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Voice Controlled Wheel Chair with Fall Detection Using Iot

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Abstract- This project aims to design and implement an assistive system for people with disabilities, combining voice- based wheelchair control, health monitoring, and emergency alert features. The system utilizes an Arduino Nano, Bluetooth communication, a mobile application, and various sensors to monitor the user's health status in real-time. The wheelchair can be controlled via voice commands received from a mobile app, allowing users to move the wheelchair with simple verbal instructions. Health monitoring is achieved through sensors that track the user's heart rate, body temperature, and detect falls using an accelerometer. In the event of an emergency, the system can send notifications via SMS using a GSM module, which includes the user's GPS location and health data. Additionally, all sensor data is uploaded to the ThingSpeak IoT platform for remote monitoring and analysis. This integrated system provides not only mobility assistance but also enhances safety and well-being for disabled individuals by offering real- time health status updates and emergency alerts.

Index Terms- wheel chair, accelerator, heartrate sensor, Temperature sensor, GPS, GSM, ThingSpeak, emergency button.

I. INTRODUCTION

People with disabilities often have to overcome many obstacles in managing their mobility and health, requiring innovative solutions to provide further independence and safety. Traditional wheelchairs, ubiquitous in movements, lack intelligent systems for health monitoring and emergency assistance. With advanced embedded systems and IoT, their functionalities may now be employed within these assistive devices. According to recent studies, assistive technologies improve the use of mobility and health monitoring for persons with disabilities Foundational work by researchers underscores the role that IoT and embedded systems could plan with respect to enhancing wheelchair functionality and healthcare support. Several studies underline the advantages of making voice control, real-time health monitoring, and emergency alert systems common features in assistive devices and the profound benefits that an individual will gain from it.
The proposed intelligent assistive system is equipped with voice-controlled wheelchair navigation, real-time health monitoring, and an alarm system to provide emergency alerting. To facilitate mobility without manual control, the system uses voice acknowledgement and communication between Bluetooth with a mobile application. This is extremely advantageous to users whose hands do not function well, making them freer. Navigation isn't the only thing available; the system will have many health monitoring sensors. Among these are a heart rate sensor that will always monitor the user's pulse, temperature sensor that will monitor fluctuations in body temperature, and an accelerometer, which will detect falls. These are real-time measurement mechanisms that allow caregivers and healthcare professionals to make assessments of the user's physical conditions and take necessary steps.

Emergency Response and Health Monitoring Based on the Internet of Things Emergency response is a major aspect of the system since messages would be sent as soon as an emergency situation would arise. In case of detection of abnormal health readings or falls, it will automatically turn on an alert via SMS through a GSM-based module containing the GPS location with the health record of the user. Research on assistive healthcare only underscores the need for the establishment of automated emergency systems to ensure rapid response time and sharpening of safety, especially for those living alone. Furthermore, it uses ThingSpeak for IoT-based data logging to store real-time data for remote monitoring. Studies highlight the advances that cloud-based health tracking contributes toward the early detection of anomalies, as well as their contributions to informing health trends of the user and supporting personalized medical interventions. Integration of cloud storage and analytics augments the long-term scalability of assistive technologies.
Future Directions and Technological Upgrades The entire intelligent assistive system shows that IoT and embedded systems can make huge strides in mobility and health services

to persons with disabilities. Modular designs in assistive technology are vital for future advancements such as augmented health sensors, better voice recognition algorithms, and expanded communication protocols. The systematic reviews advocate how best refinements in assistive devices for better patient care are made possible by state-of-the-art connectivity options and AI-driven predictive analytics usage. Further development may hinge on machine learning with respect to health anomaly detection making it possibly the most responsive and adaptive assistive experience.

This research is focused on filling the gap between assistive mobility and health management with an innovative solution powered by technology. This system is proposed to be a holistic solution for improving the lives of people with disabilities by using the features of embedded systems, Bluetooth communication, GSM technology, and IoT-based data analytics. With the application of smart assistive technologies, we will be a step closer to creating a more inclusive and accessible environment for people with mobility impairments. Continuous research on smart healthcare and assistive technology will prove the feasibility and effectiveness. of such advanced features.

