Smart Wheelchair for Old and Disabled

Prof.Sandip Shrote
Associate Professor,
Dept, of ECE, MITSOES
MITADT UNIVERSITY PUNE
Sandip.shrote@mituniversity.edu.in

Madhura Mane
U.G. Scholor,
Dept, of ECE, MITSOES
MIT ADT UNIVERSITY, PUNE
madhuramane666@gmail.com

Shashank Pandey
U.G. Scholor,
Dept, of ECE, MITSOES
MIT ADT UNIVERSITY, PUNE
shashankpandey27489@gmail.com

Aditya Kalbhor
U.G. Scholor,
Dept, of ECE, MITSOES
MIT ADT UNIVERSITY, PUNE
adityakalbhor8999@gmail.com

ABSTRACT

To develop a wheel chair control which is useful to the physically disabled person with his hand movement or his hand gesture recognition using Acceleration technology. It is wheelchair which can be controlled by simple hand gestures. It employs a sensor which controls the wheelchair hand gestures made by the user and interprets the motion intended by user and moves accordingly. In Acceleration we have Acceleration sensor. When we change the direction, the sensor registers values are changed and that values are given to microcontroller. Depending on the direction of the Acceleration, microcontroller controls the wheel chair directions like LEFT, RIGHT, FRONT, and BACK. The aim of this project is to implement wheel chair direction control with hand gesture reorganization

Keywords

smart wheelchair, sensor,mobility aid, Accelerometer

1. INTRODUCTION

For handicapped patients: Some patients that cannot manipulate the wheelchair with their arms due to a lack of force. The wheelchair is operated with the help of accelerometer, which in turn controls the wheelchair with the help of hand gesture. The wheelchair moves front, back, right and left. Now with the Hand Gesture Controlled Wheelchair the handicapped person is independent and he need not to ask for help from any other person to move his wheelchair. Just with the movement of his hand the handicapped person is able to move from one place to another without needing anyone's assistance which also makes him self-dependent. Accelerometer would yield an autonomous device small enough to apply to the fingernails, because of their small size and weight. Accelerometer are attached to the fingertips and back of the hand. Arrows on the hand show the location of accelerometer and their sensitive directions, that the sensitive direction of the accelerometer is in the plane of the hand. The gesture based wheelchair is suitable for the elderly and the physically challenged people who are unfortunate to have lost ability in their limbs due to paralysis or by birth or by old age. Elders find it tough to move inside the house for day-to-day activities without help or external aid. Our proposed system makes use of a wheelchair that can be used by elderly or physically needed. The voice stored in IC could be sufficient to analyze speaker's voice Command. Various safety measurements can also be installed on wheel chair like GPS system to track the wheelchair and its user.Electric Smart Wheelchairs are a type of assistive technology that has revolutionized the mobility of elderly and disabled people. These wheelchairs are designed to provide users with greater independence and flexibility by enabling them to move around more easily, comfortably and safely. This research paper aims to explore the benefits of electric smart wheelchairs for old and disabled people, their features, and the latest technological advancements in this field.

2. LITERATURE SURVEY

2.1.P. Upender, P.A. Harsha Vardhini, "A Hand Gesture Based Wheelchair for Physically

Handicapped Person with Emergency Alert System", 2020 5th International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT-2020), November 12th & 13th 2020. The developed system is capable to control the wheelchair motion for disabled people using hand gesture. Improvements can be made by using various body gestures such as eye gaze, leg movement or head movement accordingly. The switching operation for the mode selection that is either touch pad or accelerometer is separated by using a switch. This adds up to the efficiency of the wheelchair and reducing the cost and size of the system. The proposed wheelchair can be used in many applications such as hospitals, old age homes and airports etc.

2. 2 Priyanka Lokhande, Riya Prajapati and Sandeep Pansar Data Gloves for Sign Language Recognition
system 2015 International Journal of Computer Applications (0975 – 8887), National Conference on
Emerging Trends in Advanced Communication Technologies.

