Advanced Personal Assistant Robot for Blind and Elder People Based on GPS Fencing Using Arm Processor

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Abstract— Independent travel is one of the strongest desires of about 285 million people who are visually impaired and elder people in the world. In recent origin the concept of technological assistance for blind people is more sensitive and delicate utilization of their remaining senses. It is also designed to act as an advanced multipurpose human assistance and service robot. These robots recognize the words spoken by users; reply answers to question asked by them and take action according to the spoken voice commands. Many ways and means have been used by visually impaired persons to satisfy the basic desire to be mobile. Basically, there are three common ways have been used to achieve varying levels of mobility are a sighted human guide and the other two most accepted and proven methods are with canes of varying lengths and guide dogs.

Key words: ARM Cortex, Sonar, GPS, Analog Sensor Unit, Digital Mems Compass, Solar Panel, L293motordriver, DC Motor

I. INTRODUCTION

In daily life, the walking is one of the most important human activities. To improve the walking ability of the elder people and the walker-type rehabilitation robot has become a popular research topic over the last decade. There have been many walker-type robots comprising active or passive wheels and supporting frame. A new intelligent walker based on passive robotics to assist the elderly, handicapped people and the blind was proposed. There are still number of deficiencies in the present walker systems. First, many walker type robot are designed for the indoor environment. Second, most of them are big in size and/or heavy in weight.

Voice commands are recognized by an android smart phone and the information is transferred to the main MCU using a Bluetooth serial port that runs Bluetooth protocol stack. The robotic dog has the ability to follow a human when commanded with their voice. Touch sensitive e-skin sense human finger touch and helps answering complex user requests, date and weather conditions such as time, light and temperature. The same can be asked using voice command also and it even allows the user to set wake up alarm. GPS fencing is act as the main role to prevent the robot theft. MP3 music tracks can played by built in audio playback system. One of the music tracks is kept as the alarm tone. It also acts as a regular watchdog during night and barks like any normal dog if it finds any abnormal activity. During the day time it can charge itself by moving around within a given region in order to find the maximum sun light and intelligently avoiding the shaded areas, thereby freeing the user completely from maintenance issues such as battery charging. It has a head; eyes and a tail like a real dog which it uses to perform special gestures during human-robot interaction.

A. Sensing:

First of all your robot would have to be able to sense its surroundings. It would do this in ways that are not similar to the way that you sense your surroundings. Giving your robot sensors: light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), and taste sensors (tongue) will give your robot awareness of its environment.

B. Movement:

A robot needs to be able to move around its environment. Whether rolling on wheels, walking on legs or propelling by thrusters a robot needs to be able to move.

C. Energy:

A robot needs to be able to power itself. A robot might be solar powered, electrically powered, battery powered. The way your robot gets its energy will depend on what your robot needs to do.

D. Intelligence

A robot needs some kind of smarts. This is where programming enters the pictures. A programmer is the person who gives the robot its smarts.

II. RELATED WORK

This chapter presents the existing method they used cane robot for aiding the elderly and handicapped peoples walking. For many visually impaired people, a cane or a stick is a close friend helping them to detect and avoid obstacles in the walking paths. During walking with the cane, they sense and guess directions and locations by hearing sounds surrounding, sniffing smells in the air, feeling touches on skin, counting footsteps they walk, and memorizing events in time and spaces. However, it is difficult for them to do this all the time when surrounding environment could suddenly change, or when they get lost memory of locations. Voice recognition method is not used in existing method. Cane robot is not user friendly.

A. Omni Directional-Type Cane Robot:

The direction to which a person intends to move is referred to as the ITD. The ITD can be evaluated by the angle between the forward direction and the ITD itself. In this existing method, a new Omni directional-type cane robot was developed for the elderly and handicapped. Motion control of this robot was studied based on online estimating human walking intention. The main contribution of this study has been to present dynamic models and online inference algorithm for the human walking intention, which is significant to lead the user's walking in a natural and comfortable way. Experiments were performed on the flat ground and slope. The effectiveness of the proposed

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algorithm was confirmed through experiments. It should be pointed out that the interface between the human and the robot is the multiaxis force sensor, which is expensive and fragile. To lower the cost and improve the system reliability, in the future, we would like to construct a low-cost sensing system comprising cheaper force sensors and range finding sensors for the cane robot. By utilizing some sensor fusion approaches, the state of user can then be reliably recognized and provided to the motion controller.

