BACKGROUND EXPERIENCE ON ROBOTICS RESEARCH

Presented
by

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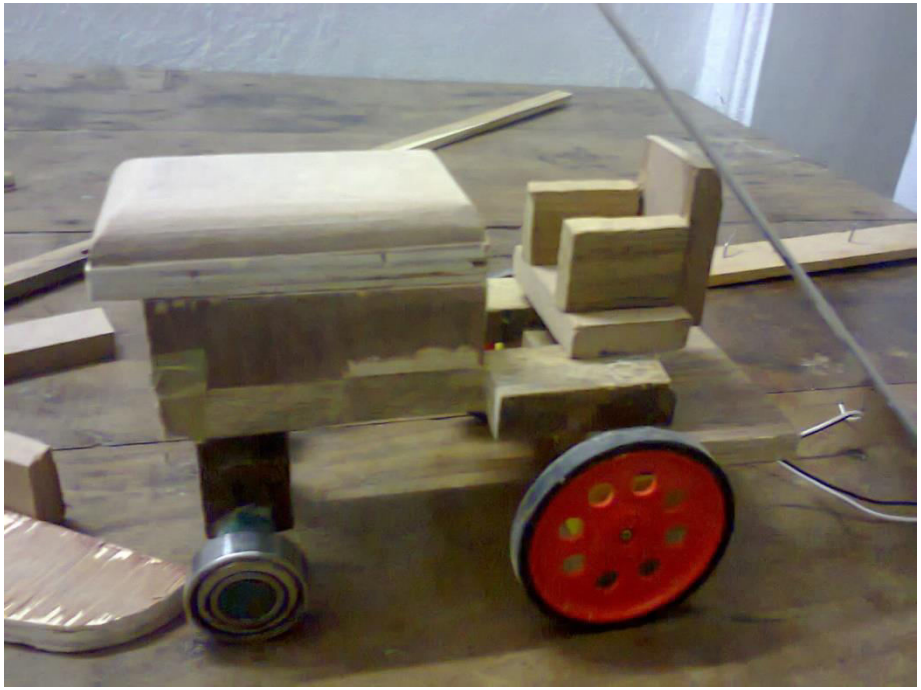
My Robotics interest start

- During my high schooling I built my robot.
- Used all the components from garbage.



