1. Research outline diagram

Outline your research proposal using graphs, charts or other visual aids in the box below.

Research Subject	Tactile Sensing Hand With Sensor Feedback for a Mobile Platform That is Useful in Indoor Exploration and Environment Manipulation

A project is proposed to develop a tele-manipulative robot hand on a mobile platform and its control algorithm (Figure 1). It will have a tactile sensing hand to send haptic feedback to the operator. The mobile platform will move in x-y plane and the arm will have the movement in the x-z plane. Furthermore, additional components for orientation in x, and y directional rotation will be introduced with rotational joints at the wrist of the hand (Figure 2). A joystick will control the platform. Cameras mounted on top of the vehicle will give the operator the visual data needed to navigate and manipulate the hand. Finer movements of the hand will be controlled according to the haptic feedback received from the robot hand and this approach will increase the manipulation accuracy compared to manipulation aided by visual feedback alone.

I intend to use 15 MEMS based acceleration sensors incorporated sensor glove for the user control of the robot hand. This approach will free the users remaining hand to manipulate the robot platform. This will allow a single operator to control all the components of the robot making the use of the robot simple and quick. The complete system will act as an extension of the operator's hand. Inbuilt balloon tactile display [1] in the glove can give the haptic feedback to the operator. Use of wireless communication devices such as ZigBee modules for communication is proposed. The use of soft fingers is proposed because it can grasp objects much easily compared to hard fingers because the fingers deform along the surface of the object.

The predominant focus of the research would be to design and build the control system of the robot hand. The control of the hand is immensely important, as precise control is needed for the precise grasping and object manipulation. Due to the none-linear behavior of soft finger deformation, an algorithm has to be devised for the control of it. Additional degrees of freedom from the mobile platform will increase the complexity of the system. Furthermore, not only sensor inputs (vision and tactile sensing) but also operator's intentions have to be included in the control algorithms making it a worthwhile research to peruse. In this research, a theoretical model for the control of the hand and a simulation of the theoretical model is to be developed. The results from the simulation are to be verified by an actual set up.
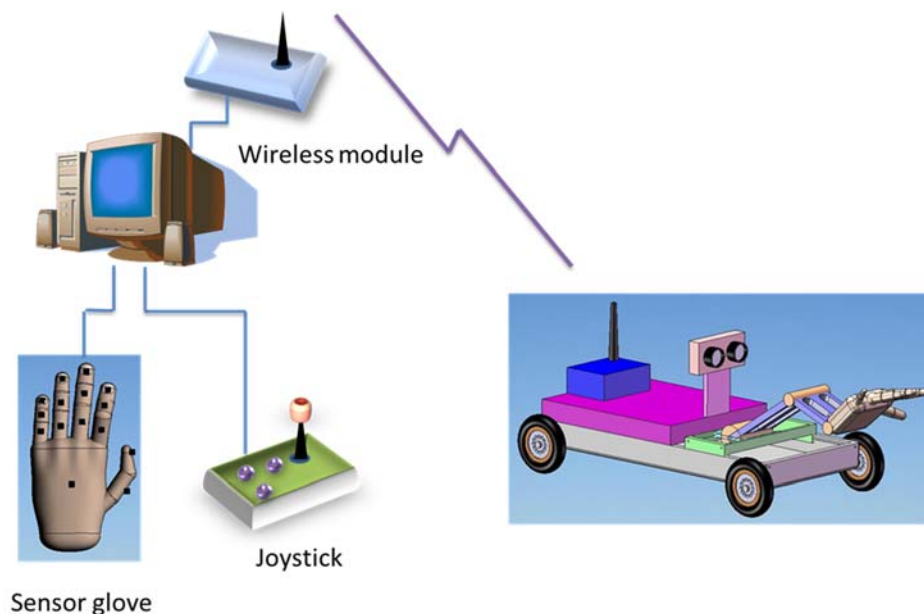

Figure 1: Schematic diagram of robot hand system
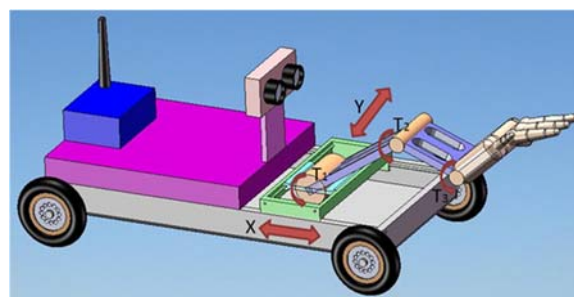

Figure 2: Proposed robot design

[1] Chih-Hung King, Martin O. Culjat, Miguel L. Franco, James W. Bisley, Erik Dutson, and Warren S. Grundfest, "Optimization of a Pneumatic Balloon Tactile Display for Robot-Assisted Surgery Based on Human Perception," IEEE Transactions on Biomedical, vol. 55, No. 11, 2008.

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