B. Experiments:

The direction to which a person intends to move is referred to as the ITD. The ITD can be evaluated by the angle between the forward direction and the ITD itself. Obviously, the ITD is a time-dependent value and is denoted by ρ (n) in the rest of the paper. Furthermore, the quantity of this intention is characterized by the measured resultant force F ρ (n) along the ITD. Note that discrete time scale n is assumed for the requirement of filtering technology. Figure1 shows a same person is almost the same for different walking directions. To verify the effectiveness of existing walking intention estimation approach and the IBAC control strategy, several experiments were performed in different situations.

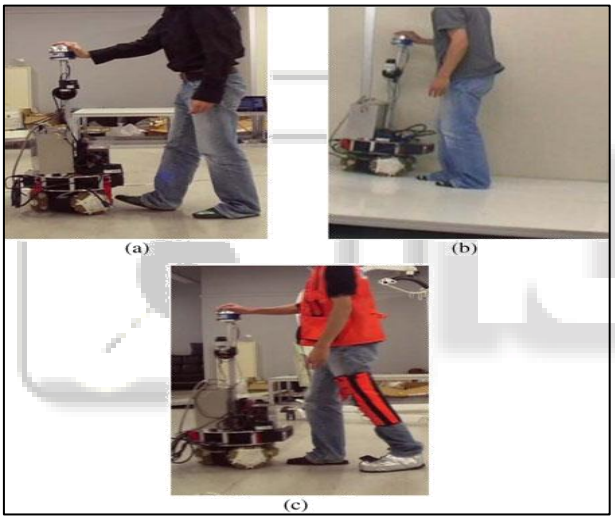

Fig. 1: Three Experiment Situations. (A) Walking on the Flat Ground. (B) Walking on the Slope. (C) Walking on the Flat Ground, While Wearing a Brace.

Then, they conducted the experiments in three situations. An intelligent cane robot is designed for aiding the elderly and handicapped people's walking. Recognizing the user's walking intention plays an important role in the motion control of our cane robot. To quantitatively describe the user's walking intention, a concept called Intentional Direction (ITD) is proposed. Normally, these people cannot walk along their ITD clearly and smoothly due to their weak or handicapped lower limbs.

The main contribution of this study has been to present dynamic models and online inference algorithm for the human walking intention, which is significant to lead the user's walking in a natural and comfortable way. An IBAC scheme was also proposed and used to drive the cane robot. Experiments were performed on the flat ground and slope. The effectiveness of the proposed algorithm was confirmed through experiments. It should be pointed out that the interface between the human and the robot is the multiaxis force sensor, which is expensive and fragile. To lower the cost and improve the system reliability, in the future, we would like to construct a low-cost sensing system comprising cheaper force sensors (e.g., force sensing resistors) and range finding sensors for the cane robot.

III. SYSTEM DESIGN

As a new proposed technology developed here for enhancing the support for the visually impaired person, guide dog robot has reached to a new level in human innovation aspect which needs zero maintenance.