Robotic Tractor which I build with Remote Control System

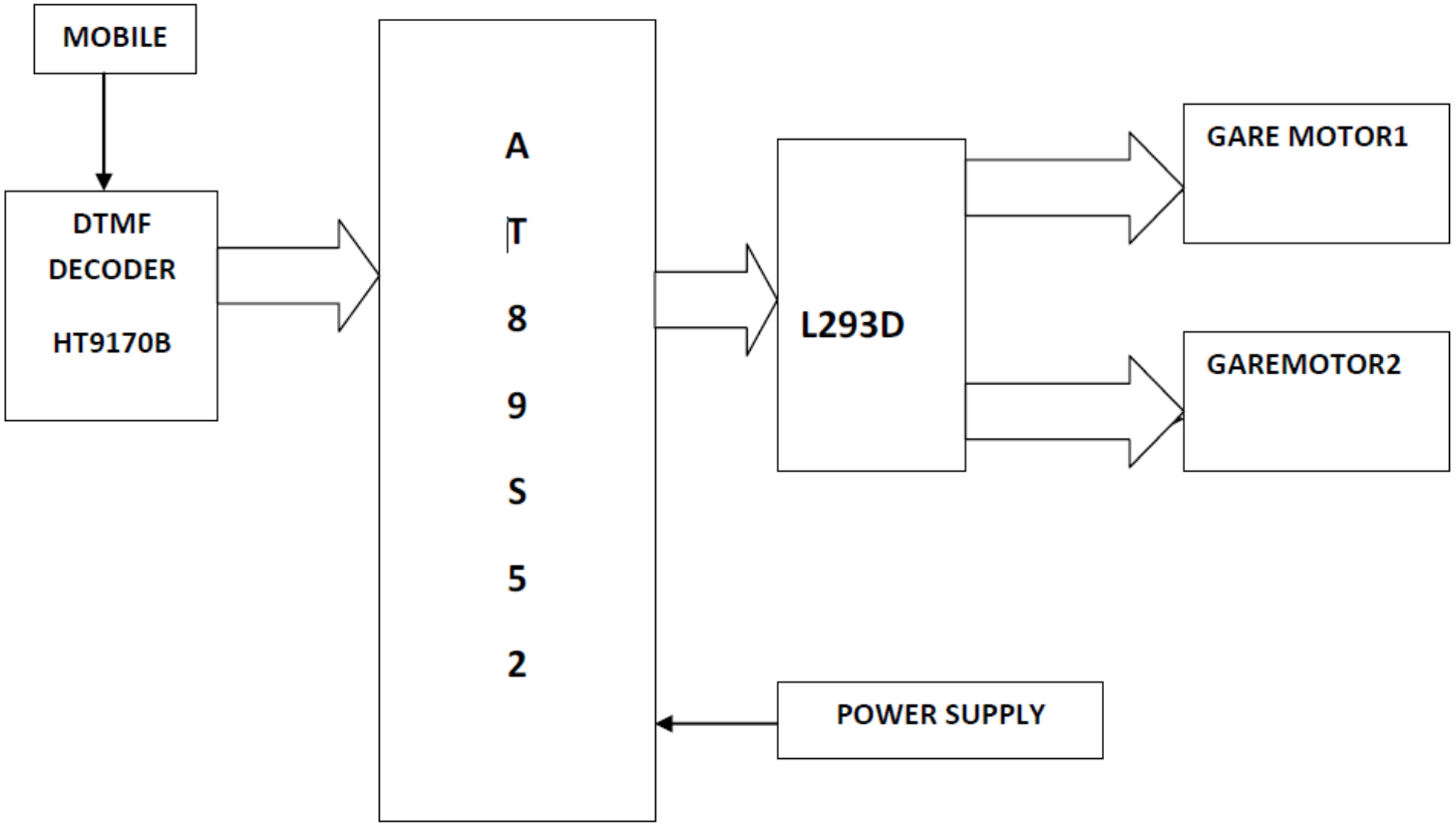
- Controlled by the Remote Controller and my aim to assist the farmers or in agriculture sector.

BACHELOR'S THESIS

CELL PHONE OPERATED LAND ROVER FOR MULTIPLE TASKS

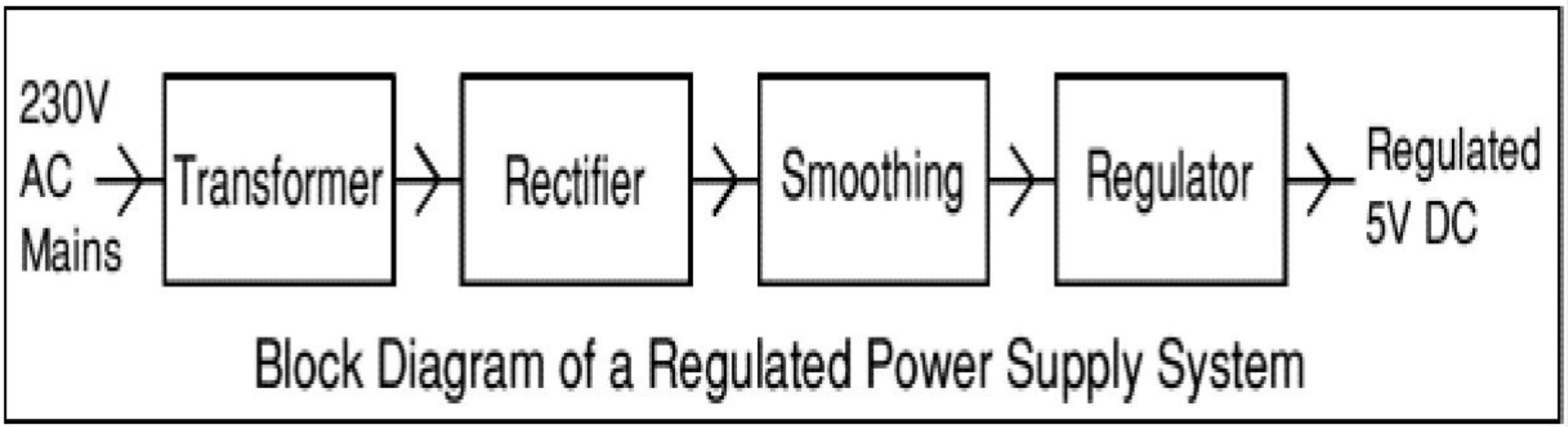
- 8052 MICROCONTROLLER (Used 8 bit microcontroller **AT89S52**).
- MOBILE.
- DTMF DECODER IC (**HT9170B**) :-It gets the signals from the DTMF decoder and it drives the motors according to the DTMF inputs
- Motor Driver (**L293D**).

