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Design of a Smart wheelchair for disabled (handicapped) personnels using the Industrial Internet of Things (IIoT) approach

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Abstract: Intelligent Wheel Chairs are mechanical devices that let the person move around on their own. As a result, the wheelchair user needs to exert less energy and effort to turn the wheels. Furthermore, it enables visually or physically challenged individuals to go from one location to another. The wheel-chair also contains a system for recognising obstacles, which reduces the risk of mishaps when moving. In recent years, smart wheelchairs have piqued people's interest. These devices are particularly beneficial for getting from one location to another. The gadgets can also be utilised in nursing homes for elderly people who have trouble moving about. For people who have lost their mobility, the devices are a godsend. There have been several types of intelligent wheelchairs developed in the past, however, new wheelchair generations are being produced and put to use that have artificial intelligence and provide the user a few options. People with certain lifelong disabilities brought on by accident, paralyses, or old aged, sometimes rely on other people for assistance. Their independence is increased by giving them access to remote health care via a health monitoring system, since the doctor continuously keeps track of their health without making any effort. By going there the services online, they can only speak with their doctors directly in the event of an emergency. Intelligent healthcare systems assist impaired individuals because they cannot afford to go acquire entry to the medical systems. There are a lot of disabled people in the world today who have trouble moving around or going about their daily lives. These people are primarily reliant on other people for support. But they can become self-independent and accomplish some everyday activities on their own with the support of assistive gadgets. Wheelchairs are the assistive technology that is most commonly utilised. A wheelchair is essentially a chair with wheels that can assist those who are unable to walk due to disease, a disability, or an injury in getting around. However, many people with disabilities who have weakened joints and limbs are unable to manoeuvre the wheelchair. So they and the rest of society can greatly benefit from smart wheelchairs. Smart wheelchairs are electric-powered wheelchairs with numerous additional features, including computers and cameras. By developing a health monitoring system based on a smart wheelchair that can accommodate more users and doesn't need as much upkeep as wearable technology does, it may be possible to track their health status. Smart wheelchairs prioritise both the user's and the patient's health monitoring in addition to the wheelchair's mobility. The current work's goal is to create a smart sensing by adding sensors to the wheelchair's frame. The project also intends to create a similar wheel chair that is intelligent and so assists the user in their movement.

Keywords: Wheelchair, Sensors, Self-independent, Intelligent healthcare system, DC motors, Battery, Raspberry pi, etc..

1. Introduction Remarks

In this section, a brief introduction to People with impairments are unable to move, smart gadgets provide them with access to healthcare systems. A conceivable method of keeping track of the patient's health by creating a health-monitoring system, you can improve your situation. The current project's goal is to create a low-cost by incorporating a microcontroller-based smart wheel chair to detect health problems, attach a health monitoring device to a normal wheel chair. Using heart rate and breath to detect any cardiovascular abnormalities By sending the alert, you can rate and alert certain cell phone users over the cellular network, a signal is sent. Persons with impairments cannot afford for travelling, intelligent devices allow them to obtain healthcare services. One method of monitoring the patient's health is by creating a monitoring system. By fusing a regular wheelchair with a microcontroller-dependent health monitoring system, the objective of this research is to produce a low-cost smart wheelchair [1][2].

Physically challenged people with various physical disabilities encounter numerous challenges in their day-to-day lives when it comes to commuting from one location to another, and they may even have to rely on others to get from one location to another. Over the last few years, there have been numerous substantial initiatives to construct smart wheelchair platforms that would allow a person to operate it with simplicity and without ambiguity [1].

A Smart Wheelchair is a Power Wheelchair that has numerous sensors, assistive technologies, and computers to help a user with a disability, such as an impairment, a physical disability, or a permanent injury, with the mobility needed to go freely and safely. Traditional wheelchairs are rapidly being replaced by these sorts of wheelchairs; nevertheless, their high costs preclude a huge number of disabled individuals from owning one. Only 5 to 10% of the world's 100 million disabled individuals have access to wheelchairs, according to the World Health Organization (WHO) [24].

As a result, we must supply a cost-effective Smart that not only reduces costs but also has a variety of features that utilise the most up-to-date components and technology. Many pleasant attempts had been made in the current scenrios to achieve this goal. They've used artificial intelligence in the construction of an autonomous wheelchair that navigates using machine learning concepts, and some have also used Internet of Things technology to control the wheelchair using a voice recognition system [24].