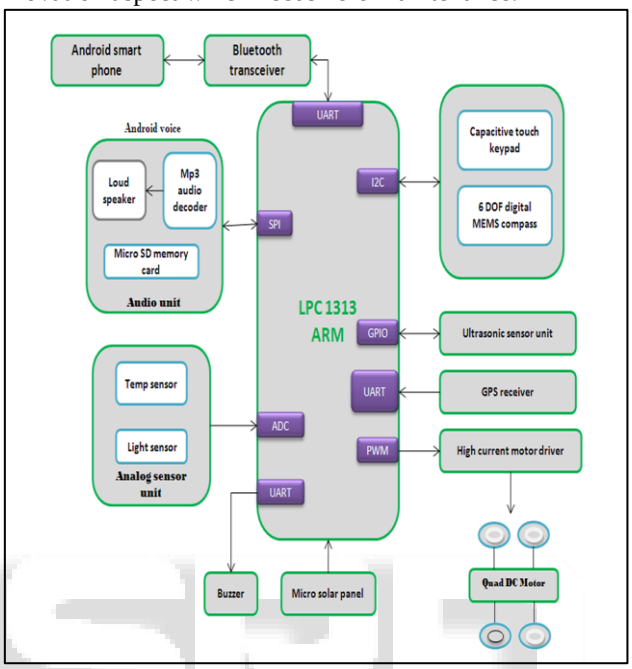

Fig. 2: Block Diagram of Proposed System

The block diagram of proposed system design is shown in figure 2. This prototype is made for not only blind people and also elderly people can use it. So that the proposed robotic assisting dog has the ability to follow a human when commanded with voice like real dog. Beyond this, many assistive technologies such as Entertainment, E-Skin Touch Emotional Intelligence, GPS fencing and General services are incorporated into this robot that further empowers the visually impaired and elder users. The purpose of this guide dog robot project is to enhance the mobility aids for the blind by providing them with the functions of guide dogs .i.e. Obedience in navigating a blind master, intelligent disobedience in detecting and avoiding obstacles and well organized with man machine communication and, like real guide dogs, the proposed robot has voice recognition which is popularly known as man machine communication. It can receive verbal instructions from users through their android smart phone and, unlike a real dog, responds back in words.

A. Android Voice Recognition Method:

Uses android mobiles internal voice recognition to pass voice commands to your robot Pairs with Bluetooth Serial Modules and sends in the recognized voice as a string. For example if you say Hello the android phone will return a sting *Hello# to your Bluetooth module *and # indicate the start and stop bits. We can be used with any microcontroller which can handle strings. Examples Platforms: Arduino, ARM, PICAXE, MSP430, 8051 based and many other

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processors and controllers HC-05 embedded Bluetooth serial communication module (can be short for module) has two work modes: order-response work mode and automatic connection work mode. And there are three work roles (Master, Slave and Loopback) at the automatic connection work mode. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of module can be switched by controlling the module PIN (PIO11) input level.

B. Answering User Questions by Robot:

The Twin MOS Micro SD Memory Card is functionally compatible with the SD Memory card but is smaller in dimensions. It can be inserted into a passive SD or mini SD memory Card Adapter and operate as an SD Memory Card. Twin MOS Micro SD Card TM is ideal for digital devices designed to use Micro SD Card. All the commands spoken by the user is stored in the memory. When the user asked any queries to the robot, the questions directly mapping with memory card, after that the commands processed by microprocessor with the help of interfacing sensors like sonar, digital MEMS, light sensor.

IV. HARDWARE DESCRIPTIONS

A. Arm Processor and Its Modules:

The LPC1311/13/42/43 operates at CPU frequencies of up to 72 MHz. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals. The ARM Cortex-M3 CPU also includes an internal prefetch unit that supports speculative branching. The LPC1311/13/42/43 operates at CPU frequencies of up to 72 MHz. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals. The ARM Cortex-M3 CPU also includes an internal prefetch unit that supports speculative branching.

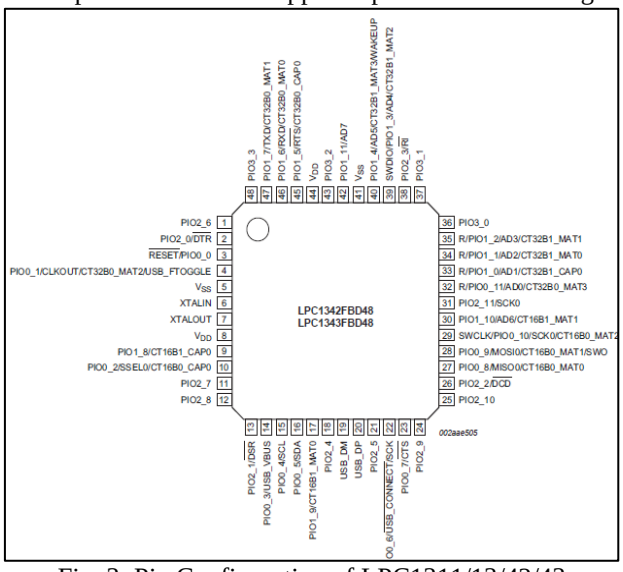

Fig. 3: Pin Configuration of LPC1311/13/42/43

Figure 3 shows the pin configuration of LPC1311/13/42/43. The peripheral complement of the LPC1311/13/42/43 includes up to 32 kB of flash memory, up to 8 kB of data memory, USB Device (LPC1342/43 only), one Fast-mode Plus I2C-bus interface, one UART, four general purpose timers, and up to 42 general purpose I/O pins. This application note describes a practical sonar system, using ultrasonic sound waves to determine the distance to obstacles, using a Microchip PIC16F87XA MCU. By measuring the time between sending the pulse and detecting the echo, the distance to the object can be determined.

