Smart Walker for the assistance of elderly and handicapped people

Ms.Vaishali B. Niranjane[1], Mr. Krushil.M.Punwatkar[2],

[1] *Asst.professor, Electronics and Telecommunication Department, YCCE Nagpur, Maharashtra, India*
[2] *Asso.Professor, Electronics and Telecommunication Department, BNCOE Pusad, Maharashtra, India*

ABSTRACT

The percentage of old aged people is escalating in many countries. There are numerous old aged people who experience functional disfigurement of the limbs, which are generally due to neurological problems or be short of of muscle vigour. Also, the abating birth rate leads to the scarcity of the youngsters for attending the old aged people. Therefore, it is greatest ***need*** *to build up rehabilitation robots and look after robots in order to indemnify for the lack of the people for nursing care of the old aged people. In this research, a structural thought for a robotic help to give maneuverability help and monitoring for the old aged people are being developed. The method is intended to help the old aged people living autonomously or in older assisted living amenities. The acknowledgment of consumer walking purpose plays an significant part in the study of the walker-type rehabilitation robots We proposed a robot which is push by 4 wheels and is known as Smart Walker. It is designed to assist old aged people and handicapped people to walk. For the control system of robot, the walking purpose provides a real-time position route for the robot activity controller. It is planned for helping the old aged people and handicapped persons for walking. This walker will ease the experience of walking and reduce the difficulties faced by old aged people and handicapped people. It will overcome the drawbacks of traditional walker. Our walker will have a night mode to use the walker at night or at dark places, a mechanical arrangement so that the user can take rest if tired, a panic button for immediate contact with the relatives, obstacle detection to avoid potholes etc and a battery indicator. These features will help in solving the issue of normal walkers making the user more independent and confident.*

Keyword - *Smart walker, GPS, GSM, ROBOT*

1. INTRODUCTION

The number of aged people is increasing very rapidly in our country. The numbers of aged people in INDIA according to 2011 census were around 104 million and is expected to reach 173 million by 2026.[3] As people grow old, they tend to loose mobility and hence their lives are affected. Carrying out routine activities becomes very difficult. Even simple activities like walking become very difficult and with the increasing IT trend, the youth is busy in their own work and paying attention towards elderly becomes a difficult task. Hence to overcome all these problems and with an intention of giving back to the society, we decided to create a SMART WALKER which can assist the elderly in a great way so that they can walk on their own and they feel independent. Visual impairment is one of the greatest cause of accidents in the elderly. [1]To avoid accidents while walking, we have used obstacle detectors using ultrasonic sensors, so in case they are unable to see an obstacle, the robot will detect it for them. From the point of view of robot control system, the user's walking will occur with the help of the keys provided on the keypad install LED on the walker. The keypad will have keys for forward and sideways motion and a panic button to send the location of the user. The motor used in the walker will also play an important role as far as the motion of the walker is concerned and will also prevent falling on slopes/ramp. [6]Thus, the research focuses on assisting the elderly and handicapped people to walk more easily and feel independent.

1.1 Block diagram and working

The Fig-1 shows the basic block diagram of our smart walker. We have used PIC18F25K22 microcontroller.. The microcontroller helps in interfacing and controlling all the modules and is the heart of the walker. It gives signals to the motor for moving in specific direction. It acts as a transmitter as well as a receiver. The most important reason behind using PIC microcontroller is that two-way communication is possible. The GPS continuously sends signals to the microcontroller and at the same time it has to send the message through the GSM module, hence this

microcontroller is used. The ultrasonic sensors are interfaced with the microcontroller.[2] Hear for detecting obstacle we use three ultrasonic sensors. Ultrasonic sensors measure the distance between the obstacle by measuring the time required for the wave to reach the obstacle and come back.