II. LITERATURE REVIEW

Mobility-impairment people face difficulties in movement and regarding their health management. Hence, this requires innovative technological solutions to improve their independence and safety. Most traditional wheelchairs are just mobility aids yet are lacking in advanced features like real-time health tracking as well as emergency responses. The fast development of embedded systems and the Internet of Things has opened new horizons to facilitate the enhancement of assistive devices. Studies indicate that there is a growing approach towards smart technologies toward the improvement of mobility and healthcare support to persons with disability. Several studies validate the assertions of improving effectiveness of IoT-enabled assistive devices in incorporation with voice command usage, continuous health monitoring, and emergency alert mechanism which will thereby impact user safety and autonomy greatly.

A recent breakthrough took wheelchair technology a step further by integrating a voice recognition software making an intelligent navigation system. This kind of wheelchair allows the patient to direct their movement by simply communicating verbal commands for going in multiple directions and avoids reliance on manual control methods. According to research conducted on the Bluetooth driven voice navigation system, such systems supplement the ease of usage and accessibility for individuals with poor upper- body mobility. Most of these systems communicate with a mobile application that interprets voice commands and passes it to the control system of the wheelchair.

Growingly, the health monitoring sensors added to assistive devices have been found useful. For example, heart rate monitors, temperature sensors, and accelerometers provide up-to-the-minute physiological information for caregivers to monitor the individual's health statuses. A typical accelerometer, it can be used in automated detection of falling incidents whereas heart rate sensor and temperature sensor functions continuously monitor vital signs and raise alarms whenever a case of anomaly is detected. One crucial functionality of assistive technologies is the automated emergency response, which ensures that users will get timely assistance in the event of health impairment or falling situations.

Some of these systems detect abnormal conditions and send their respective SMS alerts with GPS location and health data through GSM technology. The effectiveness of IoT emergency systems in reducing response times and increasing access to healthcare for people living alone has been proven in studies. Real-time health data logging by means of cloud-based platforms, i.e., ThingSpeak, strengthened these devices. Researchers point to early detection of health issues as the primary goal of IoT-enabled health tracking since it gives caregivers and healthcare professionals the opportunity for preventive action.

There is value in storing and analyzing health data over time to provide ideal conditions for a person and to personalize medical interventions.Hence, smart assistive technologies have developed, which imply that embedded systems, alongside IoT technology, have great potential to

revolutionize the realms of mobility and healthcare support up to a completely different level for disabled individuals. Future advancements including the addition of more sensors, enhancement of speech recognition algorithms, and the inclusion of newer wireless communication protocols will be made possible through modular design approaches, researchers recommend. Studies also highlight that AI-powered analytics also play a significant role in refining assisted devices to adjust to user behavior and pro-actively predict health anomalies for intervention. Presenting a very meaningful avenue into the responsiveness and adaptability of assistive systems, machine learning applications in health monitoring may well prove most promising.

This research, therefore, focuses on addressing the requirement needed to bridge mobility assistance to health management through embedded systems, Bluetooth connectivity, GSM-based communication, and IoT-enabled data analysis. These intelligent assistive features in wheelchairs comprise a holistic adopting format of facilitating the improvement in the quality of life for the disabilities. Lately, advancements in assistive technology have all gone on

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to show much possibility- by really proving feasibility and effectiveness measures of incorporating intelligent systems to realize their full potential for future innovations and inspiring healthcare access and mobility- related inclusive solutions.

III. METHODOLOGY

This project aims to create an assistive system for individuals with disabilities, which would encompass voice- controlled wheelchair maneuvering, real-time health monitoring, and emergency alerts. The methodology contains several phases that include the design of the system, hardware integration, software programming, and extensive testing. The main goal is to build a system that improves mobility, health, safety, and a quick response mode for emergencies. The methodology requires a comprehensive, structured approach from the conception of the system to its actual deployment, ensuring that each aspect integrates seamlessly to function smoothly as one entity.

System Design and Architecture

Its architecture is structured very closely to integrate various technologies to assist mobility and track health. This architecture basically consists of a microcontroller attached to the Arduino Nano brain circuitry that processes input through sensor interfaces, the Bluetooth module, and the GSM module. The system architecture is basically categorized into three major modules: wheelchair control system, health monitoring system, emergency alert system. Each module has unique purposes but are interconnected to make the entire system work very smoothly. The wheelchair control system uses any Bluetooth-enabled mobile that uses voice commands sent from the mobile application that mostly trigger the movement of the wheelchair using simple voice instructions. The health monitoring system consists of sensors that monitor vital signs like heart rate and body temperature along with an accelerometer for fall detection. The data will also be sent to health professionals through SMS when the emergency alert system is activated over the GSM module with health data and GPS location.

