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Review on Hardware's Used for an Automated Assistance System for Physically Challenged

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ABSTRACT

In the current scenario, Robots are in great scope in the field of Medicity, Industries and even in Human Assistance. Even though these are of great use, when it comes to field of human assistance, cost and space have their own impact. The main issue regarding robots in this field is Machine Man Interaction. Therefore, an assistance system with low space occupancy and low cost is definitely a great a project to be implemented. Hereby, an assistance system that is being controlled by brain signals being introduced where the robot (so called assistance system) can perform as per the human thoughts. This can be highly helpful for those who faces the issue with speech. i.e. dumped

Keywords: Electroencephalogram, Brain machine interface or Brain controlled computer, deep learning, robotic locomotion

I. INTRODUCTION

Disability is a state caused due to accidents or through diseases such as stroke or through birth. The physically challenged always require someone to assist them to perform some or their daily routine tasks. Therefore, an assistance system is a great boon to those

(A) Challenges

The basic challenges that people with various disability face are explained are explained here. Individuals those how face the disability from polio , stroke , memory loss diseases and even severe accidents or neuro disabilities should always depend on others for their locomotion even for the essential activities. Individuals those who suffer from the issues related to locomotion also faces trouble while sitting and standing and even while climbing at stairs and cleaning at their own homes. Many at times physically challenged person suffers from immediate fall and can cause severe physical damages even death especially old aged. Locomotion and muscle movements are very essential to pick up daily essentials. Those who have issues related to locomotion , muscles and neuro issues finds difficult to pick up those essentials. Alshemers patients with

head injuries and old aged people faces the issue of memory loss. Deaf and coma patients faces struggle in expressing their thoughts, ideas and necessities. Now, at this point there is yet another major issue regarding the assistance system. The major challenges that an assistance system faces are:

❖ **Intelligence**

(1) Man Machine Interaction : While introducing a machine for human assistance, man machine interaction is a necessity. Since machine does not have an emotions to understand the feel of a human, proper interaction between each other is an important factor.

(2) Intention Estimation : Machine should understand what the needy actual expect from it and should produce the expected output.

(3) Human Adapted Control : The person using the machine should have a proper control over the functions it performs. The machine should get well adapted to human needs and the humans the control over it.

❖ **Safety**

(1) Hazard Detection: Machine works as per programmed. Any malfunctioning of the system should be properly identified and should provide a hazard warning as a safely measure else can cause severe hazards.

(2) Hazard Avoidance and Prevention: Proper identification and indication for preventing the hazards is compulsory.

(3) Emergency Measure: In case of occurrence of any hazards or accident emergency alarm should be rang and message should be sent to the authorities.

❖ **Functionality**

(1) Walking Assistance: The speed of the machine should be adjustable according to the user.

(2) Navigation: Should provide proper navigation to blind, old aged, memory retarded persons etc.

(3) Speed of Reaction : The speed of reaction of a machine according to the reflex action of human is very important.

There are many existing system that can assist human. Some of the assisting robots[1] are been mentioned hereby. The i-cane robot version 3 [2], for locomotion which actually helps one to move on a flat and a sliding surface.The Ro-bear [3], which pick up people from bed to chair and vice versa. Kuri [4] is an entertaining robot specially to engage kids. Romeo [5] is a humanoid sized robot who's designed and built to assist the elderly as they lose their own autonomy. This robot is designed to be able to open doors, climb stairs and reach for objects while going about its care duties. In the future, this clever robot may enable the elderly to stay in their own homes longer rather than having to move into care homes. Buddy [6] is a revolutionary companion robot designed to improve your family life. Buddy is designed to entertain the family, help you with your everyday activities, offer reminders when you need them, support you with recipes in the kitchen and much more. You can use buddy to make video calls, keep an eye on your home while you're out, connect all your smart home devices together and even help your children learn .

These robots seems to very helpful for human assistance but they do have a lot of drawbacks as mentioned below :

(1) i-cane : rough idea about fall prevention, cannot be used in slippery floor , no other functionalities available .

(2) Robear : huge occupancy space , wired

(3) Romeo and buddy : highly costly

(4) Wearable Robots [8]: discomfort and complicated.

