-time data storage and transfer. Through the use of biomedical sensors like temperature and pulse oximeters, which continuously send data to the cloud, this enables continuous health monitoring, including critical indicators like blood oxygen levels, body temperature, and heart rate.

Through a web interface or smartphone app, caregivers or medical experts can remotely access this health data, facilitating individualized care and proactive health interventions. Furthermore, GPS monitoring can be integrated to track the wheelchair's location in real time, guaranteeing user safety and assisting with emergency response in the event that the user becomes disoriented or experiences discomfort. The wheelchair's intelligent mobility features, such as gesture control or a joystick, allow users to select their preferred method of operation. In more sophisticated versions, autonomous mobility inside mapped areas is made possible by self-navigation algorithms that use sensor fusion, path planning, and real-time environmental mapping (maybe using LiDAR or camera modules). This greatly reduces user effort and increases autonomy.

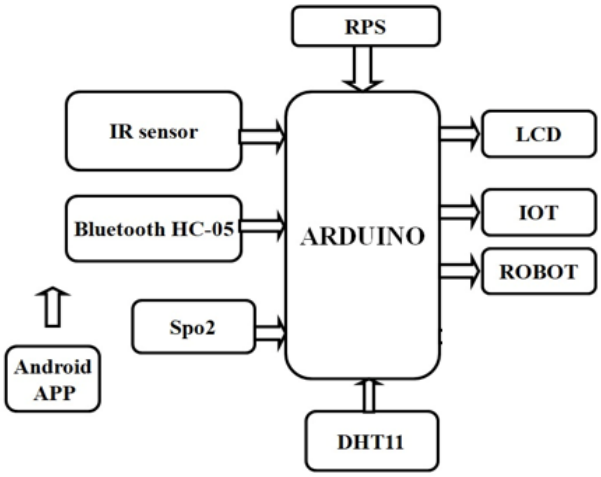
Thus, the smart wheelchair is a combination of hardware and software, utilizing IoT frameworks to provide remote monitoring, data analytics, and improved connectivity, and combining numerous modules and sensors that are synchronized through embedded programming on the Arduino platform. In addition to increasing people's physical mobility, this assistive technology offers ongoing health insights and emergency alarms, guaranteeing all-encompassing care. The cloud server serves as a central repository for user activity and health data, which can be utilized for reporting, analytics, and

alarms. The project tackles the diverse needs of users by integrating remote control, smart sensing, obstacle avoidance, and health tracking. It combines engineering innovation with human-centric design to produce a scalable, economical, and effective smart.

## HEALTH MONITORING SYSTEM:

An important development in assistive technology is the Internet of Things (IoT)-enabled wheelchair with obstacle detection and continuous health monitoring system, which combines state-of-the-art electronics, embedded systems, and IoT integration to improve mobility, safety, and health tracking for people with physical disabilities or limited mobility. The Arduino Uno microcontroller, which serves as the brain of this intelligent system, coordinates real-time data collection, decision-making, and communication amongst numerous integrated modules. A variety of sensors, including ultrasonic sensors for obstacle recognition, are integrated into the wheelchair. This allows the system to recognize and steer clear of obstacles in the user's route on its own, enhancing navigation and lowering the chance of crashes. This self-navigating feature guarantees safe and easy mobility, especially for individuals who might find manual control difficult. Additionally, the system has Wi-Fi and Bluetooth modules that enable wireless communication between the wheelchair and other devices, such as cloud servers or cellphones. While the Wi-Fi module enables real-time data transmission to a cloud server, allowing family members or medical professionals to continuously monitor the user's health parameters from any location, Bluetooth connectivity allows users or caregivers to remotely control the wheelchair or receive status updates. Integrating biometric sensors that measure vital indicators like body temperature, pulse rate, and oxygen saturation (SpO2) allows for health monitoring. The Arduino processes the data and uploads it to the cloud for analysis and long-term documentation. This functionality is essential for prompt medical intervention, emergency alert creation, and early identification of health abnormalities. The system's overall design ensures usability without sacrificing mobility or battery life by being small and power-efficient. Additionally, an intelligible representation of sensor data and GPS-based real-time location monitoring can be provided by a mobile application or online interface, giving caregivers peace of mind and increasing user autonomy.

## BLOCK DIAGRAM:




The block diagram shows a Bluetooth-controlled robotic chair system using an Arduino

microcontroller. The following is a descriptive explanation of every component and what it does:

### Components and Connections:

**Regulated Power Supply:**

Supplies a stable voltage to the Arduino and other components.

**Arduino (Central Controller):**

Acts as the brain of the system, handling inputs and outputs.

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**Bluetooth Module:**

Allows wireless communication between an Android application and the Arduino.

The Android application gives control instructions to the Arduino using Bluetooth.

**LCD Display:**

Displays system information like received commands or status.

Delivers audio output or voice instructions based on incoming signals.

**L293D Motor Driver:**

Regulates the motors of the Robot Chair so it can go forward, backward, left, or right.

**Robot Chair:**

Motorized chair that travels as per the commands from the Android application through Bluetooth.

## WORKING PRINCIPLE:

Using cutting-edge technologies like Arduino Uno, Bluetooth communication, real-time health tracking, and cloud-based monitoring, the IoT-enabled wheelchair with obstacle detection and continuous health monitoring is a creative and clever mobility aid that aims to empower people with physical disabilities by improving their independence and safety. By offering remote control, obstacle detection, and ongoing health monitoring, this smart wheelchair system combines a number of sensors and modules to provide a smooth and effective user experience. The Arduino Uno microcontroller, which serves as the system's brain, is at its heart. It receives data and orders from a variety of input sources and reacts accordingly to provide user safety and control. A Bluetooth module (HC-05 or HC-06) is connected to the wheelchair, enabling wirelessUsing a smartphone, the Android software enables the user or caregiver to give the wheelchair instructions for forward, backward, left, or right movement. When the user gives a command using the app, the Arduino Uno interprets the signal from the Bluetooth module and sends it to the Arduino Uno, which then drives the motors in the appropriate direction to propel the wheelchair. The wheelchair has ultrasonic sensors positioned strategically at the front and perhaps on the sides to identify surrounding obstructions for improved safety and navigation. By measuring the distance between the wheelchair and possible obstacles, these sensors provide information to the Arduino Uno, which then evaluates how close the impediments are.

