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A Review on Smart Wheelchair Monitoring and Controlling System

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***Abstract*—People with severe disabilities often rely on power wheelchairs for moving around. Although the needs of many people with disabilities can be met by wheelchair or portable wheelchairs, the disabled community finds it difficult or impossible to use wheelchairs independently. To meet this need, researchers have used advanced technology to enable mobile robots to build "smart wheelchairs" and have been the subject of research since the early 1980s and are built on four continents. This article presents a summary of the current state of the art and the directions for future research**

Keyword—wheelchair, mobile robot

I. Introduction

Today In the field of biomedical medicine, the wheelchair is an important tool in modern times industrial development. In this modern age many are busy their office and business functions. they can't spend time taking care of our aging parents. it means no someone can help older people if they feel hopeless and got injured. This does not help them immediately if there is no one in their house with them. But, in It's hard to keep up with the current busy schedule of this world old people. The need for the physically disabled and the elders get up regularly. As the Smart wheelchair will play an important role in the future social community. The use of smart wheelchairs promotes the idea of the machine as a partner rather than looking at its tool. According to the World Health Organization (WHO), about 15.0% (or 1 billion) people suffer from some form of mobility impairment. In addition, the development of chronic diseases compared with other diseases greatly exacerbates disability, which creates the need for wheelchairs. Developing countries like India are expected to be key earners of the wheelchair manufacturers during the forecast period. There is a great need for wheelchairs and the research and development needed to make them safer, more efficient, and more accessible. The following areas are particularly important: physician certifications, accreditation, device testing, device user training, patient education, clinical decision criteria, national contracts, and access to new technologies. This research explores the current technological access to personalized motion devices. Under this research project focuses on the areas and areas that need to be improved in the wheelchair and examines the shortcomings of the technologies in the wheelchair.

II. DISCUSSION

A. Based on sensors

[23] Wheelchair capable of automatic navigation is introduced, with a small command from the user. The wheelchair uses a LIDAR unit for navigation. The LIDAR unit provides important environmental values are used to create a map of the surrounding area. ROS receives inputs from the LIDAR sensor and rotating connectors to determine the route that can navigate to the user-defined location. However, the limit of the LIDAR unit is within the laser plane design. It can only scan a horizontal plane at a height above the user sitting in the seat; therefore, obstacles less than the length of the LIDAR unit refugees and no represented on the map. To counteract this, nearby nerves can place in strategic locations on a wheelchair for visibility obstacles that are less than the length of the LIDAR unit and include them on the map so they can go. ROS sends motion commands to the microcontroller to move wheelchair on a fixed road.

[10] The use of wearable vibrotactile solution to help people with disabilities drive safely in wheelchair is presented. one or two vibrotactile belts are used to give drivers information or in the presence of obstacles or a safe path to follow. This wheelchair is controlled with a standard 2D joystick control mounted in the right lounge area. fitted with a wheelchair with 12 SRF08 ultrasonic sensors attached to 3D printed boxes placed at each corner of the wheelchair. The distance measurement was set at 10 Hz with successive sensors activated to ensure no disturbance. Haptic response is given to one or two vibrotactile bands, depending on the nature of the test.

[17] Multi sensor data fusion sensor system consists of a magnetic compass, an accelerometer and two odometers (absolute encoders). These odometers determine the position (x, y) and the heading using the rotary encoders. Mounted on the wheel, they deliver information about elementary rotation, which by integration gives a measure of the overall motion. The sensor system consists of a magnetic compass, an accelerometer and two odometers (complete encoders). These odometers determine the location (x, y) and title using rotating connectors. They are attached to the wheel, bringing information about the basic rotation, which in combination gives a measure of overall movement.

[1] 16-beam solid laser sensor with a standard video camera for obstacle detection is introduced. a set of sensors was installed to detect obstacles at different heights. Laser sensors were installed to find obstacles in the lowest possible height, both in front on the left and right sides and behind the wheelchair. To find potential laser and potential laser obstacles collide with a chair, a series of ultrasonic sensors mounted under armrest and rear, at medium height. The Microsoft Kinect low sensor was also installed on front, to find location navigation at a nearby distance. With the proposed system, when the barrier crosses the beam, the meeting place is exposed in the associated image and optical flow are calculated on both sides of this point. Through the use of optical flow, several stages have been divided trained and inspected to automatically distinguish between user-generated intersections and those manufactured externally obstacles. the method accurately detects the presence of obstacles and the direction of their movement.