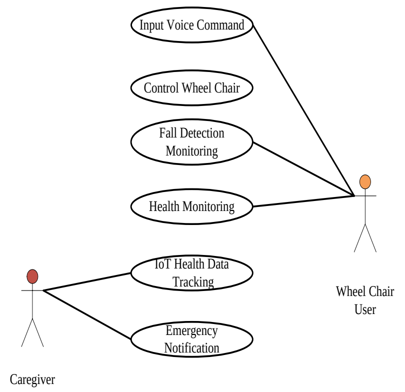

Fig. 1: Use case diagram

Hardware Integration

The selection of the hardware components is based on considerations of cost, reliability, and compatibility with each other. The Arduino Nano is the primary processing unit; very small and cost-effective, it performs the communication of the sensors, Bluetooth module, GSM module, and mobile application. The Bluetooth module allows for wireless communication between the mobile application and the wheelchair. It serves as the pathway to send voice commands to the Arduino Nano, which controls the movement of the wheelchair. The health-monitoring system consists of a heart rate sensor that constantly monitors the user's heart rate and a body temperature sensor that measures the body temperature of the user, while an accelerometer helps in the detection of falls.

All these sensors are connected to the Arduino Nano for processing of their data, which is sent to the mobile app or the cloud platform, ThingSpeak, for real-time monitoring. The GSM module handles the SMS alerts in case of an emergency. Besides, the GPS module can be activated to trace the user's location during an emergency for caregivers or other emergency responders to know where the user is. Depending on wheelchair, selecting a proper battery (e.g., Li-ion or Li-Po) is crucial. You will have to estimate the power draw of each module to calculate battery life. Power- saving mechanisms, like sleep modes or disabling idle components, can be used to maximize battery life.

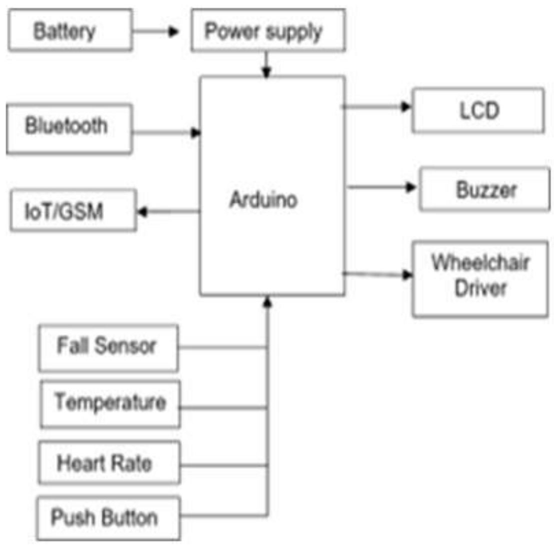

Fig.2: Block Diagram

The system's hardware is carefully integrated so that each component is interconnected and can communicate with the others. Sensors and modules are connected to an Arduino Nano mounted on the wheelchair. Power is supplied adequately, so that it can last for a long time and facilitate

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uninterrupted work. Each component, from sensors to a GSM module, has been tested for good functionality so that it operates optimally in this system. The interconnection of these various hardware components forms the backbone of the assistive system that gives the required support for wheelchair control, health monitoring, and emergency communication.