Block Diagram of the Work



Construction of the Electronic Circuit for Setup the experiment

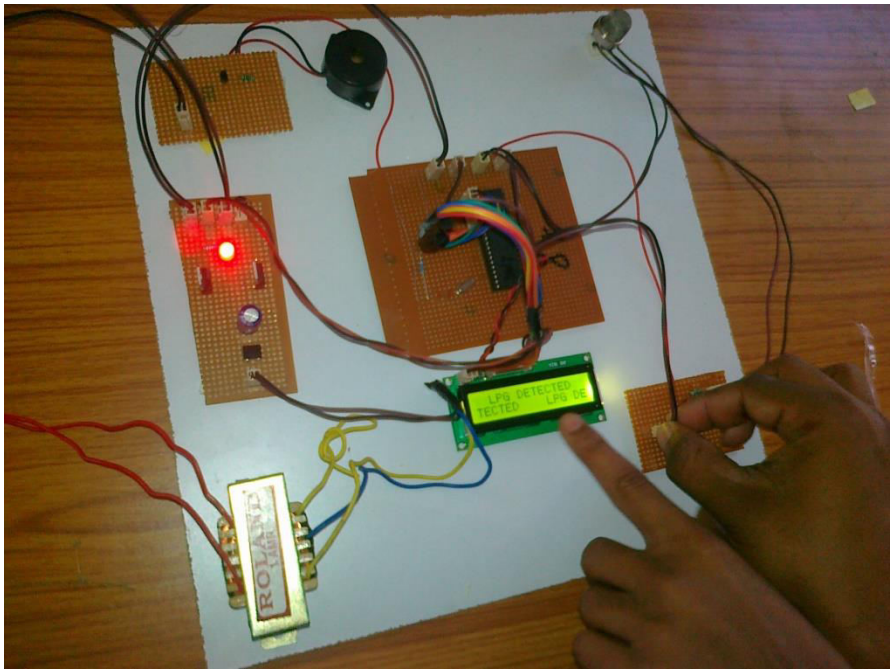
- Firstly, convert the high voltage AC to low voltage DC, then place other components on electronic board. The components like: Microcontroller, motor driver, DTMF decoder…

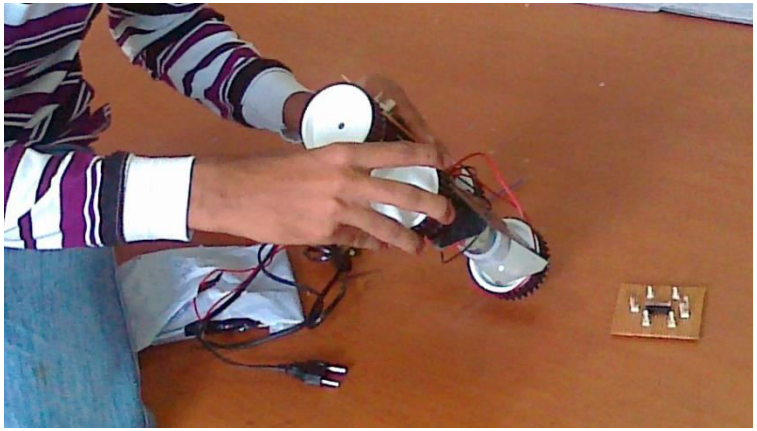


Block Diagram of a Regulated Power Supply System

Overview of the Mobile Robot and Body

- The components board is placed on the mobile robot, which included the mobile device
- Try to call the mobile device and control the rover by number pad in mobile.