The Arduino keeps the wheelchair from moving in a certain direction to prevent collisions and protect the user if it detects an object within a predetermined safe distance. In indoor spaces like houses and hospitals, where furniture and small walkways might be dangerous, this characteristic is essential. Furthermore, the system incorporates essential health monitoring sensors, like body temperature and pulse rate sensors, which continuously gather health information from the user while they are seated in the wheelchair. The Arduino Uno collects this biometric data, which is then sent to a cloud server using a Wi-Fi module (usually an ESP8266). This allows family members, caretakers, or medical professionals to remotely monitor a patient's health.

## APPLICATIONS OF EMBEDDED SYSTEMS:

### Consumer applications:

At home we use a number of embedded systems which include microwave oven, remote control, vcd players, DVD players, camera etc.

**Fig** Automatic coffee makes equipment

**Fig** Robot

### Industrial Automation:

Today a lot of industries are using embedded systems for process control. In industries we design the embedded systems to perform a specific operation like monitoring temperature, pressure, humidity, voltage, current etc.., and basing on these monitored levels we do control other devices, we can send information to a centralized monitoring station. In critical industries where human presence is avoided there we can use robots which are programmed to do a specific operation.

### COMPUTER NETWORKING:

Embedded systems are used as bridges routers etc

**Fig** Computer networking

## FUTURE SCOPE:

By combining contemporary embedded systems, sensor networks, and wireless communication, the Internet of Things-enabled wheelchair with obstacle detection and continuous health monitoring offers a revolutionary development in assistive technology to improve the mobility, safety, and general well-being of people with physical disabilities. The Arduino Uno microcontroller, the core processing unit that interfaces with numerous sensors and connectivity modules, is at the center of this cutting-edge system. Because the wheelchair has ultrasonic sensors for real-time obstacle identification, the user can go around safely and without worrying about crashes, especially in dynamic or new surroundings. This function gives users confidence while navigating

chaotic or crowded places and is essential for independent mobility. At the same time, the system uses biomedical sensors to continuously monitor vital health parameters like body temperature and heart rate. It then sends this data to a cloud server via a Wi-Fi module so that family members, caregivers, or medical professionals can view and track the user's health status remotely in real time. Proactive health monitoring makes it possible for prompt medical actions, improving user safety and giving caregivers peace of mind. The Android-based smartphone application, which serves as an intuitive control interface, is a crucial component of the system. It uses Bluetooth to communicate movement orders to the Arduino's Bluetooth module. The wheelchair's direction and movement can be remotely controlled by the user or caregiver thanks to the Arduino's processing of the input and subsequent motor driving. Those who are unable to use conventional joystick-based control methods or who have limited upper body strength may particularly benefit from this wireless control function. To further improve user safety and give caretakers the ability to know the user's precise location at all times, GPS modules can also be installed to enable real-time wheelchair location tracking. This project's combination of embedded technologies and the Internet of Things creates a clever, responsive, and connected solution that not only increases mobility but also turns the wheelchair into a complete platform for health monitoring and assistance. By ensuring that location monitoring and health data are not limited to local devices, cloud connectivity makes it possible to provide remote healthcare and support beyond regional boundaries. The future scope of this project is vast, with potential enhancements including integration of machine learning algorithms for self-navigation and path planning, enabling the wheelchair to autonomously move within mapped In order to minimize latency for important warnings and actions and lessen dependency on cloud servers, edge computing solution may also be investigated to analyze some data locally on the wheelchair itself. Additionally, to improve the wheelchair's usage in isolated or power-poor areas, energy-efficient power management systems, such as solar-powered charging devices, can be created. This project is a versatile and significant breakthrough with enormous potential for future development and commercialization since it represents the convergence of embedded systems, IoT, cloud computing, and healthcare. By enabling people with mobility disabilities to live more autonomous, secure, and healthy lives, it meets a critical societal need and paves the way for the development of intelligent, context-aware assistive technology in the fields of healthcare and rehabilitation.

## CONCLUSION:

The development of a Bluetooth-controlled IoT-enabled smart wheelchair using Arduino presents a significant advancement in assistive mobility technology, combining affordability, accessibility, and smart automation to benefit individuals with physical disabilities or limited mobility. This project successfully integrates Bluetooth communication, Arduino-based control, and IoT features to create a user-friendly system that allows the wheelchair to be navigated using a simple smartphone interface, ensuring comfort and independence for the user. The implementation of ultrasonic sensors for obstacle detection greatly enhances user safety by preventing collisions, especially in indoor and crowded environments. The system's modular design allows for easy upgrades, including the integration of health monitoring sensors (such as $SpO_2$, heart rate) and IoT

connectivity for remote tracking and emergency alerting. These features make the wheelchair not only a means of movement but also a proactive safety and health companion. Overall, the project achieves its objective of creating a cost-effective, intelligent wheelchair system tailored to modern needs. It opens the door for future enhancements such as voice control, GPS tracking, AI-based path planning, and more advanced health diagnostics. This smart wheelchair system is a step forward in empowering users with mobility limitations, ensuring they live with greater independence, safety, and dignity

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