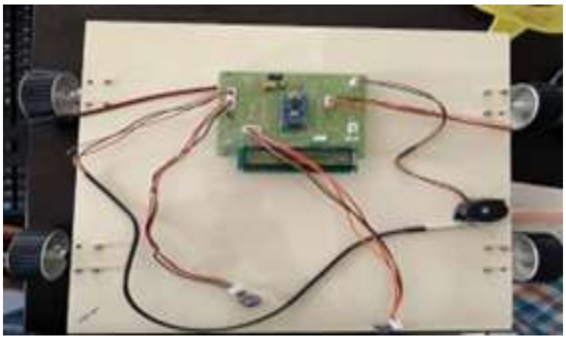

Fig.3 Hardware Setup

Voice-Based Wheelchair Control

Perhaps the most innovative feature of this project is the voice-based wheelchair control system. A dedicated mobile app allows the user to provide spoken commands that control the wheelchair's movement. The app uses speech recognition technology to convert these spoken commands into text commands, which are transmitted by Bluetooth to the Arduino Nano. The system understands simple commands like "move forward," "turn left," "turn right," and "stop." Each command corresponds to a very specific action on the wheelchair, such as varying speed or changing direction. The mobility assistance via voice command allows these individuals to control their wheelchair hands-free in an intuitive manner. The voice control system is an essential feature of the whole system: it provides independence and control of movement for users who either have some degree of limited mobility or impairment in their hands and arms. Communication between the mobile application and Arduino Nano is ensured by Bluetooth, making it stable and reliable, so that real-time wheelchair movement is achieved with very little delay.

Health Monitoring System

An assistive system must have a health-monitoring system as an essential feature. The system monitors key health parameters continuously, ensuring the well-being of the user is constantly evaluated. Three types of sensors are incorporated into this system:

The heart rate sensor, the temperature sensor, and the accelerometer for fall detection. The heart rate sensor measures the heart rate of the user continuously while transmitting data to the Arduino Nano for processing and display on a mobile app. Similarly, the body temperature sensor measures the temperature of the user. Elevated body temperature can signify fever and other health problems, making it crucial to monitor this parameter. Should the heart rate or the body temperature exceed any preset threshold, the system will alert the user and caregivers regarding a possible health concern.

A significant portion of the health-monitoring system, the accelerometer, is responsible for determining falls. It assesses the angle and acceleration of the wheelchair to determine whether the user suffered an abrupt fall. In the event of a fall, the emergency alert functionality of the system is initiated.

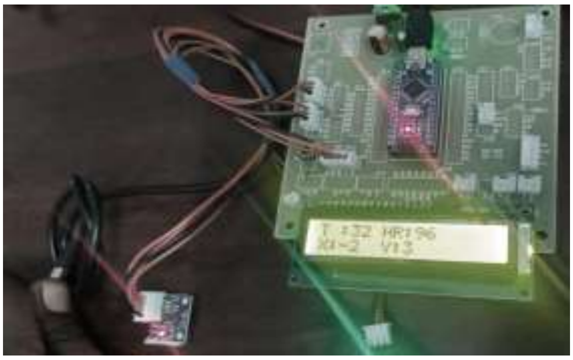

Fig.4 Output of health monitoring

Emergency Alert System

To know that an anomaly such as an abnormal heart rate or an extreme change in health parameters would activate an emergency alert system for detecting falls. The above system is poised to alert caregivers, family members, or emergency contacts as soon as such events occur in real time. When an emergency occurs, the GSM module sends out an SMS containing the user’s health data including heart rate, body temperature, and related readings along with the GPS location of that user all at once. The GPS module location describes with good accuracy where the user is so responders can get to that person in real time. The alerts through SMS ensure that the user’s status is well communicated to the other concerned contacts so they can act immediately. Emergency alert systems are stringently tested to ensure the system is reliable. Indeed, the system should send alerts accurately at the right time if it were to be really life-saving for the user in an emergency situation.

Alert messages can also be configured at the preset schedule for sending updates about the health status of the user to caregivers, irrespective of whether an emergency has occurred. It helps in remote monitoring of the users, keeping the caregivers informed about the conditions of patients at all times.

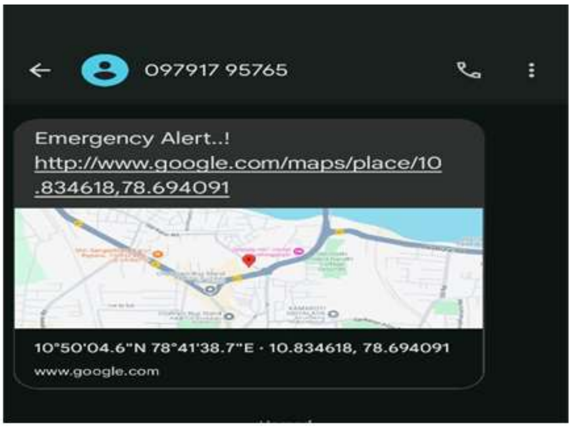

Fig.5 Emergency alert using GSM

Software Development

It allows everything to work seamlessly at the end of everything with the entire system. This mobile application that has been developed using Android or Android-related software is the one that connects a user via voice commands to control the wheelchair. The comfortability and user-friendliness of this application make it really simple for anyone just to use it, even without much of a technical orientation. The commands are passed from the mobile application to the Arduino Nano using Bluetooth for processing and then received as health data from the device.