[27] An expert plan determines direction and speed of wheelchair. The system consists ultrasonic sensors and joystick. Ultrasonic Sensors were mounted above each driving wheel. Distance to objects was measured using the time taken for pulses to reflect back from the obstacle to the receivers. A Penny & Giles joystick was used to drive the powered wheelchair. The joystick had 2D potentiometers within it and joystick position was resolved with 2D A/D converters that were connected to the potentiometers. Directions are recommended and mixed with user input from joystick representing the direction you want and the speed you want. The legal system determines at an angle to open a powerful wheelchair and lift it. Input from the play stick and sensors are mixed with a raised angle from Rule Based Professional Program.

[7] PROMETHEE II 6 uses ultrasonic sensors to detect the obstacle the way to pass position to avoid the collision in the wheelchair. The sensor system placed an imaginary potential field to detect any obstacle. Histogrammic in-motion mapping was used because ultrasonics can be noisy and give false readings. A volume in front of the powered wheelchair was divided into left-handed and right-handed. Ultrasonic transducer beams over-lapped. The center column of the matrix represents the situations when both the right and left transducers detected something.

[16] Gesture Recognition Based Wheelchair Control System A 4-wheel omnidirectional wheelchair is included with Two types of wearable sensors namely myoelectric or EMG Unit consisting of biopotential electrode and pre-amplifier Acquisition electronics and a 9 axis IMU sensor. IMU Sensor measures triaxial acceleration and wrist tilt angle in three axes. EMG signals received from the two forearms muscles, extensor carpi radialis and flexor carpi radialis and the signal is processed to calculate the EMG-RMS various gestures. All sensor related processing and class fire algorithm is processed and calculated in INTEL NUC has been placed in a wheelchair. Wheelchair Control done through dedicated embedded controller based on 32bit ARM Pro Cesar that receives and generates commands from the NUC Required wheelchair speed.

B. Based on the Algorithms

[29] adaptive polymorphic ant colony algorithm used as a way to design a way for smart wheelchairs. imagine an ant can determine the right combination of parameters in line with the real situation and make changes to the state you enter search process to effectively prevent an ant from falling for the good of the place to some degree. Deciding direction method and used to accelerate integration, the better the efficiency of the algorithm in searching for the right global solution. The advanced polymorphic ant colony algorithm is used separately for targeted planning and obstacle course planning, and compared to the advanced ant colony algorithm and the polymorphic ant colony algorithm, respectively.

[2] An intelligent system aimed at detecting a person's posture when sit a wheelchair is introduced. this system warns improper positioning and preventing serious health problems. A sensor network is used collecting analytical data in an integrated system. Selection of prototypes using Convolution Neural Network (CNN), data measurement and Kennard Stone (KS) algorithm, and size reduction through Principal Component Analysis (PCA). Finally, to make the standing position more than balanced, pre-processed data, algorithm for K-Nearest Neighbors (k-NN) is used. It turns out to be a smart system that achieves a good trade-off between the required amount of data and performance accomplished. As a significant result, the required amount training data is greatly reduced while being accepted classification is achieved through fair trade device conditions. significant reductions in size, and reduction of the required amount training-data gained by 88%. In particular, this is achieved through application CNN as the prototype selection algorithm, KS data balance algorithm, and PCA.

[19] Function of the control panel in conjunction with a smart wheelchair designed for people with mobility disabilities. the approach to dealing with it is based on the control model of the theory decision, and receives commands from both the human user and the robot control. using the Markov Decision which is less obvious, the process of developing a choice of participatory action, that is allows the system to consider user uncertainty purpose, command and location. System used and verified in the Smart Wheeler platform, to testing by 8 users shows improvement in usability and the efficiency of navigation

achieved by this method of co-management. make comprehensive user research to determine the performance co-management module, compared to the standard manual toy stick control.