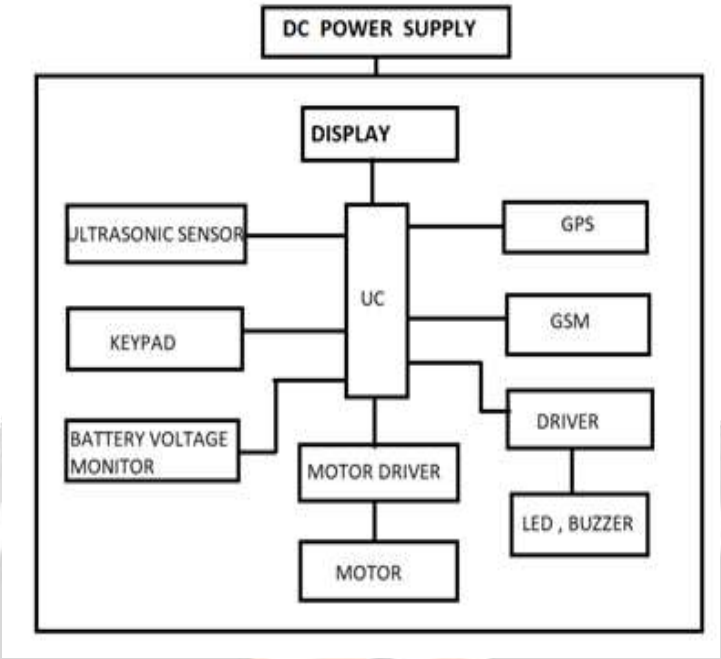

Fig-1: Block Diagram of Smart Walker

The distance is calculated by the formula:

DISTANCE L = 1/2*T*C

where L is the distance, T is the time between the emission and the reception and C is the speed of the sound. The value is multiplied by ½ because ‘ T’ is the time for go and return distance. [4]

We have used three ultrasonic sensors for obstacle detection. Two of them are connected on the front panel of the walker. Their main function is to detect obstacles such as walls, doors. The other one is connected on to the bottom shaft on the front panel The main purpose is to find any irregularities in ground level such as potholes, stairs or steep slopes.

The Global system for mobile communication (GSM) module used in our walker is SIM800l. It helps in sending and receiving the messages and also allows GPRS transmission. If the person feels uneasy or needs help, one can simply click the panic button present on the keypad provided in the walker and his location along with a message 'panic alert' will be send to the registered mobile number. All this is carried out with the help of GSM module.

Our walker also has the provision to send the exact location of the person to the registered mobile number. Thus we have interfaced Global Positioning System (GPS) module with the microcontroller as it is can receive information from the GPS satellite and calculate devices actual geographical position. So just by clicking a button on the keypad provided location will be sent to the relatives.

2. Implementation of Smart Walker

2.1 Chassis and wheel size selection

The most important thing about a walker is its stability. If the walker is not stable, then it will be of no use. If the walker is too light, then there is chance that user can fall if he puts pressure on the walker. On the contrary, if the walker is too heavy, then the user will not be able to lift the walker if in case the battery power is low. We should also consider one more thing that if the weight is too much, then the motors need to be more powerful and the battery consumption will be very high. So a walker with a very heavy weight won't be suitable. So we needed to find just the perfect weight for the walker. But the problem with selecting the perfect weight was that to experiment it, we needed to select the motors and wheel size first. So, we calculated the distance any motor can cover within a minute.[5] As a wheel is a circle, the distance covered will be the circumference of the wheel. The process for calculation is as follows

Let r= radius of wheel

R= rpm of the motor

D = distance covered

Therefore, the distance covered is given by

D = 2*pi*r*R

Where pi = 3.14

We decided to have radius of 5cm, so in one minute, the walker will cover 31.4R cm distance if the forward button is pressed continuously. Now the distance completely depends on the Rpm we choose. We have to keep in mind that if the rpm is more, the motor can rotate on its own on slopes. This will be dangerous because if the user is on slopes, then the walker will slide down very fast. Therefore, we need to choose a motor whose rpm is not very high to slide down and not very low to be very slow. Therefore the motors which we chose were of 30rpm. Now putting the value in the equation,

D = 2*pi*r*R

Pi = 3.14

r= 5cm

R= 30

D = 2*3.14*5*30

= 900 cm approx.