B. GPS Fencing:

Global Positioning System (GPS) satellites broadcast signals from space which are used by GPS receivers, to provide three-dimensional location (latitude, longitude, and altitude) and precise time. Reliable positioning and timing services are provided by the GPS receivers to users all around the world continuously in all weather, day or night, anywhere on or near the Earth. Its main features are

- On chip 1Mb SRAM
- Low power consumption
- Multi path mitigation hardware
- Reacquisition time 0.1 seconds

In this technology GPS is used for detecting longitude and latitude for GPS fencing. GPS fencing is very useful especially in case of Robot theft. During night time if Robot theft takes place, an alarm is generated when Robot crossed beyond the particular area indicating the user that somebody taking it away.

C. Ultrasonic Sensor:

In the obstacle detection module, redundant ultrasonic sensors are used to increase detection resolution and sensor data reliability. Since ultrasonic sensors have a width dihedral detection angle, the resolution of detected obstacles is very low. The implemented approach uses always two ultrasonic sensors for one half of the same angle. Hence, though the double amount of sensors is needed, the redundancy and resolution is also doubled.

Fig. 4: Ultrasonic Sensor

In figure 4 shows the model of ultrasonic sensor and Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

The basic principle of work,

- Using IO trigger for at least 10us high level signal,
- The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.
- Test distance = (high level time*velocity of sound (340M/S) / 2.

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D. Capacitive Touch Keypad:

Free scale's MPR121 capacitive touch sensor controller simplifies design in the user interface of choice touch sensing. Embedded developers require design simplicity and power conservation in a small form factor for compact system designs. The MPR121 solution replaces mechanical buttons, switches and other moving parts that typically wear out and are less reliable.

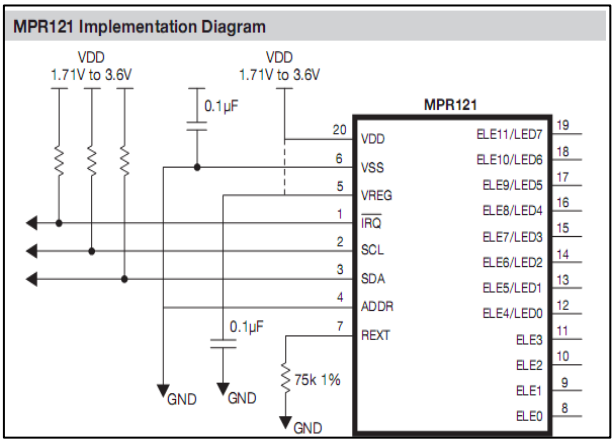

Fig. 5: MPR121 Implementation Diagram

MPR 121 implementation diagram are shown in figure 5 and the MPR121 next-generation device provides 12-electrodes with increased internal intelligence such as a flexible independent calibration feature, an increased electrode count, a hardware configurable I2C address, an expanded filtering system with denounce, and completely independent electrodes with built-in auto-configuration.

E. Motor Driver:

The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input.

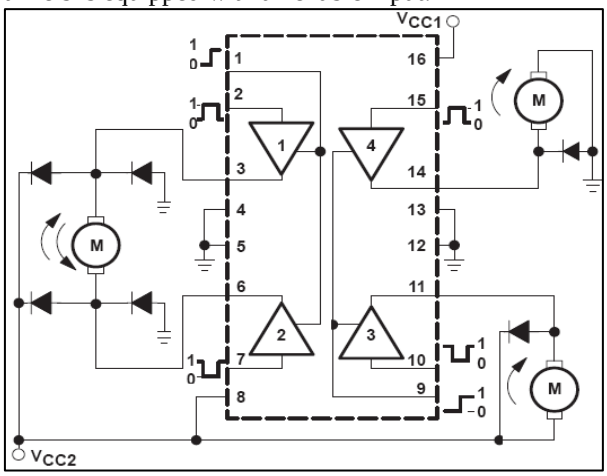

Fig. 6: Output Diodes Are Internal In L293D.

Internal L293D diode connections are shown in figure 6 and a separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together.

F. Quad DC Motor:

This DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses.