[14] The user's attitudes, needs, and preferences in a study conducted with a smart wheelchair that offers three different options user control. Users wanted to be aware of the timing of the wheelchair operation and high-level decisions, to provide specific circumstances in which an independent wheelchair may be helpful. Participants identified benefits once concern for smart wheelchairs, as well as desirable features and functionality. The paper reveals the meaning of these findings and provides specific recommendations for this development and deployment of smart future wheelchair. overall steering correction is given priority by basic safety at 28 out of 50 levels, while basic safety was preferred instead of directing at only 9 at 50 levels, Adjustment was preferred default at 26 of the 50 level, while basic security was preferred over the default at 18 of 50 estimates.

[9] Shared reading strategy to manage policies on human interaction, capabilities of this machine-learned model to make and the policies of various methods are demonstrated in comparison with personal data. Application of this proposal the process is further investigated using one-of-a-kind testing, where there are robotic shared control policies. compared to real human assistance management who uses a wheelchair. investigated the service of the haptic response during shared control with the assistant. In this arrangement, the driver of the wheelchair was not notified about whether (s) was physically connected to each other a person or a robot during work. This is done deliberately skipping the mental process and focusing clearly on car switches. the presented ideas about a common tendency for a robot assistant to physically distributed control.

[5] Three versions of wheel chair were developed. Provided a complex wheelchair ergometer in a virtual fixed seat nature designed for a wheelchair propulsion and they are all able to mimic simple translation inertia. In addition, each reported system uses a different one how to simulate rotating a wheelchair and seating circulating inertial effects. The first system offers no more resistance to rotation also depends on line stability, thinking it can provide acceptable repetition biomechanics of wheelchair maneuvers. The second and third systems, however, are designed to mimic rotating inertia. System 2 uses mechanical compensation and System 3 uses visuals compensation that mimics the impact the rotating inertia has in the visual impression of wheelchair movement to respond to rotate at different speeds.

C. Based on the monitoring system

[30] A cyber-physical wheelchair Speech controlled approach for the disabled is based on cloud harvesting and, thus, introduces a new paradigm for the development of complex cyber physical systems. The main part of the system resides in the cloud with the main opening feature and internet connection with users. In this way, tested two different cloud APIs and identified differences about the accuracy of speech recognition. this way of doing it based on a combination of a few speech recognition APIs tested by different users at the clinic using a specially designed test track. tests showed significant improvements in CER fully compliant with the theatre model. It has also been shown that there are significant differences between users in CER values and commands (for example, the “Stop” command contained one of the lower CERs).

[22] A smart wheelchair is developed to help removing people with physical disabilities through their blinking activities. The prototype is used to process eyeball images of under deliberate blink of an eye. Algorithm proposed to produce a sequence of wheelchair motion sequences deliberate blink of an eye. Deliberately spotting the blink of an eye ball images, advanced image processing methods are used by using raspberry-pi. Instructions are wirelessly transmitted to wheelchair driver. HC-05 Bluetooth Receiver connected to a wheelchair that receives the transmitted data from raspberry-pi and car driver using the command according to the pre-defined decision table. It may also recognize an obstacle using the APDS 9960 proximity sensor to avoid collision with it the surrounding area. The proposed wheelchair proved false Command Rate (FCR) of 2.1% to 13.2%. In general, the wheelchair is controlled by the blink of an eye will create an impact on physical assistance for the disabled people.

[28] Eye movement is detected using a camera attached to a wheelchair. The iris area is detected and produced using the algorithm for viola jones. After that they became processed using MATLAB. Then a decision is made with Arduino with a featured image provided. The patient's eye reader is detected by Webcam and then processed using MATLAB software. Image acquisition toolbox used for eye reader detection. According to eye pupil movement, command to Motor IC driver L293D is rendered in Arduino using a serial interface. This hardware and software can be an effective program to improve the health of patients with disabilities independent. An important part of the system is image real-time processing that can be handled using high end image processing software.

[20] Eye-tracking process through circular Hough modified algorithm to control movement wheelchair were developed. The built-in camera is compatible with the patient's eye and captures continuous summaries processed with real-time image processing techniques time, in turn, controls the way we travel and the control of wheelchair movement, this model is also designed to detect operational barriers ultrasonic sensors. The advanced wheelchair model is easy to make user performance. The user needs to keep an eye on the installed camera in a wheelchair to get to where you want to be for a little while. A quick picture processing techniques can be used to improve the speed of the wheelchair and the detection of natural blinking of the eye in a variety of lighting conditions.