This proposed model is for sign language recognition using flex sensors. The project's heart, the
Glove, is where the sign language translator begins. The black glove has nine flex sensors, four touch sensors, one two-dimensional x-y-axis accelerometer, and one one-dimensional z-axis accelerometer.
The flex sensors are the most significant sensors since most letters can be recognized based on finger
flexes. All fingers, with the exception of the thumb, have two flex sensors, one at the knuckle and the other at the lower joint. As a result, these fingers can flex to two different degrees.

2.3 Smriti Prasad, Darshana Sakpal, Soukhya Rawool, "Head-Motion Controlled Wheelchair", 2017 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), May 19-20, 2017, India. This research paper is about head-motion controlled wheelchair that would provide the flexibility of navigation. The tilting movements of the head in the four directions- forward, backward, right or left- would cause the wheelchair to move in the signalled directions. This paper represents a novel approach to developing a headmotion controlled wheelchair and aims to replicate the electric wheelchair on a small-scale basis and show its working and advantages over other electric wheelchairs available in the market

2. Nida Riaz, Junaid Bin Aamir, "Electrical wheelchair with retractable solar panels" on the proceedings of Energy Systems and Policies (ICESP), 2014 International Conference. This research paper, emphasizes the need to use non-conventional energy like solar energy for powering the wheelchair. The system, as the author admits, has some portability issues. They may be addressed by the future technologies by reducing the size and weight of solar panels. In the present-day market, it is not cost effective either

3. METHODOLOGY

The electric smart wheelchair is designed to assist individuals with mobility issues. They are an essential tool for people who have difficulty walking, standing or sitting. Electric smart wheelchairs are motorized and can be operated with the help of anAccelerometer. The chairs are equipped with sensors that enable them to detect obstacles and avoid collisions. They can be used indoors and outdoors, making them versatile and convenient for usersResearch and User Analysis: Conducting research and user analysis to understand the needs and requirements of the target users. This step involves analyzing the physical, cognitive, and sensory abilities of the elderly and disabled people, and understanding their preferences and limitations.

Concept Development: Based on the user analysis, develop concepts for the electric smart wheelchair. This step involves brainstorming and sketching out several ideas, evaluating them based on the user needs, and selecting the most feasible ones.

Testing and Evaluation: Testing the prototype to evaluate its performance and usability. This step involves conducting user tests to assess the user experience, functionality, and safety of the wheelchair.

Refinement and Optimization: Based on the test results, refine and optimize the design of the electric smart wheelchair. This step involves making modifications and improvements to the design to address any issues or shortcomings identified during the testing phase.

Production and Manufacturing: Once the design is finalized, the electric smart wheelchair can be manufactured and produced. This step involves selecting the appropriate manufacturing methods and processes to produce the wheelchair at scale.

Marketing and Distribution: Finally, the electric smart wheelchair can be marketed and distributed to the target users. This step involves developing a marketing strategy, identifying distribution channels, and reaching out to potential customers.