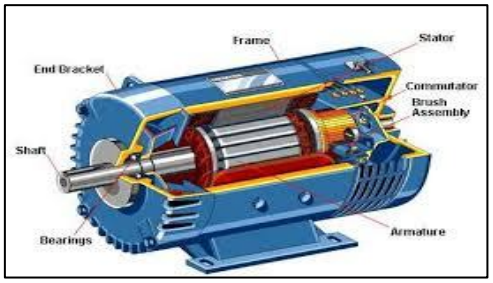

Fig. 7: Systematic View of Dc Motor

In this technology uses quad dc motor which is shown in figure 7.When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of dc motor established. The direction of rotation of a this motor is given by Fleming's left hand rule, which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which force is experienced by the shaft of the dc motor.

V. Results and Discussion

Let us discuss about the implementation of this technology. This system module is like a robotic unit, this guiding robot gives the information via external loud speaker. Memory card unit allow storing a audio file and command files. This application also used a capacitive touch pad for elder people; it eliminates the finger pain while using Braille keys. Voice recognition facility is advanced method which gives the fully hand free operations.

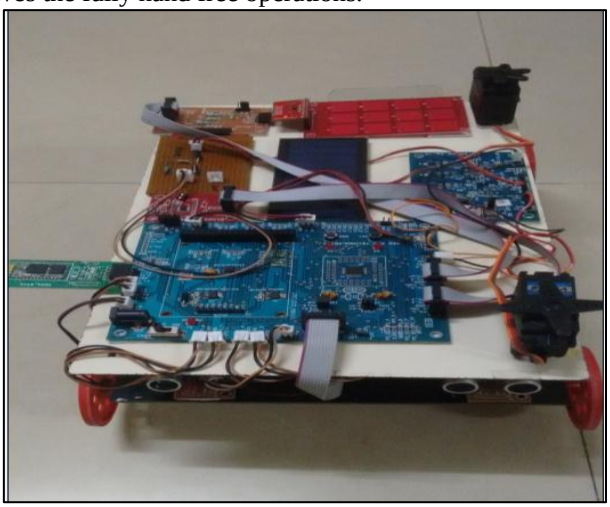

Fig. 8: Hardware Model of Completed System

The above figure 8 shows the complete model of the hardware unit. Nowadays power maintenance is a major concern, so this application solar panel used for sun finding intelligent charging, it eliminates the power maintenance

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issues. This robot provides the user information in audio format, including date, time, alarm, navigation direction, temperature and light condition. In this system additionally GPS fencing is used for safety purpose to avoid the robot robbery. Ultrasonic sensor is capable of measuring object distance up to 4m. ARM cortex m3 supports a Harvard architecture and it is a 32 bit processor which consumes a low power supply, so it also working in battery power unit.

VI. CONCLUSION

As we already discussed that 285 million peoples are in elderly and visually impaired in all around world. In this paper, a new guiding robot was developed for the blind and elder people. Detection of obstacles with the help of ultrasonic sensor, it gives the more accuracy than any other sensor types. In this technology used voice recognition method which helps to recognize the human voice, this process gives the 100% hand free operation. It is achieved by android smart phone. Additionally it acts as a watchdog robot, this helps to avoid the intruder activities. This project GPS fencing is used to prevent the robot theft and this guiding robot follows a human voice command. This system consumes low power and less maintenance.