[26] Wheelchair and intelligent robotic arm and control both of them with an EOG-based novel HMI to help patients with severe SCI to accomplish their biceps task. Wheelchair controlled by EOG-based HMI. On the arm of the robot, using shared, EOG-based HMI controls, dual cameras and the wisdom of the arm itself. Five healthy studies and five patients with SCIs you have successfully completed the drinking activity. In addition, the responsibility of the user to manage the system was

kept at an acceptable level. results have shown that the proposed EOG-based HMI can provide adequate precision control for wheelchair assembly and an arm of the robot, which can help patients with SCIs in daily life.

III. METHODOLOGY

[25] Electric wheelchairs were upgraded with stairwells by using improved power wheelchairs that can climb stairs. a review of the electric wheelchair with the latest technology for climbing stairs is provided and discussed. Proper advantages and disadvantages of different types Wheelchairs that can be climbed stairs are defined to compare the whole control system, the cost of machine construction, power consumption, and adaptability to various stairs. Details of the future stabilization method during the ascent of the stairs is discussed as it is an important feature common to all electric wheelchairs that can be climbed stairs. Finally, a summary of the electric wheelchairs that can be climbed the stairs mentioned in this article Like a special review of electric wheelchairs with ascending stairs, can provide a complete understanding modern technology with electric wheelchairs that can be mounted stairs and serve as a reference for the development of electric wheelchairs with an escalation of stairs.

[21] IoT based Arduino device for the fall of the Septuagenarian adoption has improved especially in older adults they live alone at home. When adults fall down in many cases, it will lead to serious injuries and they are unable to raise voice in fear. This function has the potential to detector on an adult Arduino based device fall down. The device is used to detect a person's fall with the help of an accelerometer and this is specially designed as to contact the right person immediately. Implementation is based on a combination of both hardware and software detects and activates the right person via SMS alert. a special feature of this device is portable and can be adjusted to any place like a wheelchair, a bed, and an older person can also adjust it is a watch for those who wear it. This helps the right person to be free from his or her duties without worrying about septuagenarian.

[12] The new power mobility device is introduced. Nino is less likely to qualify as a replacement for individual MWC operations. Nino has a small footprint there is a strong wheelchair, a rotating zero-degree radius, tiller-based steering, and relies on the front and rear user to move and brake. Most participants felt unsafe during braking, other ideas included that Nino might be another great way you can use it as an outdoor recreation device, a powerful travel option to help prevent overhead injury to overuse, has a positive impact on society interaction, but required a high level of concentration during use. The data suggests clinical focus on training people who can use these new devices may be required increasing self-confidence, safety and performance

[13] The Smart Wheelchair System Prototype includes 3D LIDAR / imaging programs that provide a solid view in informal, outdoor environments. It also helps these are the same sensors for map-based localization. In demonstrating the effectiveness of the method, SWS roamed independent of more than 12 km in area an urban environment that stands without loss and localization, and without the use of GPS. the SWS was able to take a reliable route over 12 km without loss local performance. In this case, we are looking for a map based on the proposed map The local system can provide high performance GPS system, but at no accuracy in urban environments.

[18] A simple and innovative way of wheelchairs that help to climb stairs is developed. The design method contains 2 degrees 2 legs of freedom. Each leg consists of two bars connected to each other in a certain way. Each leg is fitted two actuators help the seat move the legs as needed. The proposed design has stable leg movements and is adjustable height. Analysis of contrast kinematics has been performed and standing values for each leg are determined. The seating area is always upside down which ensures personal comfort. This will help to solve the equation problems while climbing the stairs in a wheelchair.

[24] Solar powered electric wheelchair with a health monitor is proposed, this function is to ensure more comfortable in travel and life for the people with physical disabilities. The electric wheelchair is combined with a pulse sensor that measures your heart rate the person and the load cell to which it is attached ensures the existence of a person in a wheelchair. Ultrasonic sensor It is done in a wheelchair introduces a barrier to the world person and the LDR attached to it provides emergency light when he hears the darkness. These elements make solar the electric wheelchair is smart and very practical people with physical disabilities who want independence. patients living in cities and rural areas may be far away are monitored with the help of a health monitoring system installed in an electric wheelchair and thus cost-effective.

