ANDROID CONTROLLED HUMAN ASSISTANCE
ROBOT USING SPEECH FOR HUMAN ROBOT
INTERACTION

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ABSTRACT
The paper deals with the research related to the robot development for the aged people of the society. The robotic guide will be maneuvered using a smart phone. The user will be sending the instructions via an android application that has been developed. Voice commands can also be sent from the android application to the robot which will be received through Bluetooth and finally will lead to the control of the robotic guide. The map of the route will be fed into the robot so that it can take the user to the target destination detecting and avoiding all the obstacles that might be there in the path of movement. The entire project is developed in a way so that the compatibility constraints can be met with all types of smart equipment or a like a smart phone, a tablet or a laptop etc. that is capable of supporting an android operating system.

Keywords: Android, Bluetooth, route map, google voice to text, Speech Recognition, BOEbot, RFID etc.

I. INTRODUCTION

Presently most of the nations are rapidly entering into the aging population which leads to a huge part of the population to suffer from the limitations related to motion and mobility or the inefficiencies related to limb movement due to the lack of physical strength or nerve related issues. In addition to it, the augmenting aged society population creates deficiencies for activities related to assistance and nursing. Hence there is an urgent need to develop assistance guides that can replace nurses and therapists up to a partial level. At present a lot of researchers are working on assistance related to robotics are being done which focusses on numerous applications related to the fore limbs, hind limbs and the training related to assistance robotics for the entire human body. At present mobility or locomotion is one of the primary human activities, for the improvement of which the walker type robotic devices are used centering round rehabilitation goals. The study and development of such type of robots has now been dominating the field of human robot interaction research. Currently various walker robots that are intelligent in nature are being implemented which have efficient and intelligent
framework that comprises of active or passive wheels. Moreover certain robotic guides assists human with ambulatory services as well which enables the potential users to have satisfactory services in a cost effective manner. In addition to it, various researches are going on where the primary focus is with the working of passive robots dealing with the deployment of intelligent walkers that would act as an aid to the aged section of the society. However the present scenario in the ongoing researches comes with numerous loopholes and deficiencies primarily due to the following reasons:

- A wide range of these type of walker robotic devices are predominately designed for mobility in indoor environment when the maneuverability is limited due to the limitations of the spaces in indoor domains.
- Most of the environmental spaces that are encountered while movement consists of narrow spaces which comes in way as a hurdle for these type of robots because of its enormous size and unrestricted weight.

Therefore in order to help the aged people to take a walk outside enabling them to lead a high quality life and accelerate rehabilitation sufficient support in the form of concise, easy compatible and simpler handling devices are required. In order to fulfill this requirement an easier handling robot guide is developed to help the physically handicapped people to reach a particular destination avoiding all the obstacles that might come on its way. The design and construction of the robot will comprise of a BOEbot which has a Board Of Education embedded in it and is a proprietary of Parallax Inc. This BOEbot will be controlled by the user by the aid of an android application having four prominent keys for movement in the forward backward, left and right directions through which the robot will easily be able to navigate in these four directions and can finally reach the target location. The robot can also be controlled using voice commands where similar voice instructions will make the BOEbot move in this four directions apart from being able to reach a pre specified target location which are marked as LAB1 and LAB2 for experimental purpose. The voice commands will be sent over to the robots chassis using Bluetooth and thus making its control a wireless affair. The BOEbot is explicitly chosen as it is counters the above mentioned deficiencies due to its miniature size and light weight which can traverse in any path irrespective of the path dimensions thus aiding the user to move to a particular destination and direction by efficiently relocating itself in any type of indoor and outdoor environment. The language used for coding involves BASIC STAMP 2.5 which can be done in an editor. The language is extremely simple to decipher and implement and can easily be executed by any naïve programmer who wishes to create efficient codes in this platform. The speech recognition process involves google voice to text principles to recognize the commands and then finally converting them into symbols or instructions that are easily passed on to the BOEbot via Bluetooth. Since an android application is used in its design, it is compatible with all types of modern devices that can support am android operating systems which is a part of human day to days lives and can be easily be used by any new user without any prior training or guidance thus making the entire operation an extremely simplistic process.
II. LITERATURE SURVEY AND BACKGROUND

The field of designing, understanding and evaluation of robotic systems for the use of mankind is termed as Human robot Interaction. While doing so there is a mode of communication developed between the human and the robots, the communication of which can be primarily classified into the following 2 main categories.