3.1 BLOCK DIAGRAM

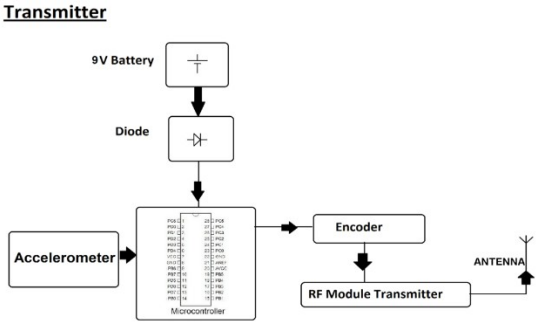


Fig 1: - BLOCK DIAGRAM

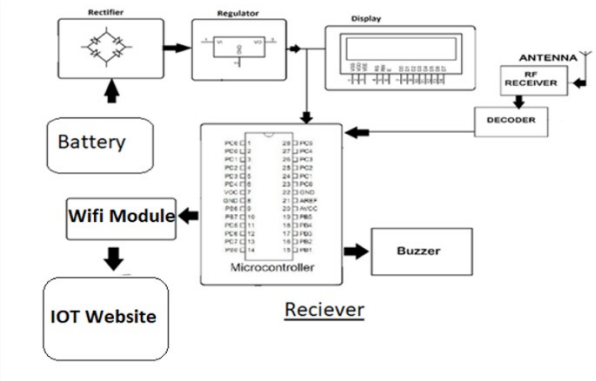


Fig 2: - BLOCK DIAGRAM

3.3 ADVANTAGES

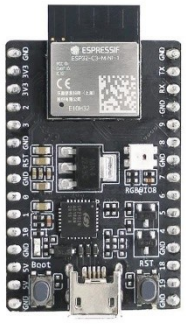
Smart wheelchairs offer a variety of advantages for old and disabled people, including:Improved mobility: Smart wheelchairs allow users to move around independently, which can greatly enhance their mobility and quality of life. With features such as joystick controls, voice recognition, and obstacle avoidance technology, smart wheelchairs can help users navigate their environment more easily and safely.Increased independence: By enabling users to control their wheelchair more effectively and with greater ease, smart wheelchairs can help people with disabilities and the elderly maintain their independence for longer. This can help boost their confidence and self-esteem, and reduce feelings of isolation or dependence on others. Customized features: Smart wheelchairs can be customized to suit individual needs, with options such as adjustable seating, specialized controls, and add-on devices such as communication aids or environmental control systems. This ensures that users can get the exact features they need to maximize their comfort and functionality. Improved health outcomes: With better mobilityand independence, smart wheelchairs can help improve overall health outcomes for users. Regular movement and activity can help reduce the risk of conditions such as pressure sores, obesity, and depression, and can help maintain muscle strength and joint flexibility. Better connectivity: Many smart wheelchairs are equipped withconnectivity features, such as Wi-Fi or Bluetooth, which can help users stay connected with family and friends, access online resources, and control other devices intheir environment. Overall, smart wheelchairs offer a range of benefits for old and disabled people, helping to improve their mobility, independence, and overall quality of life.

4. HARDWARE

Motors and wheels: These are the primary components that enable the wheelchair to move. Smart wheelchairs often feature advanced motor technology that allows for smoother and more precise movement, as well as better control over speed and direction.

Communication and connectivity systems: Smart wheelchairs may feature Wi-Fi, Bluetooth, or other connectivity options that allow the user to communicate with other devices or access online resources. Seat and backrest: The seat and backrest of a smart wheelchair are designed to provide maximum comfort and support for the user, and may feature adjustable features such as tilt, recline, or height. Additional features: Smart wheelchairs may include additional features such as automated doors, voice recognition software, or specialized control systems for people with specific disabilities. These features are designed to make the wheelchair more accessible and user-friendly for a wider range of people.

4.1 ESP32



the esp32 is a powerful microcontroller developed by espressif systems. it is a successor to the esp8266 and is designed to provide wireless connectivity for internet of things (iot) devices.

the esp32 features a dual-core processor with a clock speed of up to 240mhz, 520kb of sram, and 4mb of flash memory. it also includes built-in wi-fi and Bluetooth connectivity, making it an ideal choice for iot projects that require wireless communication.

in addition to its hardware features, the esp32 also has a rich set of software libraries and tools, including support for arduino ide, micropython, and freertos, which makes it easier to develop applications on this platform.

the esp32 is widely used in a variety of applications, including home automation, smart appliances, industrial automation, and more. its low power consumption, high processing power, and rich connectivity options make it a popular choice for iot projects of all sizes.

4.2 PIC18F4550 :

pic18f4550 is an 8-bit microcontroller manufactured by microchip with nano-watt technology with enhanced flash, usb, and high-performance. it is a 40-pin microcontroller that comes with several features such as memory endurance, self-programmability, extended instruction set, enhanced ccp module, and addressable usart and 10-bit adc (analog to digital converter). it consists of 4 timers or an external oscillator is interfaced for clocking purposes, 13 channels for adc, adc comparators, and other peripherals. it is convinient to program the pic18f4550 controller and easy to interface with many peripheral devices using 35 programmable i/o pins. with the feature of the usb interface, it provides hassle-free communication between the controller and the pc. the watchdog timer can be reset to use the systems without any human interface.