MASTER'S THESIS

Human Motion Guidance Using Vibrotactile Feedback In Direct Physical Human-Robot Interaction

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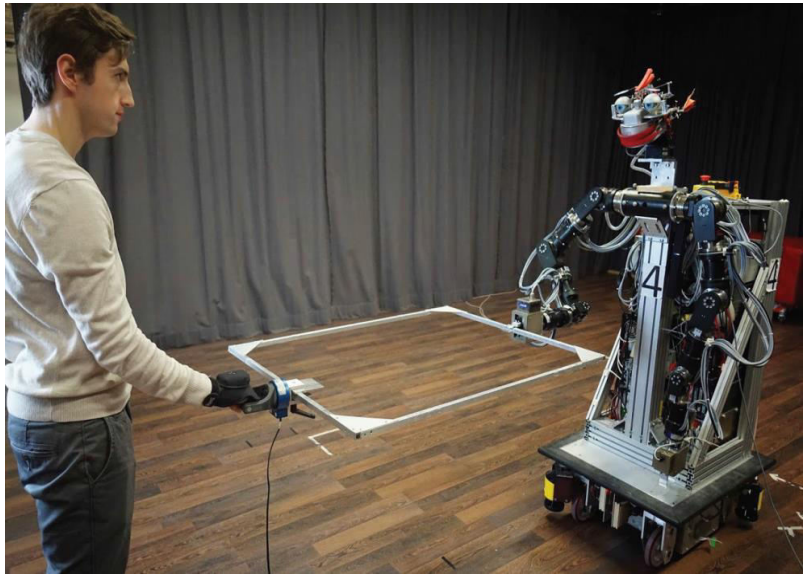
- pHRI- physical Human and Robot Interaction.
- There is no considerable information towards the human in pHRI.
- The idea and vision of this work to use the Vibrotactile feedback device to enhance the human capabilities in the human-robot cooperative tasks.

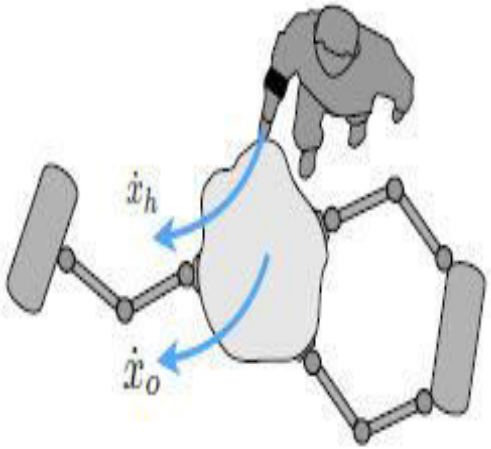


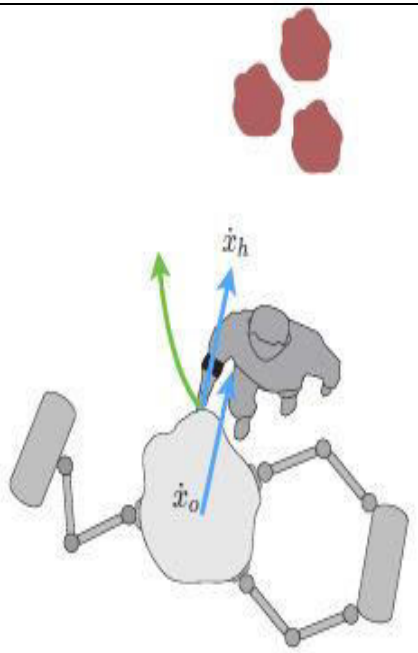
VT Feedback to the Human in Human-Robot Interaction