= 9 meters

This calculation tells us that, if the forward button is pressed continuously for one minute, then the walker will cover a distance of around 9 meters. This distance is not much, but still keeping in mind that the user of our walker will be an aged person, we have programmed it in such a way that, once the walker gets the command to move in any direction, it will move for 2 secs and then stop. So even if the switch is pressed continuously, it won't move continuously. To decide, whether or not the motors can bear the weight of the chassis and the user, we made a small base and attached these motors to it. We then kept some weight on the base to check whether it works or not. In this way, we chose our chassis and the motors.

Fig-2: Chassis before Mounting PCB

2.2 Keyboard designing

One of the most important components of the project is the keyboard. The user will need the keyboard to move in the desired direction. The keyboard should be placed in such a way that the user can access it easily. So we placed the keyboard on the horizontal rod of the walker which the user will hold. The keyboard is made by soldering the switches into a zero PCB. The zero PCB is a simple copper plate which has holes. Therefore you don't need to drill and etch it like a normal PCB. You can simply put the component and solder it. Our keyboard has 5 switches. Four of the five switches are for moving in several directions and the fifth is a panic switch. When we press the forward switch, all the motors move in clockwise direction and the walker moves forward. When we press the reverse switch, then all the motors move in anticlockwise direction resulting in the walker moving backwards. If the user wishes to turn right, he will press the right switch. This will make the two motors on the left to stop and the two motors on the right to move clockwise. Similarly, if he wishes to move left, he will press the left switch and the motors on the right will stop and that on the left will move clockwise. In this way, the keypad will work.

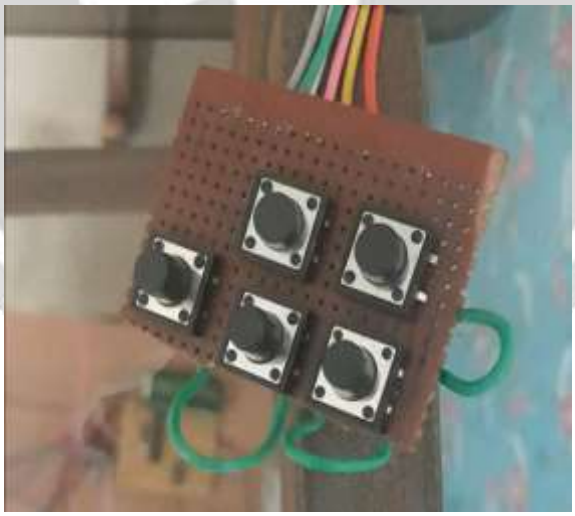

Fig-3: Keypad

3. Salient features of the walker

The walker has the following features which makes it unique and different from the traditional walker

3.1 Night Mode

In our traditional walker, there is the problem that it cannot be used at night. Because at night the visibility decreases

and the traditional do not have any provision to increase the visibility. So elderly people cannot use the traditional walker at night for going outside. This problem is eliminated in smart walker. We have introduced 'night mode' in our walker. Led lights are installed on the walker. In this mode the lights will be automatically switched on when the outside light intensity decreases or it becomes dark outside. This will help the user to increase the visibility at night. This is done by using LDR sensors. It senses the outside light intensity and its resistance are changed accordingly. This will switch on the lights on the walker and the user can be able to see at night too. This will help the user to go outside at night too. One more advantage of night mode is that while crossing the road and while walking on the road the other people can see the walker easily at night because of the LED lights. This will prevent accidents.