1.1 IOT- Internet Of Things

The definition of the Internet of Things is the extension of Internet connectivity into physical objects and everyday objects as a result of the advancement of many technologies. The Internet of Things is enabled by technologies such as embedded systems, wireless sensor networks, control systems, and automation, including building and home automation. The IOT ecosystem is made up of web based intelligent components equipped with high technology based sensing devices, CPUs & the h/w that gathers, share, and act on data collected from their surroundings. Although these gadgets can be interacted with, the majority of them operate without human intervention [3][4]. A smart wheelchair is a power wheelchair (PWC) that records the driver's actions and interactions with their surroundings. This is accomplished by placing sensors and/or cameras in strategic locations to provide feedback on a driver's ability to control the gadget and safely traverse their surroundings [5][6].

1.2 Embedded System

A computing system that is programmed and controlled by a real-time operating system to carry out a function in an embedded context is known as an embedded system. An embedded system's design is tailored to the needs and specifications of the user. A computer board is included, which is linked to an input/output. The application programme can use the functionalities provided by the embedded operating system to offer the desired functionality. Hardware, application software, and the real-time operating system, which gives the processor the means to carry out the operation, are the three key elements of an embedded system.

The RTOS establishes a group of rule based approaches for the application program's execution. As a result, an embedded system is a microcontroller system controlled by a real-time control system and driven by trustworthy software. The key benefit of employing embedded systems is that they provide improved performance at a reasonable value having power consumptions very very low which could be adjusted very easily using variable devices. Embedded system/s, on the other hand, take a longer time to establish themselves in the market & a significant amount of developmenta; efforts.

Embedded systems had been widely accepted in the medical industry, and doctors employ them in a variety of ways. They can be utilized as a preventative medicine tool by allowing patients to self-treatments. Embedded systems had also improved prosthetics by delivering innovations to prosthetic technician. Doctors can keep track of their patients by remotely monitoring them using the IoT's and an expanded inter-network. Users have been more proactive about their personal health as a result of smart technology-based embedded medical devices.

Clinicians have expressed a significant need for the service that a intelligent wheel-chair may provide, according to a recent poll. The following are some of the most important survey findings: According to clinical estimates, 10–20% of patients who receive power wheelchair training find it extremely difficult or impossible to use the wheelchair for daily activities. When patients were particularly questioned about steering and manoeuvring tasks, the percentage of patients who responded that they were challenging or impossible rose to 50%.

80 % of the doctors who responded said they saw a number of patients every year who are unable to utilize a power wheelchair due to a lack of motor based skillsets, strengths, or visual acuities. 32 percent of these doctors (27 percent of all respondents) said they saw at least as many patients who are unable to utilize a power wheelchair. According to the professionals who treat them, over half of the patients who are unable to manoeuvre a powered wheel-chair using traditional ways might benefit from an automated navigation system.

2. Literature Survey

The majority of the studies under review include driving and steering aspects of smart wheelchair control. The topic of controlling a wheelchair with a variety of methods—including brain waves, tongue-driven systems, face movement control, hand gesture control, etc.—is covered. A Health Monitoring System that may be fitted into a wheelchair and uses a range of sensors was only briefly discussed in a few articles. There is a research opportunity due to the accessibility of inexpensive sensors and the paucity of thorough research on health-monitoring smart wheelchairs. The choice of a wheelchair is difficult and reliant on a variety of elements, such as the disease, morphology, rate of evolution, and environment of the user (at home, in the office, etc.).

As a result, there is no such thing as a "model" wheelchair. As a result, the wheelchair is chosen based on both financial and technological considerations. Where one force sensor is positioned in each pressure zone, the position of every force sensor could be found out. Temperature sensors are connected in the same way as force sensors are connected, with a temperature sensor placed directly in front of each pressure sensor. Many studies have shown that a smart wheelchair can provide the most help to its user.

Survey-1

A survey conducted by Agnes Ghorbel, Nader Ben Amor, Md Jallouli on controlling smart wheelchair (2014)

Advantages: - This method is based on sending signals to a device using air pressure by inhaling and exhaling into a straw mounted on wheelchair

Disadvantages: - By this method It can be moved only front and back and completely dependent on respiratory system

Survey-2

A Smart Wheelchair Prototype Controlled by Head Movements by Richard C Simpson – Norway University (2015) Advantages: - it is based on control through head movements

Disadvantages: - To be successful they have to keep the head stable otherwise it will lead to a different direction

Survey-3

A survey conducted by Phaeton Northeastern University, U.S. (2018)

Advantages: - User controls wheelchair through deictic interface, user chooses object from video screen that wheelchair then uses as target.