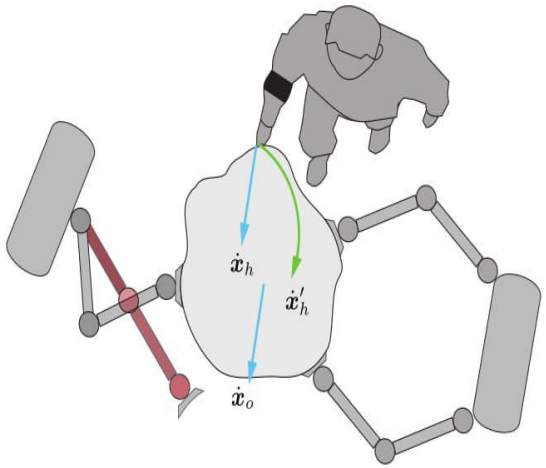
Subtask-1: Human motion guidance towards the desired trajectory/motions, which would lead to an effective manipulation in the pHRI.

Subtask-2: Human's desired motions leads the HRT to a collision with obstacles. Where the VT feedback assists to avoid the inadmissible area.

Subtask-3: Human desired motions reach to the singular configurations of the robot in the human-robot team.







Equipments Used for the Experiments

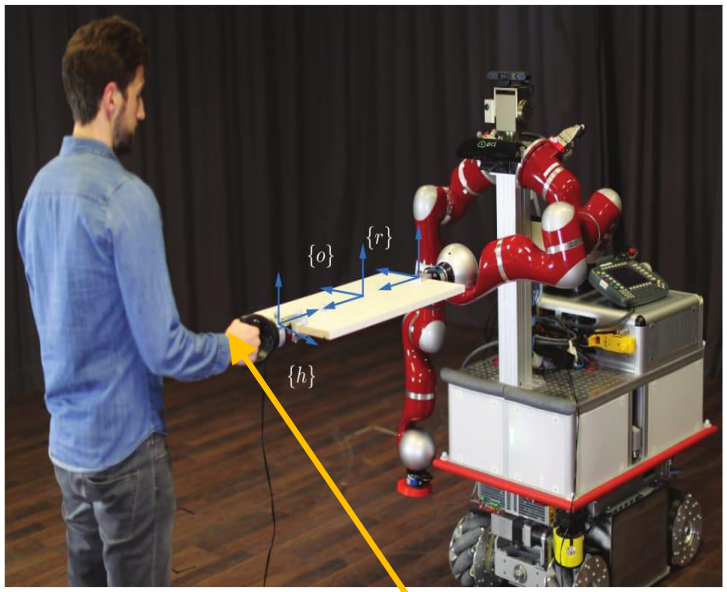
- KUKA LWR 7 DOF mobile platform robot with impedance controller and collision detection technique @ TUM.

- VT wearable wristband device with Bluetooth supported communication system @ UNISI.

- Tracking the position and velocities in real-time with the help of Qualysis tracking system @ TUM-ITR lab.

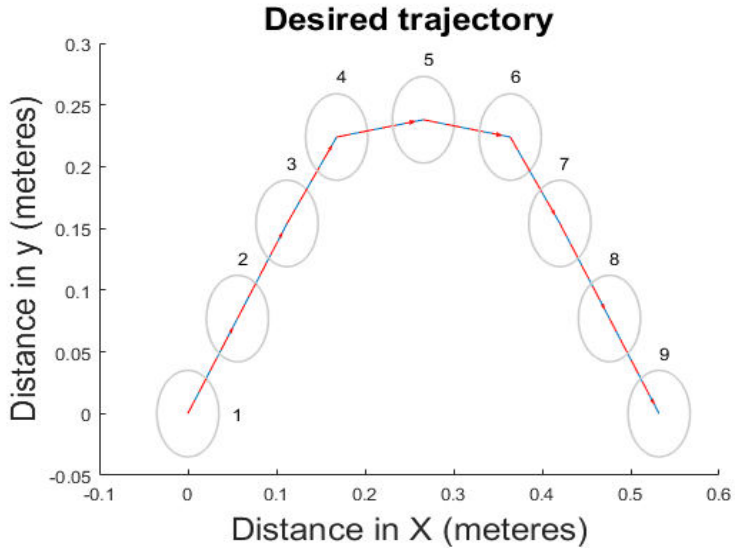
- Used solid rectangle object which weight $\cong 3kg$. It conists of handles on both sides for robot manipulator and human arm.

