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ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

A Review: Haptic Glove in Medical Training

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Abstract: Pointing at actualization of direct and instinctive collaboration between human and robot, we are developing an interface system for a mobile robot to communicate with the user via hand gestures. Autonomous and semi-autonomous mobile robots are often equipped with sophisticated sensors designed to provide the system with a model of its surrounding environment. The paper describes widely used haptic technology in a form of glove. The invention of force and touch feedback has raised their realism to virtual world. The glove is designed to feel and interact with virtual environment. The mobile is designed along with the glove to explore the virtual world. The developed haptic glove provide force feedback to the fingers of users and accordingly it will interact with the mobile robot. So, basically the device should be light in weight and wireless actuator system; so that it can easily fit on the bare hand of the user and the user can freely make a hand movements without feeling restricted. The primary goal of this project is to achieve such a mobile robot which is controlled by wireless system i.e glove by recognizing hand gestures which is based on haptic technology.

Keywords: Exoskeleton, haptic interface, Force Feedback, mobile robot, telesurgery.

I. INTRODUCTION

Haptic technology can be defined as generation of touch sensation through tactile feedback. This tactile sensation can be in the form of appied force, motion vibration. Every haptic device consists tactile sensors which are used to measure the force applied by the user. Generally motors or actuators are used to achieve haptic sensation through vibration. Haptic enables user to experience a realistic environment, with users feeling the action of the application being accessed. Haptic perception relies on sensory signals arising from haptic interaction with a real or virtual environment. They can be used in many areas of application; like telesurgery, medical training, gaming, rehabilitation etc.

Haptic feedback is divided into two modalities-Force and touch feedback. Touch feedback is needed to gain the information about virtual object like temperature, size, distance etc. Force feedback opposes the user's motion, and is intended to convey information on virtual object hardness, weight, and inertia. Haptic feedback increases the simulation realism and the application domain of virtual environments. For example, it is hard to imagine how a surgical simulator could be useful without haptics.

The Haptic Glove is a wearable device that simulates tactile sensations of virtual objects. Past many years, different haptic devices with multiple fingers were implemented. These devices are further divided into two categories-Grounded haptic devices and Exoskeleton haptic devices. Ground-based haptic devices provide the capability of adding force feedback to virtual environments; however, the physical workspace of such devices is very limited due to the fixed base. Exoskeleton type haptic devices are mainly shaped like a glove to fit into the back of the hand. Since the shape of the device is just like a human hand, the operator can manipulate it instictively.

We created a glove that provides tactile feedback of virtual objects. When activated, it provides real feedback about the tactile sensation of holding a virtual object. There are indeed certain reasons behind using haptic technology. One main reason is that a haptic system with a real force-feedback is capable of delivering a maximum force that matches the human hand output force**.** The system contains some challenges related to the given haptic design. These challenges are listed below-

1) Size and Weight- The proposed design has to be small in size and light in weight; So that it can easily fit on the bare hand of the user;
2) Flexibility of mechanism-to give sufficient ability without constraining any hand motions;
3) Dynamic range- to be flexible enough to be used in sensitive activities and large force situation.

The other main challenge includes, The hand gestures should be unrestricted so that user can make desire hand movements.

II. RELATED WORK

The given glove system provides a real feel of grasping applicable to all segments of the finger, and also fulfills the requirements of size, weight and flexibility mentioned in the introduction. An Arduino board is used .Servo motors and accelerator is mounted on the glove. PCBs are used to maintain the weight of the glove design. The mechanical motion is converted into the electrical motion using potentiometer. The potentiometer produces these electrical pulses which are on the way for the arduino board. Now this board processes on these signals received from the potentiometer and convert those signals into the digital form and sends to the servomotors. This motor reacts as per the pulses and hand motion of the user. It can

be summerized as the microcontroller interfaces these components described above.

III. PROPOSED METHODOLOGY

The system involves control interface and glove skeleton. The inverse kinematics is applied to measure the finger's position. The control unit plays main role into this system. It will calculate the velocity commands and transmit it to the mobile robot to control it. When the mobile robot receives the command, it controls the speed of the two wheels accordingly.

A. Proposed Block Diagram

The proposed system consists the haptic glove and mobile robot. The microcontroller is used to read force sensor data and to communicate with the robot. Different force sensors are used here to feel the virtual object. Flex sensors are embedded on the fingertips of the user's glove. Meanwhile, the obstacles distance information collected by ultrasonic sensors is converted by the mobile robot in the form of a virtual force and sends it back to the haptic glove, which generates force feedback to the user to represent the robot's proximity to obstacles. Position sensors are used to determine the distance information, which can be helpful in mapping. Hand gestures are extensively used in the literature for control of mobile robots. Glove mechanism can be measured through the hand gestures of the user and then it is converted into the command form and transmitted to the mobile robot in the form of velocity commands. Communication between the robot and the glove can be established via wireless module called XBee (1-mW transmission power at 2.4 GHz provides 30-m working range indoors). The adoption of such RF module makes the glove portable, wireless and compatible.

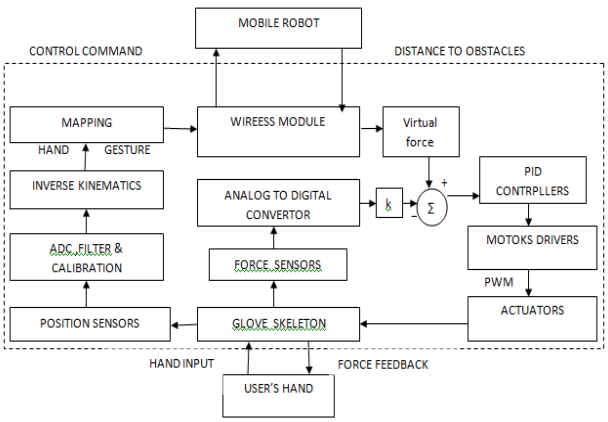

Fig. Proposed system block diagram.

When the glove is in active state,force feedback can be felt by the users on the fingers.When the robot is getting close to any object or moving fast;The user will feel large force feedback.

IV. CONCLUSION

The paper is all about haptic technology used to implement the glove. A sensor based haptic glove is designed along with mobile robot. And the robot is controlled through the hand gestures making by users. The main objective of this paper is to introducing such a haptic technology which might be useful to induce desire movements. The proposed device is light in weight and wireless as per required. Future work contains certain opportunities. There are areas of improvement, which needs to be considered. Firsty, Designing such a method which allow user to interact with virtual world which consists comparatively larger workspace. Other furtherance includes todetermine the method how to avoid object collision. This needs to be consider. In order to meet this requirement, we should use on board sensors on the mobile robot to detect limits and to modify the velocity commands received accordingly.

ACKNOWLEDGMENT

The author is grateful to her guide **Prof. Dr. A.D. Kumbhar** for contributing his knowledge, guidance and support. Without his persistent help this dessertation would have not been achieved. Author would also like to thank her Head of department **Dr. S.K. Shah** for all her encouragement she could seek for.

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