Survey-4

Disadvantages: - There will be no random movement or on spot go due to it choose and target working mechanism, which may greatly effect during emergencies

Survey-5

Smart Wheelchair Toyohashi University Japan (2017)

Advantages: - Omnidirectional wheelchair that uses force feedback joy-stick for preventing the collision of the wheel-chair with the obstacles
Disadvantages: - It works only if the person has proper hand movements which is required for the movement of joy-stick and also evenly dependent on another person due to its lack of navigation/assistance system.

Survey-6
A survey on Smart Wheelchair Kanazawa University, Japan (2017),
Advantages: uses time-of-flight calculations from ultrasonic beacons to pinpoint its location. provides autonomous navigation using location information.
Disadvantages: Prototype does not provide obstacle avoidance.

3. Overview

In recent years, smart wheelchairs have received a lot more attention in comparison to power wheelchairs. Traditional/manual wheelchairs that are powered by a battery or electricity are known as power wheelchairs. They are largely deficient in terms of functionality and safety features. Smart wheelchairs, on the other hand, have functionality and safety features. Typically, a smart wheelchair contains an electrically propelled wheel-chair with a computer and numerous sensors. The advancement of artificial intelligence, computing, and robotics has resulted in the growth of smart wheelchairs.

A smart wheelchair is made up of a computer that controls the movement of the wheelchairs using inputs from sensors. Sensors acquire data from the environment, which is then processed by a computer and the necessary procedures are conducted. The user can also control the smart wheelchair manually. Smart wheelchairs are currently available on the market, but they are out of reach for most people. Because they are driven by high-capacity batteries and high-torque motors, the price of the product rises accordingly.

A person who is 90–95 percent handicapped cannot drive the wheelchair because the motion is given by a Joystick and Toggle switch. As a result, these individuals require the presence of a companion or a caregiver. The most common type of wheelchair used by laypeople is the manual or traditional wheelchair. Because a middle-class individual cannot buy a power wheelchair, they must rely on the manual wheelchair. These chairs will be manually operated, which will make it difficult for the disabled to move from one location to another without assistance.

As a result, smart wheelchair upraises must be used to replace power and regular wheelchair upraises in order to provide more maneuverable motion to the wheelchair. Smart wheelchairs have been developed to assist users with navigation in a variety of ways, including ensuring collision-free riding, assisting with specific tasks (e.g., passing through doorways), and autonomously transferring the user between sites. Pictorial representation of the proposed module is shown in the Fig. 1.

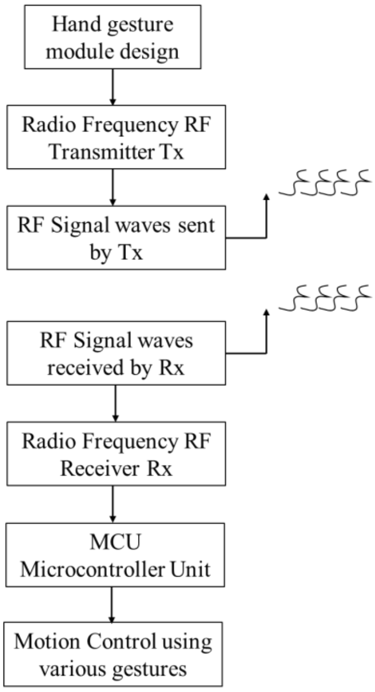

Fig 1: Pictorial representation of the proposed module

4. Research Objectives

This paper address the five important research objectives' which are listed one after the other as follows.

- Gesture controlled wheel chair
- wheelchair control through eye blinking
- voice controlled smart wheel chair
- wheelchair guidance and assistance system
- wheelchair fall detection

5. Literature Survey

The results of previous studies under review include driving and steering aspects of smart wheelchair control. The topic of controlling a wheelchair using a variety of methods—including brain waves, tongue-driven systems, face movement control, and hand gesture control—is covered. A Health Monitoring System that may be fitted into a wheelchair and uses a range of sensors was only briefly discussed in a few articles. There is a research potential due to the accessibility of inexpensive sensors and the paucity of in-depth research on health-monitoring smart wheel-chairs.

The selection of a wheelchair is challenging and dependent on a number of factors, including the user's pathology, morphology, rate of evolution, and surroundings (at home, in the office, etc.). As a result, there is no such thing as a "model" wheelchair. As a result, the wheelchair is chosen based on both financial and technological considerations. Where one force sensor is positioned for every zonal pressure area, then the force sensor (each one) in the module could be identified [7][8].