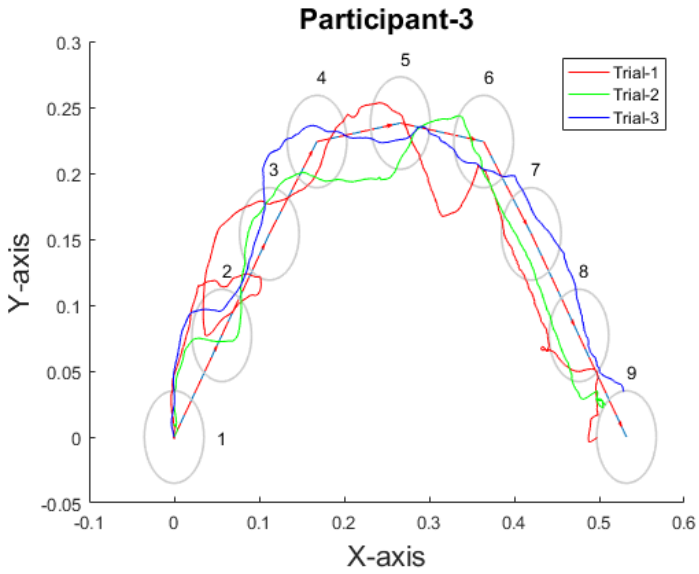
Tracking systems @TUM



Vibrotactile wearable wristband device

Subtask-1 Experiment

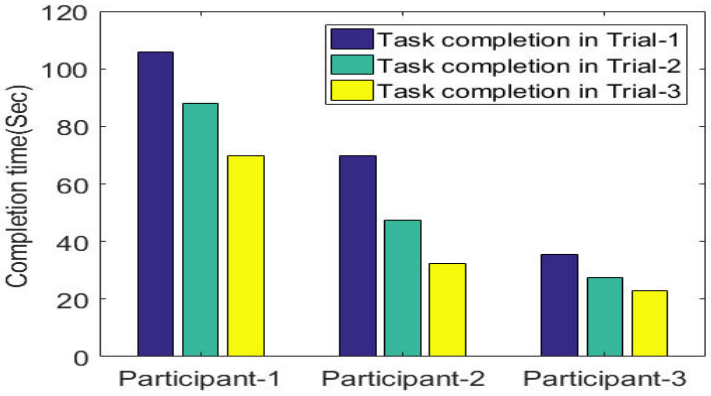




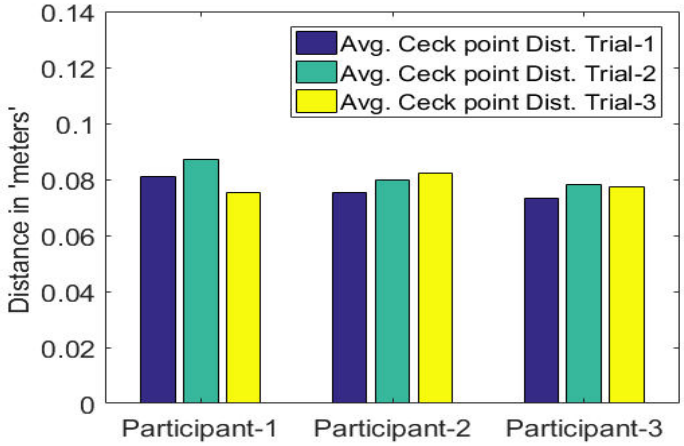
Real human trajectories for different trails

- Given the desired trajectory which is unknown to participants for placing an object from one point to another point.
- Checkpoints are created throughout the desired trajectory and no. of check points radius are arbitrary.
- The task is successful if and only if the participant completes the check points sequentially.
- The human real-time position is guided towards to the check points sequentially.

