Voice Controlled Human interacting Wheelchair

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Abstract - *Many physically disabled users are unable to operate a powered wheelchair safely, without causing harm to themselves, others, and the environment. Human interacting wheelchairs that help out or replace user control have been developed to make available for these users, utilizing systems and algorithms from autonomous robots. Even though a constant period of research and development of robotic wheelchairs, there are very few available commercially. Developing a navigation system that is intended at being retro-fitted to powered wheelchairs. The navigation system developed takes a systems engineering approach, integrating many existing open-source software projects to deliver a system. The navigation system introduced in this opinion is aimed at operating in an free indoor environment, and requires no a priori information about the environment. The key components in the system are: obstacle avoidance, map building, localization, path planning, and autonomously travelling towards a goal. The test electric wheelchair was instrumented with the following: a laser scanner, wheel encoders, camera, and a variety of user input methods.*

Key Words: **Raspberry Pi, Laser sensor, Methodology, POMDP algorithm**

1. INTRODUCTION

Power assisted wheelchairs give a level of independence to mobility impaired users. Control of the wheelchair is usually through the use of a joystick. However, there are many users who have various cogitative impairments that prevent them controlling an electric wheelchair safely, without causing harm to themselves, others and collisions with the surrounding environment. Despite the need for higher levels of user-assisted control modes, few intelligent wheelchairs are available. Due to the lack of commercial availability, this has given result in a limited clinical impact and thus lag of acceptance.

The goal is to provide for this group of users, by creating a wheelchair navigation system capable of providing autonomous operation, obstacle avoidance, and simplified command routines that is commands given in natural languages. Currently there are no commercial systems available with this capability. Develop a navigation system that is able to drive an electric wheelchair from point to point without human interference. The focus is on cost-effective solutions able to operate in free indoor of residential environments which can be easily retro-fitted to a range of electric wheelchair types while being simply pushy to the user.

2. REVIEW OF LITERATURE

In paper [1], it gives the study of use of Joystick, and sensors in one direction. [2] This paper proposes the use of joystick and Head Movement based control wheelchair. [3] Integrated robotic architecture that can achieve the above steps by translating natural language instructions incrementally and simultaneously into formal logical goal description and action languages. [4] Use of Joystick for control of speed and direction, use of controllers for transmission of emergency data and activation of alarm system. [5] The tour-taking behavior is demonstrated in a multi-floor office building and evaluated by assessing the comfort of the tour guides, and by comparing the robot's map partitions to those produced by humans. [6] System that follows natural language directions by extracting a sequence of spatial description clauses from the linguistic input and then infers the most probable path through the environment given on information about the environmental geometry and detected visible objects.

The different paper related to wheelchair has studied. Form study it is found that the recent studies shows that the user facing some problems with joystick-controlled powered wheelchair. For this reason the necessity of the voice command come forward which become easy to use. Some common problems can be solved with the help of controlling of wheelchair using remote, typing, or by touch screens. But some people who are unable to type or having visual problem but able to speak they can easily use this wheelchair.

3. PROPOSED SYSTEM

Powered wheelchairs that have been instrumented with sensors and have an on-board computer. They have been designed to provide navigation assistance in a number of different ways, including: collision avoidance, aiding specific tasks (e.g., passing through doorways), and autonomously transporting the user between locations. It is controlled mainly through speech recognition. Unlike previous voice controlled smart wheelchairs, the user is able to use natural speech. This makes the wheelchair suitable for patients who may have suffered a brain injury or the loss of limbs but who are still capable of speaking. Fig 1 represents the proposed system of wheelchair.

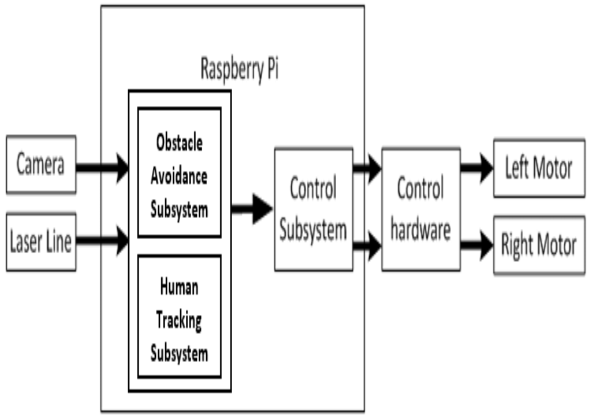

Fig 1: Block diagram of proposed system

Absolute positioning within a composite is based on spatial variations in WiFi signature. When the wheelchair came across an unfamiliar access point's signature, the system prompted the user to enter their location. Gradually, the system learns the positions of the access points, and can thus localize itself to within 10m 92% of the time. The wheelchair has also been able to with forward- and rear-facing laser scanners, used for obstacle avoidance and to generate a map of the environment (on Simultaneous Localization and Mapping (SLAM)). The natural speech interface is also used to train the wheelchair. When it is being trained, it follows a `tour guide' around the environment. The keywords the tour guide says are spatially tagged to locations within the environment. This permits the user to ask the wheelchair to take him or her to a destination autonomously.