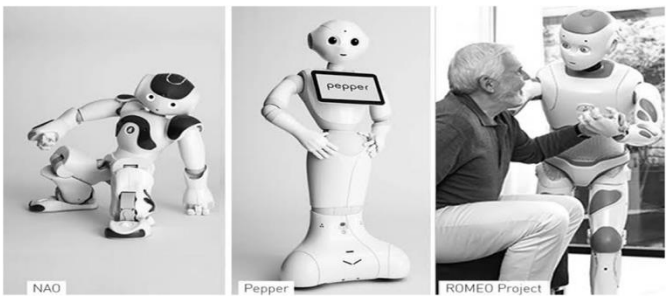

Fig. 1 . Romeo , Pepper and Nao

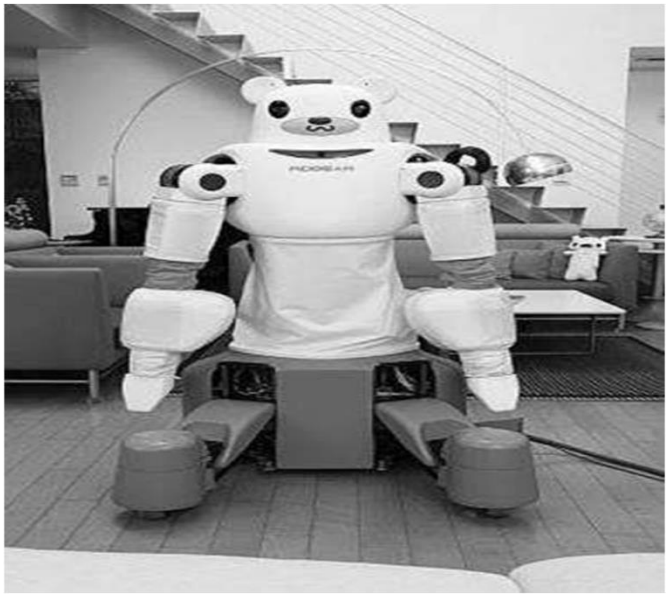

Fig. 2 . Robear

Fig. 3 . i- cane

(B) Solution

In-cooperated more functions to robot cane like Picking up objects, Fall alert, Thought capture and Braking system .

(C) Expected output

(1) Effective and
(2) Affordable Assistance System
(3) Adaptivity

Microchip Technology PIC microcontrollers (PIC 16, PIC24 There are several works performed easier emphasis mainly on how to assist physically challenged from various sectors. There were various studies carried out in the field of developing i-canes and robo-canes [7] for walking, visually assistance for blind, post stroke rehabilitation [8] and even on wearable robots [8] to help the paralysised. The brain signal based machine interaction (BMI) when introduced on a machine may help the machine to act according to the relax actions that the brain produces. As the years passes by robotics plays an important role in field of research and even as hobby robotics. It comes from the basic robotic kit that anyone can make to the most advanced and complex ones like Sophia the humanoid robots. Microprocessors [9] are low level devices and its commonly used to program them using an assembly language, this provides a great deal of control over hardware connected to the controller. Most of the manufacturers provide high level language compilers for chips including the BASIC and C. The most commonly used microprocessors [9] [10][11] include:

(1) Atmel AVR microcontrollers (ATmega , AT tiny etc)
(2) Microcontrollers based on ARM Technology
(3) Environmental boards based on microcontrollers like Arduino(AVR), Basic Stamp (PIC) and Lego NXT (ARM)
(4) RVP: VLSI Robotics Vector Processor

The sensors [12] play a major role making the robots an active participant in real world environment. They provide the robots a physical quantity not a state. In fact, there are other sensors too that helps robots to get connected to the various human activities like touch, vision and muscle contractions. Tactile sensors[13] are those sensors that measures information that are produced from the physical interaction with its enivornment. The various tactile sensors used in robotics are clearly shown in the table. Contact Switches perform switch function by mechanically switching between contact pins. If the switching takes place without physical contacts, then they are called non-contact switches. They can be