Subtask-1 Experiment (contd.)



Completion Time for all participants



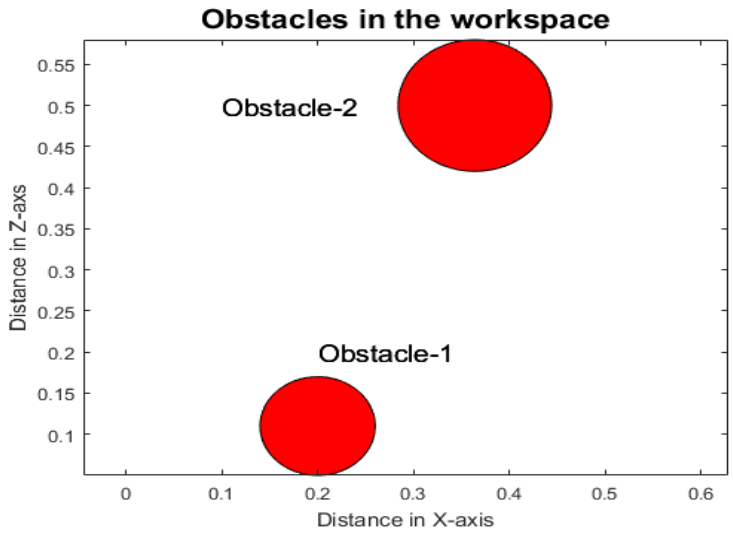
Avg. Dist b/w the human hand to the desired trajectory

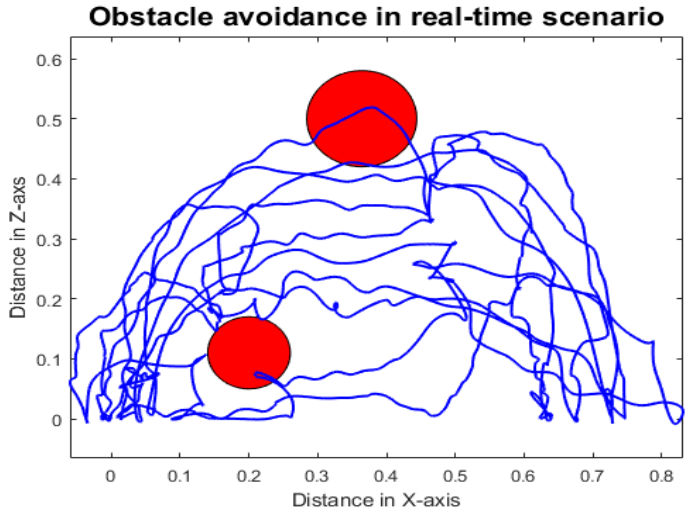
- Task is conducted on 3 participants for 3 trials and all tasks are completed successfully.

- Completion time of each task gradually decreased from trial-1 to trial-3. This shows the users are adapted learning/training very well.

- The results show that, the deviation between the actual human's position and desired trajectory.

Subtask-2 Experiment





Real time human trajectories in workspace and inadimmisble area

- Created two obstacles (in 2D –ZX plane) in free space with different radius, where no information to participants.

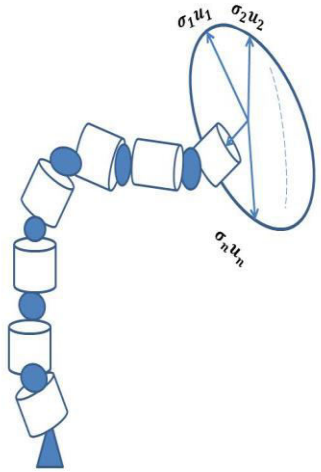
- Participants are known only initial and final point position roughly and can choose any his/her desired motions.

- The VT feedback is given in the repulsive way in this subtask. i.e. the VT guides away from obstacles.