REFERENCES

[1] Angelica Lim and Hiroshi G. Okuno. 'The MEI Robot: Towards Using Motherese to Develop Multimodal Emotional Intelligence' Vol.6, No.2, pp.126-138, 2014.
[2] Banse R. and Scherer K. R. 'Acoustic profiles in vocal emotion expression' J. Personality Soc. Psychol., Vol. 70, No. 3, pp. 614, 1996.
[3] Boucenna S. and Gaussier P. et al. 'Imitation as a communication tool for online facial expression learning, and recognition' in Proc. IROS, Vol.1, pp. 5323–5328, 2010.
[4] Burges C. J. 'A tutorial on support vector machines for pattern recognition' Data Mining Knowledge Discovery, Vol. 2, No.2, pp.121-167, 1998.
[5] Chuy O, Hirata Y, and Kosuge K. "A new control approach for a robotic walking support system in adapting user characteristics, "IEEE Trans. Syst., Man, Cybern., Vol. 36, No. 6, pp. 725–733, 2006.
[6] Fujie M, Nemoto Y, Egawa S, Sakai A, Hattori S, Koseki A, and Ishii T, "Power assisted walking support and walk rehabilitation," in Proc. 1st Int. Workshop Humanoid Human Friendly Robot., pp. 2693–2695, 1998.
[7] Hirata Y, Muraki A, and Kosuge K. "Motion control of intelligent passive-type walker for fall-prevention function based on estimation of user state," in Proc. IEEE Int. Conf. Robot. Autom, pp. 3498– 3503, 2006.
[8] Hirata Y, Hara A, and Kosuge k. "Motion control of passive intelligent walker using servo brakes," IEEE Trans. Robot., Vol. 23, No. 5, pp. 981– 990, 2007.
[9] Iwan Ulrich and Johann Borenstein 'The GuideCane-Applying Mobile Robot Technologies to Assist the Visually Impaired' Vol. 31, No.2, pp.131-136, 2001.
[10] Kiguchi K, Iwami K, Yasuda M, Watanabe M, and Fukuda T, "An exoskeletal robot for human shoulder joint motion assist. "IEEE/ASME Trans. Mechatronics, Vol. 8, No. 1, pp. 125–135, 2003.
[11] Kiguchi K, Tanaka T, and Fukuda T, "Neuro-fuzzy control of a robotic exoskeleton with EMG signals," IEEE Trans. Fuzzy Syst., Vol.12, No. 4, pp. 481–490, 2004.
[12] Kosuke Sekiyama and Toshio Fukuda 'Human-Walking- Intention- Based Motion Control of an Omnidirectional-Type Cane Robot' Vol.18, No.1, pp. 285-296, 2013.
[13] Lim A and Okuno H. G. "Using speech data to recognize emotion inhuman gait," in HBU. Berlin, Germany: Springer-Verlag, pp. 52–64, 2012.
[14] Masatoshi Seki, and Masakatsu G. Fujie 'A Haptic Interface "Force Blinker 2" for Navigation of the Visually Impaired' Vol.59, No.11, pp.4112-4119, 2012.
[15] Mavroidis, J. Nikitczuk, B. Weinberg, G. Danaher, K. Jensen, P. Pelletier, J. Prugnarola, R. Stuart, R. Arango, M. Leahey, R. Pavone,A. Provo, and D. Yasevac 'Smart portable rehabilitation devices' J. Neuroeng. Rehabil, Vol. 2, No.1, pp. 18–32, 2005.
[16] Mori.H and S. Kotani 'A robotic travel aid for the blind Attention and custom for safe behavior' in International Symposium of Robotics Research, New York: Springer-Verlag, pp. 237–245, 1998.
[17] Polzehl T and Schmitt A et al., "Approaching multi-lingual emotion recognition from speech-on language dependency of acoustic/prosodic features for anger detection," in Proc. Speech Prosody, 2010.
[18] Somnath Koley, Ravi Mishra,"voice operated outdoor navigation system for visually impaired persons", international journal of engineering trends and technology- Vol.3 issue.2, 2012.
[19] Shen P. and Changjun Z. et al. "Automatic speech emotion recognition using support vector machine," in EMEIT. Piscataway, NJ, USA, Vol. 2, pp. 621–625, 2011.
[20] Takeda, Y. Hirata, and K. Kosuge 'Dance step estimation method based on HMM for dance partner robot' IEEE Trans. Ind. Electron., Vol. 54, No. 2, pp. 699–706, 2007.
[21] Ulrich I and J. Borenstein 'The guidecane: Applying mobile robot technologies to assist the visually impaired' IEEE Trans. Syst.,Man, Cybern., A,Syst. Humans, Vol. 31, No. 2, pp. 131–136, 2001.
[22] Yu H and Dubrowsky S, "Omnidirectional mobility using active split offset castors," presented at the ASME IDETC/CIE 26th Biennial Mech. Robot. Conf, 2006.
[23] Yuusuke Oonishi and Yoichi Hori 'A New Control Method for Power-Assisted Wheelchair Based on the Surface Myoelectric Signal' Vol. 57, No. 9, pp.3191-3196, 2010.
[24] Xie L, Soh Y.C, and de Souza C.E "Robust Kalman filtering for uncertain discrete-time systems," IEEE Trans. Automat. Control, Vol. 39, No. 6, pp. 1310–1314, 1994.

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