Features & Specifications:

It uses an 8-bit CPU with 12 MIPS speed and consists of 28 pins. The operating voltage is between +4.0 Volts to +5.5 Volts (where +5.5 Volts is the absolute maximum voltage)It has 24 programmable I/O pins and supports various communication interface. Type of communication interface: USB serial interface for programming the controller (pins 15 and 16); Master/Slave SPI Serial Interface is also for programming the controller (pins 7,18,21,22); Serial programmable UART for programmable (pins 17,18) and 2-wire serial interface used to connect peripheral devices like LCDs and sensors (pins 21,22). It has an ADC module with 10 channels and 10-bit ADC resolution. The timer modules contain one 8-bit and three 16-bit counters. It has 2 analog comparators and 2 PWM channels. The size of program memory or flash memory is 32 Kbytes (10K cycles for

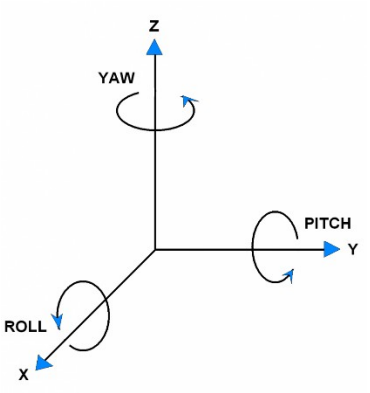
write/erase). The size of RAM is 2 Kilo bytes and the size of EEPROM memory is 256 Bytes. The watchdog timer is the programmable type with a separate on-chip oscillator.

4.3ADXL335

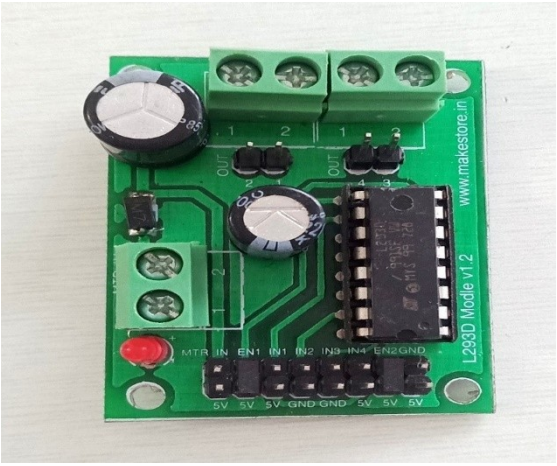
The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It is a capacitive accelerometer. It works on the principle that when the acceleration is applied to the sensor, the capacitance inside the sensor changes. This change in capacitance is then used to measure the acceleration of the object. It reads off the X, Y, and Z acceleration as analog voltages. By measuring the amount of acceleration due to gravity, an accelerometer can figure out the angle it is tilted at with respect to the earth. Rather than using additional temperature compensation circuitry, innovative design techniques ensure that high performance is built in to the ADXL335. As a result, there is no quantization error or nonmonotonic behavior, and temperature hysteresis is very low (typically less than 3 mg over the —25^{0}C to +70^{0}C temperature range).

FIG 5 :- ADXL335

We can calculate angle of inclination or tilt by using X, Y, Z's value. Also, we can calculate Roll, Pitch and Yaw angles with respect to X, Y and Z axis. So first we need to convert 10-bit ADC values into g unit.