often used in functions like that of automatic door open systems. Bumpers are those structures attached to or integrated with the front and rear ends of a motor vehicle system inorder to absorb the impact in a minor collision, thus minimizes repair costs. The very common example for bumpers are the car bumpers. There is another kind of bumpers called optical bumper used in where the enivornment is too harsh like that of coke plants and rolling mills. In case of a device such as for example an obstacle detection system potentiometer sensor is being used to detect the presence of nearby objects without any kind of physical contact. These sensors help a device for obstacle free and damage free locomotion. Wheels and motors are yet another most important like of a mechanical device used in non- stationary machines or systems. Encoders are one of the most important sectors that one should explain while explaining wheels and motors. Encoders are electromechanical devices that provides an electrical signal that is used for speed and position control. They include a series of circumferential copper tracks etched onto PCB which is used to encode the information via contact brushes sensing the conductive areas. Potentiometer is another 3 – terminal resistor with a sliding or rotating contact that forms an adjustable voltage driver. In case if only two terminals are used ,i.e. one end and the wiper ,then it will act as a variable resistor or rheostat. These are often used for volume control. There is another type of a sensor called as the Synchros and Resolvers which are similar to transformers . They are mechanically almost like a motor. The primary winding can be physically rotated with respect to secondary winding. A type of rotary encoder called optical encoders that use a sensor to identify position changes as light passes through a patterned encoder wheel or disk . They are commonly used in restaurants where robot serves the job of waiters. These are sensitive to dust. In the early days, ultrasonic sensors are being used to calculate the distance for locomotion using RRSI algorithm [14]. RSSI found a better place in the field of locomotion in indoors and outdoor but found very complex and much more complex in outdoors. Triangular algorithm [15] and Advanced Generalisation Triangulation Methods [16] are also being introduced in the field of locomotion of robotics systems where wireless sensors placed a very important role for the position determinations.

BCI Speller [16] has being introduced in the last few decades which has a set of letters, numbers and spellings which helps the system to compare with the brain signals which helps one to type and spelling. Audio outputs can also been obtained by modern speech synthesis. The spellers are being developed in such a way that the end user is happy with its features . They are represented in a “easy to understand” taxonomy . These are more helpful for MND patients in order to communicate and retain social life with the help of brain signals and not with muscular operations. GIU helps to connect the words and letters in place. Most commonly used speller is P300 .

TEA and NTSA [17] algorithms can be used to retrieve the brain signals securely while transmitting. The brain signals are been collected using an electrode headset and is converted into the TEA form for better transformation. Through the application of deep learning technique, the algorithm can be further simplified.

General Classification	**Sensors/Sensor systems**	*EC/ PC and P/A*
Active Ranging	Reflective Sensor	EC / A
	Ultrasonic Sensor	EC / A
	Laser Rangefinder	EC / A
	Optical - Triangulation (1D)	EC / A
	Structured Light (2D)	EC / A
Ground Based Beacon	GPS	
	Active Optical / RF Beacons	EC / A
	Active Ultrasonic	EC / A
Heading	Compass	EC/A
	Gyroscopes	EC/P
	Inclinometer	PC/P
Motion / Speed Sensor	Doppler Radar	EC / A/P
	Doppler Sound	EC / A
Tactile	Contact Switch	EC / A

	Bumpers	EC / P
	Optical Barriers	EC / P
	Non-Contact	EC / A
	Proximity Sensor	EC / A
Wheel / Motor	Brush Encoder	EC / P
	Potentiometer	PC / P
	Synchros &	PC / A
	Resolvers	PC / A
	Optical Encoder	PC / A
	Magnetic Encoder	PC / A
	Inductive Encoder	PC / A
	Capacitive Encoder	PC / A
	CCD / CMOS Cameras	EC / P
Vision – Based Sensor	Visual Ranging Packages	EC / P
	Object Tracking Packages	EC / P

In the case of HSR[18] , the hardwares vary according to the disability of the person using them . For elderly person , a designed trajectory accurately in a complex and narrow environment. Therefore, to study the trajectory tracking control further, one must use Lagrange's equation[19] to construct a dynamic model of the HRS .When omni-wheels are introduced another problem that must be considered, namely, the vulnerable mechanical strength. By designing a saturated controller, the omni-wheel inputs and outputs are constrained to protect the omni-wheels and also guarantee the safety of the HSR assisting process. In a recent study a saturation function of the omni-wheel inputs by a hyperbolic tangent function has been described, there by guaranteeing the smoothness and boundedness of the controller. The above mentioned study also derived an exponential stability of the tracking error (TE) system from Lyapunov stability, Lagrange's mean-value theorem, and Markov's inequality. Power supply is one of the major issues in any fields. In robotics, large power supply equipments required and they make them wireless which makes them enable to move outdoors. Recently wireless power supply sensor techniques [20] are been taken into account for studies where heat is converted to power using thermoelectric sensors. However, it is not sure of how much these techniques can be implemented in an high end processor occupied robot.

II. CONCLUSION

The literature survey provided above helps one to get the exact idea of the varies hardwares used for developing an assisting machine. Even though the best selection of components are available with this paper as reference and compare with the functionalities required, the accuracy of the system depends mainly on the algorithms and the softwares used to operate the system.

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