A overview of the various types of smart wheel chairs is accessible in Sibai & Manap's research work. They also talk about joy-stick steering's, head / chin / tongue movements, and gaze / face direction on the HMI. Sip and Puff Technology, EEG (Brain Signals), Voice Input, Hand Gesture Control, Navigation Methods & Devices, and Future Work on Health Monitoring are all discussed in the study. For those with severe disabilities, Kim et al. discuss a Smart Wheel Chair with a Tongue Driven System (TDS). Purnomo et al., explore upcoming technologies and recent developments in Pervasive Biomedical Engineering [9][10].

6. Methodology

In this section, the proposed methodology for the wheel chair control & design is presented as follows. Required equipments to make a smart wheel chair is mentioned as below [11][12].

a) Arduino UNO
b) Motor Driver
c) Bluetooth Module
d) Ultrasonic Sensor
e) DC Motor
f) Lipo Battery
g) Breadboards
h) LEDs

The following disabilities we are incorporating in our wheel chair. The disabilities that require wheelchairs are [13][14]

a) Alzheimer's Disease.
b) Amputations.
c) Amyotrophic Lateral Sclerosis (ALS)
d) Cerebral Palsy (CP)
e) Diabetes.
f) Multiple Sclerosis (MS)
g) Muscular Dystrophy.
h) Parkinson's Disease.

6.1 Gesture Control

This project was created with the goal of allowing physically disabled persons to navigate and move around their homes without the assistance of others. The current structure of the project involves using hand gestures as commands to control the wheelchair. As we saw in this module using the RF receiver transmitter module, the method can be used wirelessly. The wheelchair's mobility is currently controlled by a microcontroller (Arduino Open Source Prototyping Platform). The hand gesture method is used to explain how the complete system operates in the block diagram below [15][16].

6.2 Through Eye Blinking

The integration of hardware and software is the objective here. The essential data must first be sent to the computer from the hardware once it has observed the environment. The data must then be analysed by computer software to determine whether it is necessary and, if so, where the wheel-chair should be pointed [17][18].

6.3 Voice Controlled Strategy

At the side of the Bluetooth module, the voice controller is paired with an Android smartphone. BT Voice Control for Arduino is supported by Android smart phones. This application programme sends voice commands to the microcontroller using the internal voice recognition of an Android phone. When paired with Bluetoothed Serial Module, the detected speech is sent in as a string. We can supply audio input like forward, left, right, back, as well as line follower inputs to go to certain sections of the hospital while the android device is coupled with the microcontroller (ATmega328) through Bluetooth. The Bluetooth device in the microcontroller portion is used to receive the data string sent by the Android phone. These string inputs are processed by the microcontroller and output through PWM pins [19][20]. Flow chart (DFD) of the assistance & navigation system is shown in the Fig. 2.

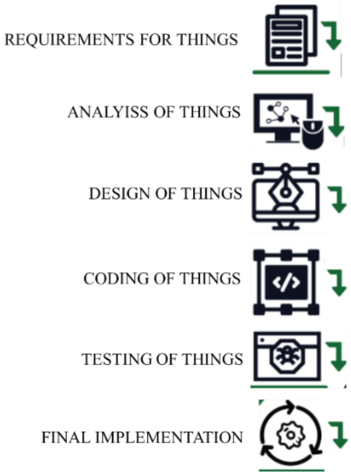

Fig. 2: Flow chart (DFD) of the assistance & navigation system

6.4 Guidance & Assistance System

The waterfall model is a conventional system development life cycle that employs a linear and sequential approach for system design. This model derives its name from its methodical progression, flowing downward from one phase to the next. Notably, the waterfall model does not outline a process for revisiting a prior phase to accommodate changes in requirements. It stands as one of the earliest software development approaches [21][22]

6.5 Fall Detection Strategy

The smart wheelchair that will be developed consist of a start button. When the start button is pushed, the whole system will start function. All the sensors from the smart wheelchair will start its own program. Each of the sensors had set a threshold value. The sensor that will be used in the system is accelerometer with a gyroscope sensor and FSR402 Round Pressure Force Sensitive Resistor Sensor [22][23].

7. Implementation

A triple axis accelerometer sensor was used to prepare the hand gesture module (ADXL 335). The low-cost sensor offers information about the hand's orientation, which aids in the recognition of gestures. The accelerometer sensor detects the accelerating force (gravitational acceleration, or g) and outputs a specific voltages for the three coordinate orientation axes (x y z). The data may be viewed in integer formats on the computer's serial monitor via the MCU's serial port, and the hand orientations can then be sorted out accordingly [24][25].

The camera will begin to capture images for the eye blinking technique. The Haar cascade algorithm is used to recognise the face and eyes. Following the recognition of the face, the algorithm will try to locate the eye within the face and draw a rectangle box around it. The system's ultimate purpose is to detect the eye pupil and establish its centre points, which is accomplished by capturing many photos and using processing techniques [26].