4.4 L293D

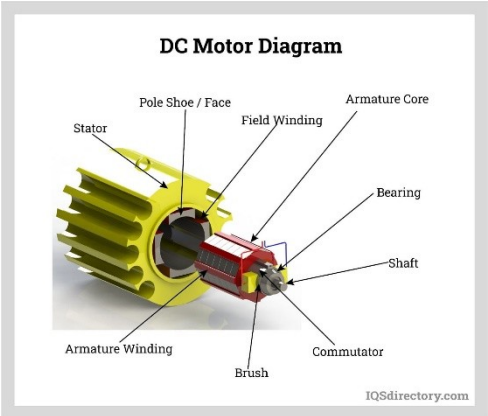


L293D is a typical Motor driver or Motor Driver IC. We use motor drivers to give high power to the motor by using a small voltage signal from a microcontroller or a control system.It is a dual H-bridge motor driver IC. One H-bridge is capable to drive a dc motor in bidirectional. It is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. The L293D is most often used to drive motors, but can also be used to drive any inductive load such as a relay solenoid or large switching power transistor. It is

capable of driving four solenoids, four uni-directional DC motors, two bi-directional DC motors or one stepper motor.

FIG 6: -DC MOTOR DIAGRAM

4.DC motor uses Direct Current (electrical energy) to produce mechanical movement i.e. rotational movement. When it converts electrical energy into mechanical energy then it is called as DC motor and when it converts mechanical energy into electrical energy then it is called as DC generator. The working principle of DC motor is based on the fact that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force and starts rotating. Its direction of rotation depends upon Fleming's Left Hand Rule. DC motors are used in many applications like robot for movement control, toys, quadcopters, CD/DVD disk drive in PCs/Laptops etc. In order to appreciate the benefits of DC motors, it is important to understand the various types. Each type of DC motor has beneficial characteristics that must be examined before purchase and use. Two of the main advantages of DC motors over alternating current (AC) motors are how easy they are to install and that they require little maintenance. DC motors are differentiated by the connections between the field winding and the armature. The field winding can be connected parallel to the armature or connected in a series. In some cases, the connection is both parallel and in a series. A further distinction of DC motors is how the rotor is powered; it can be brushed or brushless. In brush DC motors, current is applied to the rotor by brushes. In a brushless DC motor, the rotor has a permanent magnet. The main components of the DC motor are stator, shaft and the rotor.



4.6 DHT11

the dht11 is a commonly used temperature and humidity sensor. the sensor comes with a dedicated ntc to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. the sensor is also factory calibrated and hence easy to interface with other microcontrollers. the sensor can measure temperature from 0°c to 50°c and humidity from 20% to 90% with an accuracy of ±1°c and ±1%. dht11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. the humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. change in the capacitance value occurs with the change in humidity levels. the ic measure, process this changed resistance values and change them into digital form.for measuring temperature this sensor uses a negative temperature coefficient thermistor, which causes a decrease in its resistance value with

increase in temperature. to get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers. this sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation, and air conditioning systems. weather stations also use these sensors to predict weather conditions. the humidity sensor is used as a preventive measure in homes where people are affected by humidity. offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure. it's compact size and sampling rate made this sensor popular among hobbyists. some of the sensors which can be used as an alternative to dht11 sensor are dht22, am2302, sht71.

