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Autonomous Navigation of Smart Wheelchair using Kinect Camera

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***Abstract*— The smart chair assisted navigation system is being developed to increase the movement of handicapped individuals. The smart chair has a linux based computer system with infrared sensors and RGB-D kinect camera. Work on the smart Chair has prompted the development of obstacle avoidance, door passage and automatic wall following. This paper details this past work on the Smart Chair and also presents work that is to come.**

***Index Terms*— Smart chair, kinect camera, obstacle avoidance, door passage, RGB, SLAM,NavChair etc**

I. Introduction

which gives mobility to users and transport the human users that require it to move from an initial position to its final position with specified acceleration and velocity By sharing vehicle control decisions regarding obstacle avoidance, safe object approach, maintenance of a straight path, etc.,it is hoped that the motor and cognitive effort of operating a wheelchair can be reduced.. In the present decade the controlling of a wheelchair is through the arm rested mounted joystick. Here the mobility refers in terms of independent as it plays an important role in “aging” these types of assisted living (wheelchair) is usually necessary when adults become unable to walk. All the movements are predetermined before the operation start and the mobile robot will navigate accordingly. The autonomous vehicle can acquire this task by using sensors to “see” (SLAM) [1] where it is and what is around it. The goal in developing the smart Chair is to try to provide the individual with an appropriate level of navigation assistance that permits them to independently operate a powered wheelchair. In working to obtain this goal every attempt is also made to provide the highest level of performance possible.

I. TYPES OF SMART CHAIRS

The NavChair

It was initially started at University of Michigan during the year 1993 to 2002 with computer system and a series of ultrasonic range finders for detecting and finding obstacles and wheel encoders for odometry with the help of a joystick[2] [3]. Examples of individuals who get benefited from this level would include those who are suffering with quadriplegia or quadripareses resulting from spinal cord injury, neuromuscular disease, or cerebral palsey, and those individuals who are suffering with perceptual impairments resulting from brain injury, stroke, congenital conditions, etc. The architecture is shown in fig 1

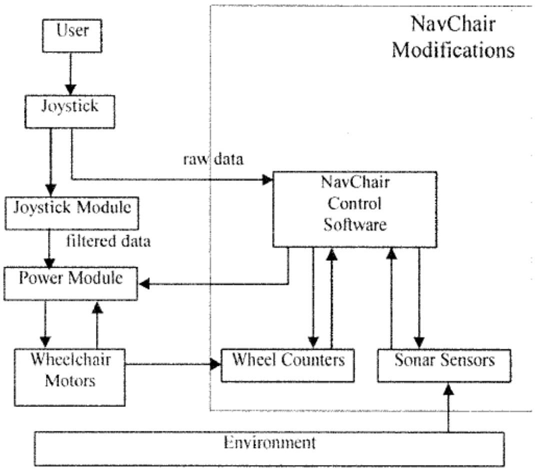

Fig.1 Architecture of smart chair

A. *MIT Intelligent Wheelchair Project*

The MIT Intelligent Wheelchair Project [5] was initially started in era of 2005 shown in fig 2.This project is controlled through speech recognition. But this is not in case of voice controlled smart wheelchairs (such as NavChair [3] and TetraNauta [4]). This makes the wheelchair suitable for those patients who may have suffered a severe brain injury or the loss of limbs in any case but who are still capable of speaking.

Fig.2 MIT intelligent smart chair

II. RELATED WORK

Researchers [6] developed assistive wheelchair system for handicapped people and system receives input via joystick and sonar sensors and uses specific set of commands. For obstacle avoidance in autonomous mobile robot, one navigation algorithm used that is Minimum Vector Force

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Histogram. One useful way to categorized smart wheelchairs is based on how they allocate control between the wheelchair operator and the wheelchair itself.

Some smart wheelchairs [7], [8], [9],[10], [11] operate in a way very similar to autonomous robots, the individual gives the wheelchair a final destination and supervises as the chair plans and executes a path to the target location. To reach their destination, these systems typically require a complete map (SLAM) [1] of the area through which they navigate and are usually unable to redress for unplanned obstacles or travel in unknown environment.

One group of smart wheelchairs assists only with collision avoidance, and the individual has all the duties of planning and navigating. These smart chairs do not normally require an internal map of an area or any specific alterations to the environment. In lieu of that, they do require more planning and continuous individual assistance and are only appropriate for individuals who can effectively plan and execute a path to a destination.

A final group of smart wheelchairs offers both autonomous and semiautonomous navigation. Smart chairs have also been used to explore a variety of alternatives to the more "traditional" input methods associated with powered wheelchairs (e.g., joy-stick). Automatic speech recognition has generally been used for smart wheelchairs, because of the low cost and wide availability of commercial speech recognition softwares.

III. Proposed Methodology

This paper discusses proposed system which uses Vector Force Field approach. VFF was developed for autonomous robots. The VFF method has been modified to work with irregularly shaped mobile robots [12] and has been implemented to the smart Chair system, as well (see Fig.3) But the core is that, VFF works by permitting every object detected by the Smart chair's sonar sensors to exert a repulsive force on the Smart Chair's direction of movement, modifying its path of movement to avoid collisions.

The repulsive force exerted by each object is proportional to its distance from the vehicle.

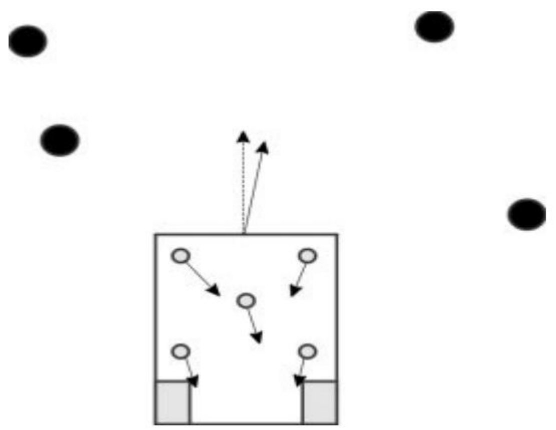

Fig. 3 The black circle represent obstacle the gray circles are the five locations at which repulsive forces are calculated and extended lines are repulsive forcesat each of the point

IV. Results

Table1 Measure performance are compared using Vector Force Field as approach 1 when smart chair moving in a hallway.

	Approach 1	
Speed(m/s)	0.73	0.74
turn	0.55	0.53
jerkiness	0.95	0.68

The results shown in table 1 are totally based on movement of smart chair.

V. Conclusions and Discussions

This paper has provided an overview of the Smart Chair system Performance of the Smart Chair has demonstrated its potential as an efficient approach to providing independent mobility to a wide range of individuals who cannot independently control a powered wheelchair system. The design of the Smart Chair promptly allows for different operating levels ranging from simple obstacle avoidance to fully autonomous navigation. There is also a need to add more environmental sensors to the Smart Chair. Currently, the Chair has very few sensors on its sides and does not have any sensors at all on its back.

There is lot of work to be done, if there is any presence of error that is Circular Error probability (CEP).

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