To code the controller, we had used the embedded "C" on the Arduino IDE platform. The BT voice controlled android application performs the voice control operation. This application programme sends voice commands to the microcontroller using the internal voice recognition of an Android phone. When paired with Bluetooth Serial Modules, the detected voice is sent in as a string. While the Android device is connected to the microcontroller through Bluetooth, we may provide audio input such as forward, left, right, and back as well as line follower input.

The Wheelchair Guidance & Assistance System informs users about basic and vital services in their area. First and foremost, the user must grant location access. After the user accepts the permissions, the app obtains the user's current location coordinates as well as data relevant to their position. The location of the user can even be changed. Following that, data such as Wheelchair, Toilet, Police, Hospital, and so on will be displayed. All of these locations are marked on the map with a google map marker that includes their name and category.

The IoT-based system for detecting wheelchair falls comprises two integrated sections: the first section focuses on wheelchair fall detection and monitoring, while the second section involves the graphical user interface.

8. Results & Discussions

After all of the components are combined, we have a working skeleton model for the wheelchair. According to the hand movements, the wheelchair model works properly. Fig. 3 gvies the prototype of the wheel chair (Similar one will be designed & built by us). Fig. 3 gives the prototype of the wheel chair (Similar one will be designed & built by us).

Fig. 3: Prototype of the wheel chair (Similar one will be designed & built by us)

The Eye Blink sensor-controlled wheelchair has been successfully designed. The design shown enables for wheelchair control using a variety of hardware and software components, resulting in an efficient system. The Fig. 4 gives the eye blink sensor design.

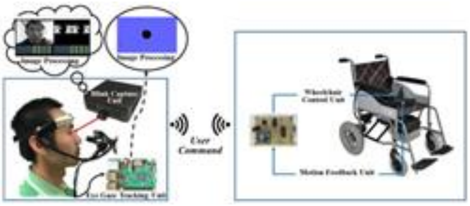

Fig. 4: Eye blink sensor design (Similar one will be designed & built by us)

The wheelchair that is operated by voice commands has been designed successfully. The design provided allows for wheelchair control using a variety of hardware and software components, resulting in a functional system. The process of control & navigational guidance is shown in the Fig. 5.

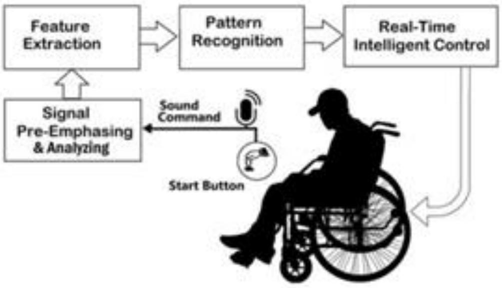

Fig. 5: Control & Navigational Guidance (Similar one will be designed & built by us)

Helps disabled people in locating wheelchair accessible or handicapped-accessible facilities in their area.

Fig. 6: How to stay independent with the help of the wheel chair (Similar one will be designed & built by us)

The Fig. 6 gives an idea of how to stay independent with the help of the wheel chair. When the system detects a fall, the warning system is activated. The buzzer will sound, and the collected data will be analysed before being transferred to the IoT platform. The blink mobile application was used to achieve the second and third objectives. The wheelchair's location was determined using a Google map. The Fig. 7 gives us an idea of how to develop a fall detection system.

Fig. 7: Fall detection system development (Similar one will be designed & built by us)

9. Block Diagram

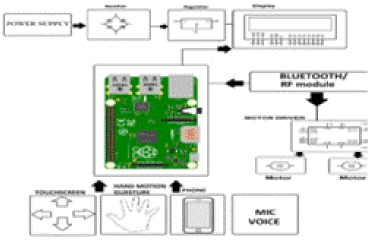

Fig. 8: Block diagarm of the smart wheel chair for the disabled persons

The block diagram consists of Raspberry pi 3.0 shown in the Fig. 8, GSM Module and antenna, Mobile Phone, Bluetooth module, L293D Motor driver, Hand gloves, LCD Display, Power supply. It includes PCB boards that have a programme controller, a Bluetooth or RF module, a display, a power supply, motor drivers, a mobile phone (App), and other components. The signals for hand gesture control come from gloves that are placed on the receiver's hand, and the command is followed by the movement supplied by the person. The wheelchair is connected to the computer for voice control. Bluetooth mobile app and user commands, the wheelchair begins to move in response to the message to it.Antenna is utilised for the precise location in fall detection. where the fall happened, when it happened, and how it happened. Fall detection has already occurred and is now shown on screen will display its position as well as the GPS location will be messaged to the user who registered.