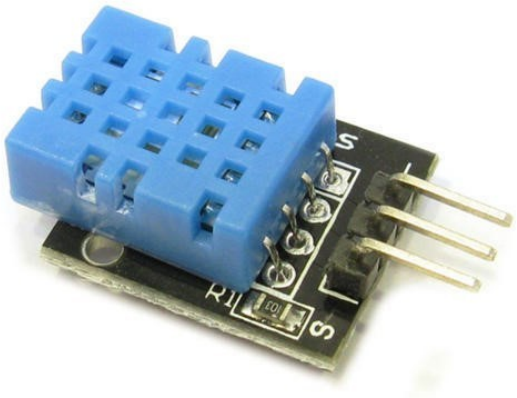
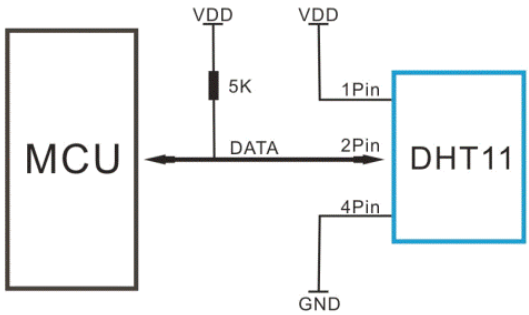
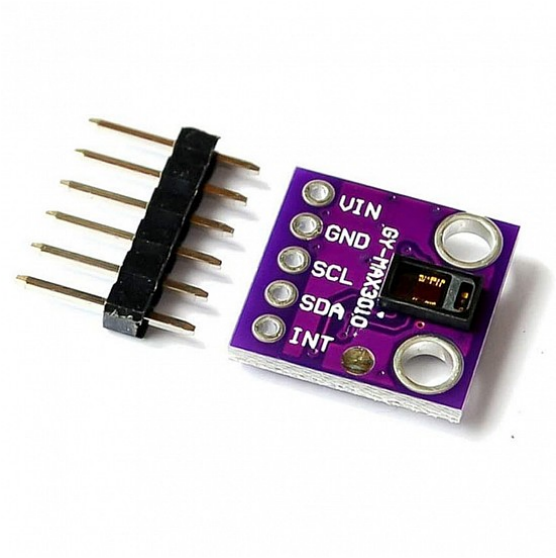


FIG 8: DHT11



5. MAX30100



MAX30100

The MAX30100 is a pulse oximetry and heart-rate sensor module developed by Maxim Integrated. It is a low-power, integratedsolutionthat uses reflective photoplethysmography to measure blood oxygen saturation (SpO2) and heart rate.

The MAX30100 uses a combination of red and infrared light to measure SpO2 by detecting the amount of light absorbed by oxygenated and deoxygenated blood. It also measures heart rate by detecting the pulsatile signal caused by blood flow in the arteries.

The module consists of an integrated LED driver, photodetectors, analog signal processing, and a digital interface. It is designed for use in wearable health and fitness devices, medical monitoring devices, and other applications that require accurate and non-invasive measurement of SpO2 and heart rate.

The MAX30100 is easy to use and can be interfaced with a microcontroller using the I2C interface. It has a low power consumption, making it suitable for battery-powered applications. The

module also includes built-in ambient light rejection and motion artifact detection, which helps to improve the accuracy of the measurements.The MAX30100 is an integrated pulse oximetry and heart- rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. It is an I2C-based low-power plug-and-play biometric sensor. It can be used by students, hobbyists, engineers, manufacturers, and game & mobile developers who want to incorporate live heart-rate data into their projects.

. CONCLUSIONS

The electric smart wheelchair is an essential tool for old and disabled individuals who have difficulty walking, standing or sitting. These chairs are equipped with advanced technologythat enhances the user's quality of life. They offer a range of benefits, including increased mobility, convenience, safety, comfort, independence, and ease of use. However, they also have some limitations that need to be considered, including cost, maintenance, battery life and weight.Overall, the electric smart wheelchair is an excellent tool for enhancing the quality of life for old and disabled individuals.Electric smart wheelchairs are a valuable addition to the mobility aids for elderly and disabled people. They provide numerous features and benefits that traditional manual wheelchairs cannot match. The development of these wheelchairs has made a positive impact on the lives of many people by improving their mobility, independence, and quality of life. As the demand for mobility aids increases with the aging population, it is essential to continue developing and improving electric smart wheelchairs to meet the needs of users.

Benefits of Electric Smart Wheelchairs:

Electric smart wheelchairs have a variety of benefits over traditional manual wheelchairs. They offer users greater independence, freedom, and flexibility, enabling them to move around more easily and quickly. Smart wheelchairs are also designed with advanced features like intelligent controls, automatic obstacle avoidance, and advanced seating options. These features provide users with greater comfort, safety, and convenience.

Some other benefits of electric smart wheelchairs are:

Automated navigation: The wheelchair can be programmed to navigate through different environments, using sensors and mapping technologies to avoid obstacles and find the best routes.