[3] Electrooculogram (EOG) -based HMI introduced for wheel chair controller. Thirteen bright buttons used each in accordance with the order, presented in graphical user interface (GUI). These buttons illuminate one way at a time in the predefined sequence. User can choose button by blinking in sync with its lights. Algorithm receives instant blinks from a direct EOG data channel as well determines the targeted user button based on compliance between the blinked detection and the flashing of a button. achieved an average accuracy of 96.7% / 91.7% response time of 3.53 s / 3.67 s by false positive measurements. Using a single line of associated EOG signals in the blink of an eye, the proposed HMI can accurately deliver sufficient instructions with a satisfactory response time.

[4] Hybrid brain-computer interface which includes vehicle image and P300 power of harmonious function of the brain-controlled wheelchair is introduced. The method was confirmed by an eight-point test This paradigm is complete user-centric. By performing MI tasks sequentially or by focusing on P300 light, the user can use eleven tasks to control wheelchair: forward / backward, move left / right, move left45 / right45, accelerate / slow down, turn left / right and stop. the effectiveness and effectiveness of the proposed method was confirmed in eight studies, all of which achieved efficiency. preliminary results revealed the proposed hybrid BCI system with different conceptual strategies it is also possible has potential applications for active self-regulation.

[6] Asynchronous control paradigm based on conventional vehicle model were developed to enrich control the commands of the MI-based brain-computer interface. By taking pictures in sequence left and right movements, subjects can complete four SMI functions in inconsistent mode, then encoded controls six wheelchair steering functions, including movement forward, left turn, right turn, acceleration and standing. Two tests, a simulated experiment and the internet wheelchair test, performed to test implementation of the proposed method in seven subjects. The success rate was 94.2%, which indicates the proposed asynchronous function and function control the paradigm in the wheelchair controller.

[8] Improving the performance of a robotic system that works in the brain, a shared control of the novel based on the Bayesian approach is cleverly proposed by combining automatic robot control and brain modification control, which takes into account the instability of the robot human vision, action and control. Based on a lot Rear Opportunity, this method introduces possible models of human and robot commands to see complete control of brain-stimulated sharing control system. Application to the wise Bayesian a shared control system based on the appearance of a static state power-based brain machine interface is presented at wheelchair rotation at all times function. In addition, gaining more accurate brain control shared control commands and sync proposed electroencephalogram uncertainty program, a sequential brain control system with a response rule built. Tests are performed to confirm the proposed system in several cases.

[11] An inexpensive virtual reality (VR) app that takes advantage of VR computing at the consumer level were developed. System it can be easily planted in a testing centre or used at home, and does not depend on a special high-level environment. such as Powerwall or CAVE. This paper reviews previous work that has used visual technology to perform training tasks, especially the impersonation of a wheelchair. then described the implementation of the system and the initial verification research conducted through thirty-three powerful volunteers. Research results show that at a critical level of 5% then there is improvement driving skills from the use of VR system. Therefore, the opportunity to improve the ability of the person using the wheelchair to avoid it the dangers that exist in training in the real world. However, the emergence of cybersickness is a particular problem in this application it has to be talked about.

[15] Design and implementation of the optical connector for a multi-sensor brain computer interface were developed. The Developed system consists of a wheelchair, high power Car control card, Kinect camera, electromyogram and electroencephalogram sensors and computer. Consumer-level EMG device was used to locate eight EMG channels data. EMG data is the first is classified using an artificial neural network, support vector equipment and random forest schemes. The class is then determined by a system based on the law built into each of the three output filters. EEG-based regulation was adopted as an alternative enhanced wheelchair control. The 14-wireless EEG sensor is used to obtain real-time EEG data. Effects of EEG-based control of the robot wheelchairs are promising although they vary depending on user information.

IV.CONCLUSION

There are several barriers that must be overcome before smart wheelchairs can become widely used. A significant technical issue is the cost versus accuracy trade-off that must be made with existing sensors. Until an inexpensive sensor is developed that can detect obstacles and drop-offs over a wide range of operating conditions and surface materials, liability concerns will limit smart wheelchairs to indoor environments. Another technical issue is the lack of a standard communication protocol for wheelchair input devices (e.g., joystick, pneumatic switches) and wheelchair motor controllers. A standard protocol would greatly simplify the task of interfacing smart wheelchair technology with the underlying wheelchair.

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