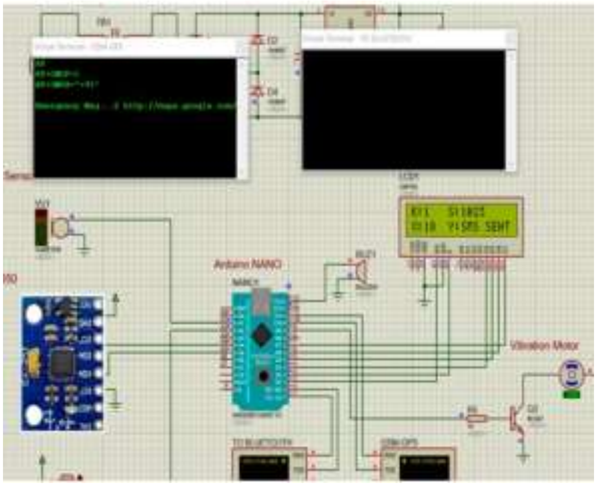

Fig.6 simulation diagram

Arduino programming would involve writing code that also interprets voice commands via Bluetooth and controls the wheelchair movement as per them. The program would also be designed to read data from sensors and process various activities before relaying that information back to a mobile app. The uploading data from the sensors are integrable in real time in conjunction with the ThingSpeak platform's Application Program Interface. This is vital in remote health monitoring concerning providing healthcare professionals with real-time information on the user's condition. The SMS alerting notification is programmed in GSM for emergencies. The software should function constantly, processing data from sensors, interpreting commands and controlling the entire system effectively.

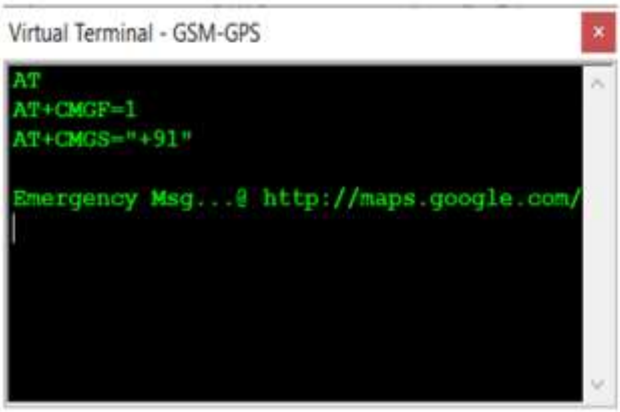

Fig.7 Simulation output

Testing and Evaluation

The process of rigorous testing comes after the building of the system, ensuring its reliability and effectiveness. Testing on the health-monitoring system is performed so that the sensors render correct and reliable readings. Testing of the voice-based control system is to ensure that the system correctly interprets voice commands and executes appropriately on the wheelchair. An important facet of this whole testing phase is checking whether the emergency alert system works correctly so that any alert is sent in time, as soon as an emergency arises.

Integration testing comes next, whereby all the components are tested together to see if they can communicate well and if the system works to specification. It is this particular testing that lets us identify possible issues: slow response to voice commands, incorrect sensor data readings, or failure to send. Alert are to mention but a few. Finally, user testing is conducted involving people with disabilities to ensure that the system is user-friendly and meets their needs effectively. This feedback is used to apply any needed modification or improvement to the system.

IV. CONCLUSION

Targeting further maximization of the quality of life for disabled individuals, this assistive system integrates a fully voice-controlled solution for real-time health monitoring and emergency alerting. An easy and reliable system to ride on and monitor health parameters endorses independence and safety for the users. The integration of these features into a system makes the users able to move freely while continuously monitoring their health and giving them timely assistance in the event of an emergency

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