Remote monitoring: Caregivers or family members can remotely monitor the wheelchair's location and condition, ensuring that the user is safe and comfortable.

Improved Mobility: Electric smart wheelchairs are designed to provide users with greater mobility and flexibility. These wheelchairs can easily move over uneven surfaces and climb slopes, enabling users to explore their surroundings and enjoy their daily activities with greater ease.

Enhanced Comfort: Smart wheelchairs come with advanced seating options like adjustable backrests, headrests, and armrests. These features enable users to sit comfortably and reduce the risk of pressure sores, back pain, and other discomforts.

Increased Safety: Electric smart wheelchairs come with advanced safety features like automatic obstacle avoidance, anti-tip mechanisms, and

remote monitoring systems. These features ensure that users are safe and secure while using the wheelchair.

Features of Electric Smart Wheelchairs:

Intelligent Controls: Electric smart wheelchairs come with advanced control systems that enable users to control the wheelchair with greater ease. These controls can be operated by voice, joystick, or other input devices.

Automatic Obstacle Avoidance: Smart wheelchairs are designed with sensors that detect obstacles and automatically steer around them, preventing collisions and injuries.

Advanced Seating Options: Smart wheelchairs come with adjustable backrests, headrests, and armrests, which enable users to sit comfortably and reduce the risk of pressure sores and other discomforts.

Remote Monitoring Systems: Smart wheelchairs can be remotely monitored by caregivers or family members, enabling them to keep an eye on the user's location, speed, and other vital signs.

Technological Advancements in Electric Smart Wheelchairs:

Artificial Intelligence (AI): AI technology is being used in smart wheelchairs to improve their intelligence and decision-making capabilities. These systems can analyse user data, detect patterns, and provide personalized recommendations to users.

Robotics: Robotics technology is being used to develop advanced smart wheelchairs that can move on their own, without any manual input. These wheelchairs can be controlled by voice commands or other input devices.

Augmented Reality (AR): AR technology is being used to develop smart wheelchairs that provide users with enhanced visual feedback about their surroundings. These systems can detect obstacles, provide directions, and highlight important landmarks.

7. REFERENCES

1] Prof. Vishal V. Pande, “Hand Gesture Based Wheelchair Movement Control for Disabled Person Using MEMS” et al Int.Journal of Engineering Research and Applications Vol. 4, Issue 4 (Version 4), April 2014

2] Health monitoring smart glove using esp32 microcontroller T S Jahnavi et al 2022 J. Phys.: Conf. Ser. 2325 012007.

3] J. Arnil, Y. Punsawad and Y. Wongsawat 2011 Wireless Sensor Network based Smart System for Healthcare Monitoring international conference on robotics and biomimetics, pp. 2073- 2076.

4] Mufrath Mahmood, Md. Fahim Rizwan, Mohammad Hasan Imam, Masuma Sultan “Design of a low-cost Hand Gesture Controlled Automated Wheelchair” Dept. of Electrical & Electronic Engineering American International University Bangladesh ,2020 IEEE Region 10 Symposium (TENSYMP), 5-7 June 2020, Dhaka, Bangladesh.

5] P. Upender, P.A. Harsha Vardhini, “A Hand Gesture Based Wheelchair for Physically Handicapped Person with Emergency Alert System”, 2020 5th International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT-2020), November 12th & 13th 2020.

6] R. K. Megalingam, S. Sreekanth, A. Govardhan, C. R. Teja and A. Raj, "Wireless gesture controlled wheelchair," 2017 4th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, 2017.

7] Mubdi-Ul Alam Sajid, Md Firoz Mahmud, Mim Naz Rahman, “Design of An Intelligent Wheelchair for Handicap People Conducting by Body Movement” , 11th ICCCNT 2020 July 1-3, 2020 - IIT – Kharagpur.

8]Pushpendra Jha, “Hand Gesture Controlled Wheelchair”, International Journal of Scientific & Technology Research Volume 5, Issue 04, April 2016.