10. Objectives

Hand Gesture Controlled Wheelchair

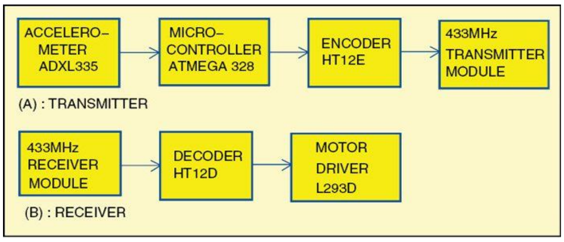

Fig. 9: Block diagarm of the hand gesture controller

The working of wheelchair is controlled by hand gesture shown in the Fig. 9, as we hold the transmitter in our hands, the wheelchair moves in accordance with our hand motions. When we tilt our hands forward, we begin to move ahead and keep going until the next command is delivered. When we move our hands in a reverse direction, they change state and begin to move backwards until another command is issued.

It turns left until the next command when we tilt it to the left. When we tilt our hands to the right, they turn to the right. We must maintain firm hands in order to stop the robot. To reduce assembly errors, mount all components on the PCBs displayed below. Attach the 4.5V battery and receiver PCB to the robot's chassis. Fix a castor wheel on the front of the robot and two motors, wheels, and wheels at the back.

Remove the microcontroller from the Arduino Uno board after the main code has been uploaded there, and place it into the populated transmitter PCB. Now turn on the power supplies in the reception and transmitter circuits. Your hand should be attached to the transmitter circuit, and you should move your hand in all directions. Table I has movement instructions for the robot. If you maintain your palm horizontal and parallel to the Earth's surface, the robot will come to a stop.

Voice Controlled Wheelchair

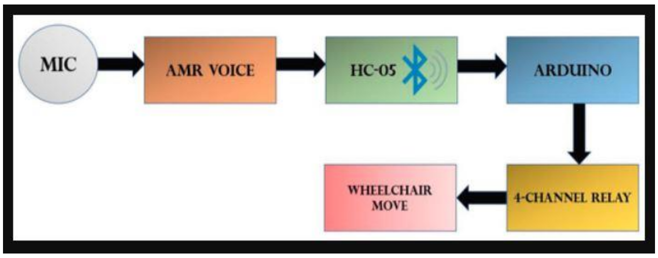

Fig. 10: Block diagarm of the voice controlled wheel chair

The voice recognised by the Bluetooth module using the AMR voice command Application controls the wheelchair's movement. The Bluetooth module and the AMR Voice application must first be connected. The app will be accessible through the iOS App Store and Google Play Store. The application will cause it to move in the FORWARD, BACKWARD, RIGHT, and LEFT directions as needed to meet the needs of the user. Using an application once more, the user must command stop in order to stop a wheelchair from moving. Fig. 10 gives the block diagarm of the voice controlled wheel chair

Here, the performance of the microcontroller and microphone is managed by a voice recognition module. Giving the five commands trains the voice recognition module. A hex file containing the five commands is created. These hex files identify 5 microcontroller address locations. When a command is sent, the software executes in the appropriate location, controlling the motor's movement or rotation. This is how the "voice controlled wheel chair" functions on a basic level. The voice recognition module receives a voice input through an address, executes the location, and moves the chair accordingly. For power supply, the battery and battery charger unit is present.

Fall detection of Wheelchair

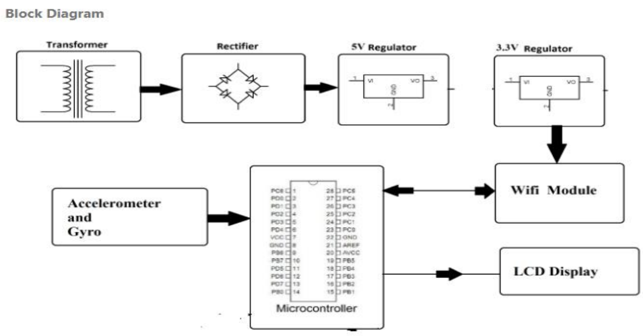

Fig. 11: Block diagarm of the fall detection of wheel chair

The gadget can be installed on a person's hand or wheelchair to detect motions and uses an accelerometer and gyro sensor to do so. To communicate the acceleration data continuously, the sensor is wired to a microcontroller. The system is currently watching for falls and sudden changes in a person's mobility. A quick shift that causes the system to jolt is handled as a fall. And if a fall occurs, a notification and the location of the wheelchair will be sent to the registered person or user using a GSM module and antenna. It becomes vital to keep an eye on our elderly relatives' health and safety as they age. They are at a high risk of falling because of their frailty and weak joints. Fig. 11 gives the block diagarm of the fall detection of wheel chair.