4. RASPBERRY PI

The latest one Raspberry Pi 4 is used for this. It has a 1.5GHz quad-core 64-bit ARM Cortex-A72 CPU (~3× performance) 1GB, 2GB, or 4GB of LPDDR4 SDRAM. Full-throughput Gigabit Ethernet. Dual-band 802.11 ac wireless networking. Bluetooth 5.0, Two USB 3.0 and two USB 2.0 ports, Dual monitor support, at resolutions up to 4K, Video Core VI graphics, supporting OpenGL ES3.x 4Kp60 hardware decode of HEVC video. Complete compatibility with earlier Rasberry Pi products.

5. FRONT AND REAR LASER

A laser emitter transmits visible laser light through a lens, towards a target or object. Advanced laser sensors operate based on the principle of optical triangulation, which incorporates the linear imager, identifying where the target is in front of the sensor to achieve an accurate, stable measurement.

6. VOICE RECOGNITION:

Due to low bandwidth devices as they provide adequate control without the safety net provided by obstacle avoidance. So that voice recognition control system contains the obstacle detection and avoidance system in built. There are many voice recognition systems are available for example Nav Chair[7], SENARIO[8], and The MIT Intelligent Wheelchair Project[9]. Who suffer from severe motor impairments these types of voice recognition control systems are beneficial. By giving the defined key-words like “Go”, “Stop”, “Forward”, “Backward” etc. wheelchairs can be controlled. But the controlling of wheelchair by using natural speech will be more beneficial and it will be more helpful to the persons who have brain injury, loss of limbs or physically disabled persons but who can able to speak. Controlling of the wheelchair by using natural speech can be achieved by using Partially observable Markov Decision Process(POMDP). BY using this process the model can able to determine the user’s intension in the presence of ambient noise, linguistic ambiguity etc.

7. POMDP ALGORITHM

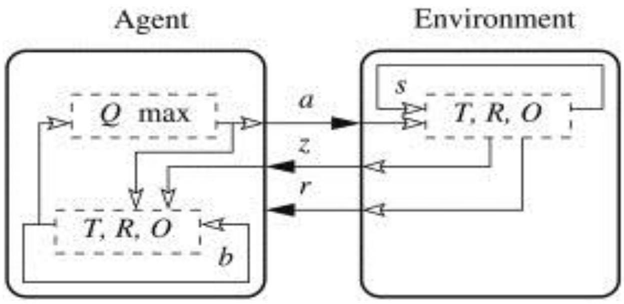

Fig 2: Partially Observable Markov Decision Process

POMDP stands for “Partially Observable Markov Decision Process. It is generalization of Markov decision process. System dynamics are determined by MDP and a POMDP models an agent decision process but the agent can not directly observe the underlying state[10]. It contains the variety of real-world sequential decision processes such as robot navigation problems, machine maintenance and uncertainty.

A discrete-time POMDP models the relationship between an agent and its environment. Formally, POMDP is a 7-tuple (S, A, T, R, Ω, O, **γ),** where S is a set of states, A is a set of actions, T is a set of conditional transition probabilities between states, R=S×A is the reward function, Ω is a set of observation, O is the conditional observation probabilities γ ∈ [0, 1]is the discount factor. At every transition there is a time period. For every time period the environment is in some state s ∈ S, agent takes an action a ∈ A. The discount factor γ determines how much immediate rewards are favored over more distance rewards.

8. FUTURE SCOPE

The future scope is to make the advancement in this wheelchair are possible by decreasing the power requirements of the wheelchair or finding a way to automatically charge the battery with the help of the motion of wheels and also it affects the cost of wheelchair.

9. CONCLUSION

The designing of human interacting wheelchair enables the movement of wheelchair in any direction with the help of voice commands. This wheelchair improves an ordinary powered wheelchair using sensors to perceive the wheelchair's surrounding, a speech interface to interpret commands, a wireless device for room level location determination, and motor-control software to effect the wheelchair's motion. As it is aware of its surrounding so that it can assist its user in many of tasks. People who uses joystick-controlled powered wheelchairs, this technology can also develop safety for users by preventing collisions with walls, fixed objects, furniture and other people.

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BIOGRAPHIES

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