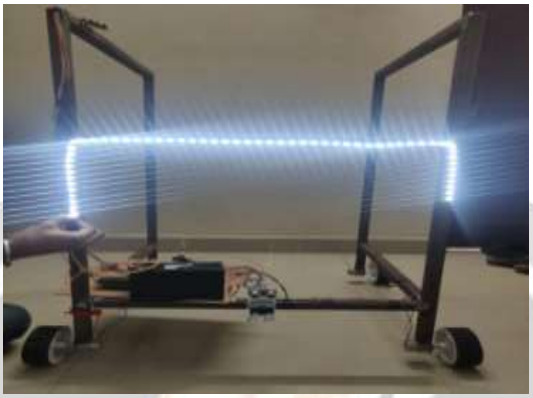

Fig - 4: Smart Walker in the Night Mode

3.2 Panic Alert

It is clear that while walking the user may feel uneasy or may get panic at any point because of age factor. In this situation the user needs help. The family of the user must be informed first. This problem is eliminated I smart walker. We have introduced a panic alert button on the keypad. We have interfaced GPS and GSM module in the circuit. We have interfaced both of these modules in such a way that whenever the panic alert button is pressed the exact position of the user is sent on the registered mobile number which will be of user's family member. This location can be accessed by that person using google maps. And he will get to know the exact location of the user. This will be useful for the family member to find the user and provide the desired help.

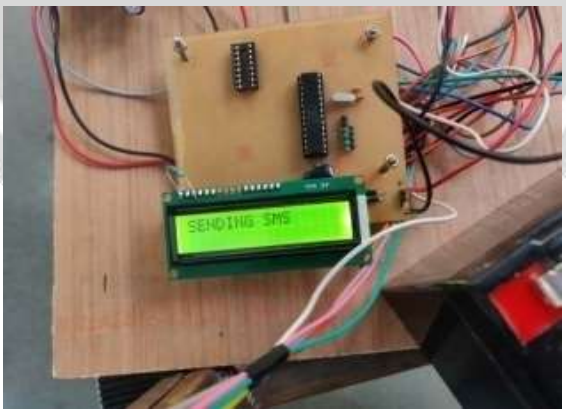

Fig-5: Panic Alert Mode

3.3 GPS and GSM

GPS used is neo-6 and GSM is SIM800L. GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM).

Fig-6: LCD Showing Latitude and Longitude

In our smart walker the GPS continuously gets the position and GSM is used to send it to the registered mobile number.

3.4 Obstacle Detection

Smart walker has a special feature of obstacle detection to prevent the accidents. This is done by using Ultrasonic sensors. The walker will get blocked (won't move) whenever there is an obstacle in the range of those ultrasonic sensors. The obstacles like uncertainty of road, rocks, potholes can be detected and accidents can be prevented. We installed a servo motor which will be moving continuously. On it an ultrasonic sensor is placed to cover the maximum range for obstacle detection. One sensor is installed at the bottom for detection of the potholes. Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. then wait for the sound to be reflected back, calculating distance based on the time required.

3.5 Battery indicator

Battery is the most important component as it provides the power to all the other components. So the user should know about the status of the battery. Hence we are providing a battery indicator in our walker. Whenever the battery is low it will indicate the status. It will be seen on the LCD display. A buzzer is installed in the walker. So, whenever the battery is low the buzzer gets activated and the user will know about the low level of the battery.

4.Results of Smart Walker

4.1 Mechanical Implementation

The walker is made up from three of three main modules: standing structure, wheels and operating part. Three ultrasonic sensor are placed on standing structure.. Two sensors are placed parallel to the ground and one is placed slightly declined towards ground to detect obstacles and pot holes respectively.

Fig-7: Smart Walker

The height of the walker is around 3 feet and its width is 2 feet. The wheels of the walker are having the diameter of 10 cm and width of 4 cm. The base of wheels are supported by ball bearings..To obtain symmetry, the wheels are armed with short weight encoders. For advancement of a wheel of 1 mm full quadrature decoding is used .it gives resolution of encode with 2000 pulses per revolution. The operating part used as the key factor for interface between the consumer and the walker.