In order to provide prompt assistance to an elderly person who has fallen, it is increasingly crucial to identify if they have. Additionally, wheelchair users must be monitored for signs of a fall. We suggest a sophisticated fall detection system to achieve this goal. The gadget can be installed on a person's hand or wheelchair to detect motions and uses an accelerometer and gyro sensor to do so. To communicate the acceleration data continuously, the sensor is wired to a microcontroller. In the event that the individual did not fall and the alarm was false, the system now allows the user to snooze the alert if they touch the snooze button within 5 seconds. The system detects when a person has fallen and immediately notifies their loved ones over wi-fi if they don't use the snooze button..

11. Applications, Advantages, Outcome and Limitations

Applications:

Mobility: A suitable wheelchair gives the user the freedom to move around, enabling them to engage in everyday physical activity as they go about their daily lives, boosting their overall levels of physical activity and day-to-day mobility. Additionally, it gives people the best chance at independence and the freedom to pursue their interests. It also increases comfort and encourages an active lifestyle while enabling people to move around their homes more readily.

Independence

The health of a wheelchair user can be enhanced in numerous ways. Increased levels of physical exercise can improve both physical and mental health when a wheelchair is practical, comfortable, and effectively propelled. Pressure sores, the advancement of deformities or contractures, and other secondary conditions linked to poor postures can be decreased with the use of a well fitted wheelchair with cushions and thorough user training. Proper postural support can also lead to additional advantages like enhanced head, trunk, and upper extremity control as well as general stability.

Self esteem & self confidence

High self-esteem in people with disabilities is connected to numerous favorable health outcomes, including decreased depression and greater life satisfaction and well-being. Self-esteem is defined as a general evaluation of one's self-concept or sense of personal value and sufficiency. It has been demonstrated that wheelchairs have a significant impact on participation and quality of life. When a wheelchair, which is frequently seen as an extension of the user's body, fits them and they can use it well, the user may feel more confident and have higher self-esteem. However, the weight and dimensions of the chair have an impact on the user's ability to move around the house and the community.

Quality of life

Increased access to chances for employment, education, and community involvement are all benefits of maintaining good health. These elements also improve the quality of life for wheelchair users.

Economy

A wheelchair can frequently mean the difference between being an active participant and a passive receiver. When users have access to options for work and education, the economy benefits. Without a wheelchair, a person may remain isolated and be a burden to the family and the country as a whole. With a wheelchair, a person can work and contribute to the family's income and the national economy.

Advantages

- Easy to operate
- Single equipment is equal to multiple applications
- It is portable and hence can be placed anywhere
- The micro controller can be reprogrammed if any modification is required
- No need of lengthy wires
- Capable of controlling wheelchair motion for disabled persons using hand gesture or through by voice recognization
- Spontaneous output

Outcomes of the project work

The project displays a mockup of a smart wheelchair that can be operated by voice commands, hand gestures, and wheelchair fall detection with GPS position. When a wheelchair is hand gesture controlled, it moves in accordance with the user's hand movements. The transmitter is attached to the user's hand gloves.

A voice-activated smart wheelchair responds to user-given commands like right, left, back, front, and stop. The accelerometer and gyro sensor used in the fall detection system are installed on a person's hand or wheelchair to detect movement. For different movements as needed by an individual, which functions more intelligently. Additionally, it is user-friendly because it produces spontaneous output while minimizing physical effort and human engagement.

Financial barriers

Around 80% of the world's population with disabilities reside in low-income nations. Most of them are impoverished and lack access to basic services, such as rehabilitation centres. According to the International Labour Organization, several developing nations have unemployment rates for people with disabilities that are as high as 80%. The majority of users are unable to afford wheelchairs on their own because government assistance for their provision is rarely available.

Physical barriers

The majority of wheelchair users live in areas that are inaccessible and in poverty. Additionally, they reside in areas with weak road infrastructure, little pavement, and frequently terrible climatic conditions. Public and private facilities can often be challenging to enter in a wheelchair. The strength and durability of wheelchairs The strength and durability of wheelchairs are further strained by these physical obstacles. Additionally, if users are to be mobile, they must exercise a high level of competence.