A. Remote interaction — This interaction typically deals with the communication between humans and robots that are not located in the same place or time zone. Eg: various robots that are deployed in other planets for study based purpose like Mars Rovers etc.

B. Proximate interaction — this mode deals with the interaction between humans and robots that are collocated. For example the various service robots or the assistive robots are generally located within the same timeframe and space. Based on the social interaction, tele operation or supervisory control the interaction can be classified as remote operations. Generally proximate interactions are in the form of physical interactions and can be categorized into robotic assistants which involves social interactions in the form of peers and companions.

There are several researches that have been going on in the existing domain. O. Khatib et al., [1] have studied on the development of algorithms, models and strategies that are focused with various autonomous capabilities that are essential for the robot operations in human environments. These researches are related to the manipulation and integrated mobility, interaction efficiency with the humans and cooperative skills between multiple robots.

Hyun Keun Park et al. [4] developed a robot system named DO-U-MI to be used for nursing for The Elderly and The Disabled. The robot thus developed will help the old and handicapped people to move freely in the indoor environment primarily focusing on moving inside a nursing home. The project is extremely user friendly, however a minor limitation in case of manual control and lack of speech recognition comes into picture in this scenario. A major significant research work done by R. Rangarajan et al. [5], leads to the development and deployment of a speech controlled assistance robotic guide for the visually impaired so that it can aid the aged people as well as the blind people to reach the target location avoiding the various types of traffic and hindrances on the pathway. The robot can also charge on its own and can behave as a watchdog thereby proving an efficient mechanism for human robot interaction.

Similar work has been done by Arpit Sharma et al. [7] and they have developed a robot which is arduino based and this robot can be controlled via an android phone wherein an android application has been developed in order to control the maneuverability of the robot. Related works are also being done in the field of automated mobility issues and orientation for the visually impaired people by Abdel Ilah Nour Alshbatat [8], which involves the implementation of GSM-GPS module to pin point the location of the individual as well as to provide any type of information that is related to the obstacles that are obtained from the ultrasonic sensors. However the system depend on braille learning for its operation due to which it might be problem for its use as the individuals need to be trained exclusively. However results have shown that the blind people can smoothly travel to their respective destinations with ease and comfort.

A smart vision prototype for navigation has been developed by Joao Jose et al.,[9] which comes in wearable form and is concise in shape and size. Efficient Human Robot Interaction is achieved wherein dynamic obstacles are being avoided and the main functionality involve a camera to be worn at the height of the chest and is connected to a laptop that is worn in a bag pack or a pouch. It also consists of a speaker into which the user can speak into so that effective interaction with the machine is obtained. Similarly Brice Burger et al. [10] studied on multimodal
interaction between the human and robots specifically focusing on mutual assistance between speech and vision. A speech processing system was developed that detects the anaphoric and deictic utterances in speech forms. Life has become easier for the aged society with the various inventions and developments in the Human Robot Interaction field. Cumbersome activities like shopping etc. are also being dealt with in this research area wherein Chaitanya Gharpure et al. [11] developed mechanisms for enabling the blind people to move around for shopping experiences. This research has revealed several issues related to spatial cognition and product selectionin supermarkets. Additionally, Songmin Jia et al. worked on multiple user interfaces which has been deployed to enhance and improve quality of life, care and cost. Here an extensive use for the Radio Frequency Identification tags are being done which is easily detected by a camera and thus enables the user to avoid the obstacles. In a similar process Iwan Ulrich et al., [13], developed a Guide cane which could assist the elderly people to move about avoiding the obstacles as robotic technologies could be implemented by the device. However speech recognition and dynamic obstacles still are a limitation to this work.