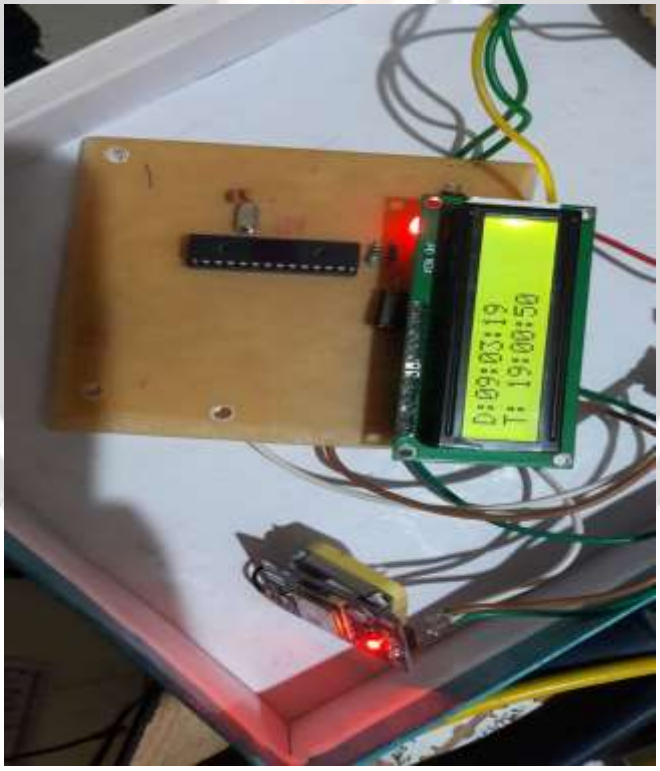

Fig-8: LCD display showing date and time

There is an operation pad where buttons are provided. There are buttons for forward motion, reverse motion, for turning right and left too, and a stop button. A special 'Panic button' is provided which when pressed sends the location of the user to the registered mobile number. Because of this feature, to find the location of the user will become easier. Night mode is provided which will switch on the LED lights for better visibility. Whenever the user is tired, a mechanical adjustment is made for the user to sit.

Fig-9: LCD display showing latitude and longitude values

5. CONCLUSION

In this research robotics and mechanization would make it more efficient. This will be more comfortable for the user. the "SMART WALKER" was presented as one of the examples of advanced service robotics system. By escalating the effortlessness and security of using a walker, the Smart Walker in addition has the prospective to cheer a more lively lifestyle in elderly adults with partial mobility.

6. REFERENCES

[1]G.PRABHAKAR REDDY, K . SATISH BABU "Intelligent Cane Robot for Walking Assistance of Elderly and Handicapped people" G. Prabhakar Reddy and K. SatishBabu (IJETTCS) Volume 2, Issue 5, September – October 2013

[2]Toshio Fukuda ; Pei Di ; Fei Chen ; Kousuke Sekiyama ; Jian Huang ; Masahiro Nakajima "Advanced Service Robotics for Human Assistance andSupport", 2011 International Conference on Advanced Computer Science and Information Systems Jakarta, Indonesia

[3]WorldPopulationAgeing19502050.PopulationDivision,DESA,UnitedNations.
[http://www.un.org/esa/population/publications/worldageing]

[4] Bouri M, Stauffer Y, Schmitt C, Allemand Y, Gnemmi S, ClavelR, Metrailler P, Brodard R"The WalkTrainer: A Robotic System for Walking Rehabilitation." IEEE International Conference on Robotics and Biomimetics. ROBIO '06.

[5] O. Postolache, P. Girão, J. M. Dias Pereira, and G. Postolache; "Smart walker for pervasive healthcare," in Proc. Int. Conf. on Sensing Technology ICST, Palmerston North, New Zealand, pp.1-5, Dec. 2011.

[6] P. Di, J. Huang, T. Fukuda, K. Sekiyama and T. Fukuda, "A Novel Fall Prevention Scheme for Intelligent Cane Robot by Using a Motor Driven Universal Joint," Proc. of 2011 Int. Symp. on Micro-NanoMechatronics and Human Science (MHS 2011), pp. 391-396, 2011.