Access to service

Only 3% of those with disabilities who need rehabilitation services can obtain them in many developing nations. In 62 nations, there are no national rehabilitation services available to individuals with disabilities, according to a report by the United Nations Special Rapporteur. This indicates that a large number of wheelchair users are at danger of secondary problems and early death, both of which might be prevented with appropriate rehabilitation programmes.

12. Conclusive Remarks

This project shows a wheelchair model that can be operated by hand gestures, eye blinking, vocal commands, fall detection, and navigation help. The sensor is utilised to control the wheelchair, making it more intelligent and user-friendly by decreasing human activity and physical strain while also providing spontaneous output. We've employed numerous facial actions, such as sipping and puffing, to control the wheelchair. Other devices, such as Bluetooth and ZigBee, could be used to communicate with various devices.

Research activities have begun to investigate various mechanical replies in order to improve human administrations process of action in a way that complements existing organizations by utilising the IoT's potential. The proposed structure lays out clear research techniques for how the Internet of Things may help with pediatric and senior care, continuous disease monitoring, private prosperity, and health management. To gain a better understanding of IoT social protection security, we looked at a variety of security requirements and proposed a model that can help mitigate security risks. Overall, the survey's findings are expected to be beneficial to researchers, engineers, prosperity experts, and politicians working in the field of IoT and social protection advancements.

We have a prototype that can be controlled with an accelerometer sensor, DTMF decoder, control over the internet, or voice at the conclusion of project phase 2, which is scheduled for the eighth semester. The perception system, which uses sensors to detect obstacles in the wheelchair's immediate vicinity, has been deployed successfully. The sensors are also employed for the elevation and depression sensing. Every programme has been created in PYTHON3 and is operational. The raspberry pi provides power to the prototype's motors. The motors on the Raspberry Pi are driven by a motor driver IC and can be powered by a battery or an adapter with a voltage range of 5V 750 -1250 mA. (L293D).

According to inputs from the relevant device, this IC receives control signals. Through the web server (WebIOPi) that the Raspberry Pi runs, the website can operate the device. We will soon need to merge all the components into a single software. In order to accommodate all use cases and patient demands, several programmes must be built that allow the patient, the caregiver, or anyone else to have full control of the chair. The wheelchair hardware is available in the mechanical sector. The necessary motor skills are being assessed. The wheelchair will then incorporate the control modules. A wheelchair-specific application created by computer science students is available for download on any Android smartphone.

The Raspberry Pi must receive a signal from the wheelchair's wheels measuring their speed in order for the Raspberry Pi to stop powering the wheels in the event that one wheel stops moving due to physical restraint. This could result in dangerous circumstances. The feedback mechanism ensures the speed and stability of the wheel in addition to the programmes created for the prototype. Various modules must receive power distribution. The vital signs monitor that has been constructed has to be put on the Raspberry Pi in order to boost the wheelchair's functionality. Indoor mapping should also be added.

Due to the SPI and I2C interfaces on the Raspberry Pi, any number of sensors can be added. The Raspberry Pi can be connected to eight MCP23017 port expander ICs, each of which supports 16 GPIO pins. There are now 128 extendable GPIO pins in all. This is advantageous since the same controller may be used to address any subsequent requirements. As a result, we have successfully used our master controller to manage the wheelchair's mobility. Our wheelchair is very smart thanks to all of these features.

13. Advantages & Scope for Future Works

In this section, the advantages of the system developed is presented as follows. It will provide the patient independence, allowing him or her to go around without needing to be pushed in a wheelchair and without the nurse being present all of the time. It will provide back support and encourage proper posture.

Internet of things

A scenario in which physical objects can actively participate in business activities and are easily incorporated into the information network. There are services available to communicate with these "smart things" over the Internet, query and update their status and any associated information, while taking security and privacy concerns into consideration. Smart wheelchairs can be a part of the internet of things and assist patients with household tasks like paying bills and other professional tasks.

Home Automation

The raspberry pi can automate the patient's environment and house to increase their comfort. Doors, for instance, may be operated from a wheelchair. On the wheelchair, lighting controls can be attached.

Vital Signs Monitoring

The patient's vital signs and condition can be tracked in real time, and the patient has access to and storage for his medical records.

Indoor mapping: It is possible to automate the wheelchair's movement to the specified location inside the mapped area by storing a picture of the floor plan of the house or hospital in the controller.

Feedback system

If a wheel cannot move because of physical constraints, the controller must be informed immediately. Otherwise, it will power the other wheel, which will result in malfunction. A feedback mechanism can let the controller know how the wheel is doing.

Solar battery chargers

Thanks to technological advancements, lightweight solar panels can be mounted on wheelchairs to provide power for their various batteries.

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