III RESEARCH GAPS

The numerous researches executed in this field involved a huge number of loopholes predominately the following:

A. Portability

The current researches comprises of enormous equipment especially laptops and other accessories that needs to be carried around for an efficient rehabilitation. The robot that has been developed is small in size and is controlled via an android phone and hence need not be carried around. Moreover since it is developed in an android platform it can be mounted on any smart device that can be carried around in a pocket or palm.

B. Lack of Speech Recognition system

Most of the robots that are being developed lacks the speech recognition system thereby making it a very complex process of controlling the guide and involves rigorous amount of training and guidance to perform simple operations. However in the developed project the Speech recognition system that has been integrated comprises of google voice to text system which makes the entire system to integrate with the cloud thereby deriving information from the cloud database as a whole and makes the entire system a cloud based robotics framework.

C. Limitations related to Route Decision System

At present the available systems lack the decision making procedures due to the loopholes related to path related attributes due to which the robot is unable to reach the pre specified target location. This project involves a suitable path definition system where the robot can chose a path efficiently and the assigned path will efficiently make the robot reach a particular target location at the earliest possible time limit without any collision with any of the obstacles on the way.
D. Complex Operation mechanisms

The mode of operations in the existing system involves a lot of complex mechanisms for its smooth functionality which involves a large number of Radio Frequency Identification tags and sensors thereby making the framework very complicated and difficult to understand and utilize.

E. Presence of Dynamic obstacles on the path

Generally fast moving vehicles, humans and animals may come in the path thereby creating dynamic obstacles on the way which are sudden occurrences and are difficult to control. The study of the limitations related to the present work reveals the need for a robotic guide which is simple in architecture and operations and leads the user to the specified target location without colliding with any of the obstacles on the way. The robot should be built in such a way that it doesn’t requires any prior training for its smooth operation and can be easily operated using voice commands.

IV METHODOLOGY

A. Module 1: BOEbot controlled by Android application

Initially the development process involves the design of an Android application which consists of four different keys to control and maneuver the BOEbot in four different directions namely ‘left’, ‘right’, forward’ and ‘backward’. The android app thus developed will be connected with a BOEbot via the Bluetooth module primarily a Easy Blue 500 Bluetooth module developed by Parralax Inc. The application is developed in such a way that it can maneuver the robot in the above mentioned four directions and it will continue to move in the direction in which the key is pressed. Moreover the additional keys that are named as ‘LAB1’, ‘LAB2’ and ‘ROUND’ will make the robot move to a pre specified target location without colliding with any of the obstacles on its way. The instructions are transmitted from the android application to the BOEbot via a Bluetooth module. The instructions thus received are then processed by a microcontroller embedded in the BOEbot’s chassis for the desirable direction of motion.

B. Module 2: BOEbot controlled by Speech Recognition

The next module involves integration of the speech recognition module along with the initial module so that the robot can be controlled by sending voice commands. For this purpose the most simplistic and easily available google API has been used which is known as Google Voice to Text. With this tool certain voice commands are given into the application which then connects to the cloud database to retrieve the text equivalent information. The converted text from the voice inputs are then again converted to numerical instructions and are passed on to the robot via Bluetooth and are processed for further actions to be taken. This module too performs equivalent operations as compared to the initial module. However the only difference which lies with both the modules is that the second module can easily communicate using the voice commands and thereby reduces the manual activity to a great extent.
C. System Architecture: The complete system architecture of the framework is shown in Fig 1.

![System Architecture](image)

Fig 1: System Architecture

V REQUIREMENT SPECIFICATION(HARDWARE AND SOFTWARE)

The hardware and software requirements of the entire project is given below

A. Software framework

- Eclipse IDE-Juno (Java Developers version) with the Android plugin.
- The Java Development Kit (JDK)
- Android SDK and add-ons
- Basic Stamp 2 (Parallax Inc).

B. Hardware Requirements

- RAM 3 Gb and above (as android applications require high end processing)
- BOEbot (Parallax Inc) robot.
- EasyBlue 500 SER which represents the Bluetooth module
- Any type of smart phone or a tablet which can support an android operating system.

The primary development phase requires a mobile phone with an android operating system mounted on as the initial hardware component. Due to its platform independent nature and open architecture it is widely used by the software developers in addition to the provision of various communication devices like Bluetooth, USB, WiFi etc. which can enhance the cost effectiveness as compared to any ARM based processing unit. The robot’s brain constitutes of a Basic Stamp microcontroller where the program can simply be fed into from the basic stamp editor. It is low in cost and easily available. For Bluetooth communication the Easy Blue 500 SER Bluetooth module developed by Parallax Inc. is used which looks like figure 2 a shown below. This Bluetooth module is then configured with the BOEbot robot (shown below) and is used for communication with the android application.
Java programming language along with Android SDK and add-ons are used for the development of the android application. The application development involves Eclipse IDE and Java Development Kit (JDK) and Basic Stamp 2-2.5 is used to write into it. The android application looks like Fig 3 that is shown below:

Fig 3: Android Application

The four different keys will make the robot move in four different directions with involves left, right, front and backwards The three keys that are present in the lower panel represents the functionality that involves the robot to maneuver to 2 particular target location for experimental purpose and then a take a round trip from the destination points. The Google voice to text API is used and is used for the recognition of voice commands thereby creating an interface as to where the user will speak and retrieve the voice commands in the form of text or strings which are then finally processed and sent to the target BOEbot’s microcontroller to derive the necessary actions. This application can be supported in all the android operated devices.

VI DESIGN

The overall design strategy of the project is divided into 2 parts:

1. Wired communication or Initial System design.
2. Wireless communication or Final System design.
A. Wired Communication design.

Fig 4: Wired Communication design

The initial system design comprises of the BOEbot robot to be connected to a laptop via a USB cable and the program thus used to maneuver the robot is simply dumped into the microcontroller of the robot through the wired medium. The android application will be sending the keystrokes via the wireless medium i.e. the Bluetooth module that is being mounted on the robot will make the microcontroller receive the instructions.

B. Wireless communication design.

Fig 5: Wireless communication design

The final system design comprises of wireless communication from both the end i.e. application will communicate with the BOEbot via Bluetooth medium and the voice commands can be transferred from the android application to the BOEbot using Bluetooth and thus the robot can be controlled wirelessly efficiently performing all the functionalities.

VII ACHIEVED GOAL

The following are the primary functionalities that are executed by the developed project from the laptop terminal thus directing the robot to move in any particular direction.

1. Forward, Backward, Left, Right with the help of the four keys. Of the keyboard W, A, S and D respectively.
2. Steer to Lab 1 using 1 key
3. Steer to Lab 2 using 2 key
4. Steer to Home using 3 key
5. Make a round trip using the 4 key.

The left, right, forward, backward keys will make the robot move to the respective directions till the key is continuously pressed. The Steer to Lab 1 and Steer to Lab 2 functionalities will be accomplished when the robot
will move 22 seconds forward and then take a left turn or a right turn depending on LAB1 and LAB2 respectively. These type of similar functionalities are also attained using the android application. However an additional benefit to it comes in the process when speech recognition was integrated with the current application and BOEbot can be controlled wirelessly through the android application on any android device by simply sending voice commands into the console. The app is capable of recognizing all of the above instructions and can perform similar functionalities with lesser amount of effort and manpower involved.

![Laptop Implementation window which enable the BOEbot to be controlled via keyboard in a wired communication.](image)

**VIII CONCLUSION**

This project would serve as a boon to Human Robot Interaction domain and can assist the aged society and the partially visually impaired category of people to a great extent. Locomotion and mobility becomes a simple affair in the presence of such type of assistive guides which involves minimum amount of effort in addition to keeping pace with the latest technology. The application greatly reduces manual effort and no prior training is required to use this equipment. It will prove much more user friendly to the blind people as it can be controlled by voice commands and no prior knowledge about braille is required to efficiently use this application. The application is built using the latest technology and hence it is compatible with any type of devices that can support an android operating system proving it to be a blessing in technology to make life simpler.

**REFERENCES**