- After 10 trails of the experiment, the human collides with obstacles partially on some trails.

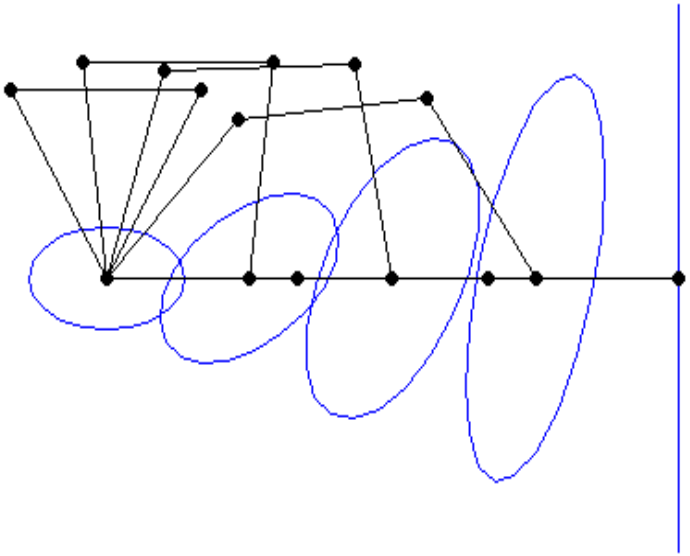
- The overall subtask is finished successfully and also got similar results with different participants.

Subtask-3 Experiment



- The HRT singularities are calculated according to the manipulability ellipsoid index (**MI**) value- Yoshikwaka method.

$$W=\sqrt{\det(J.J^T)}$$



- Due to robot limited capability space, the robotic arm cannot make all configurations according to the human desired configurations.

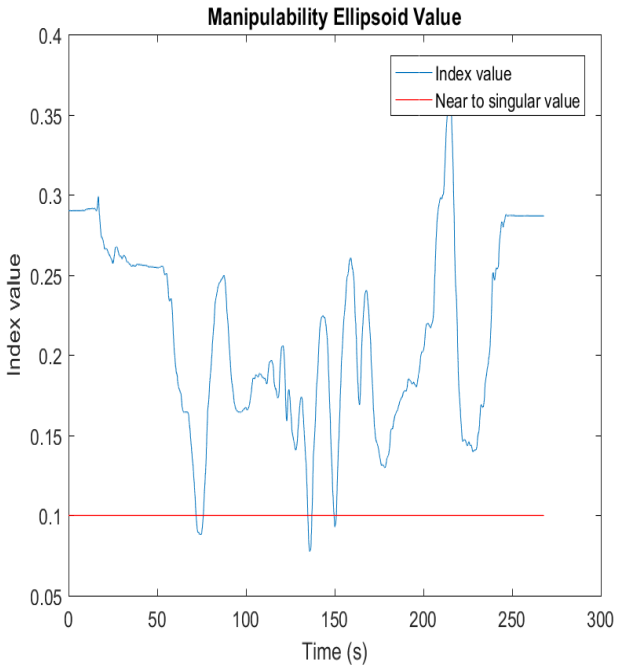
- The worse the value of MI makes to singularities in pHRT.

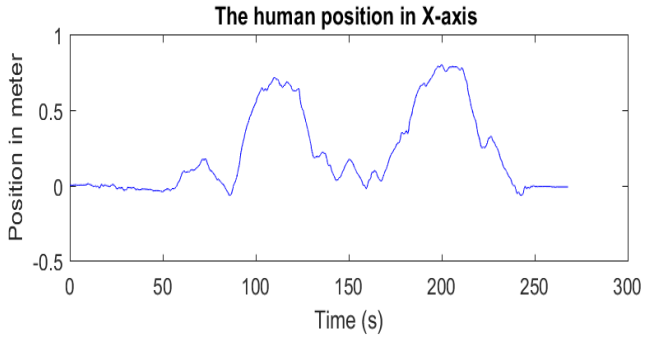
- Setting the threshold value (0.1) for of MI, then the VT wrist band activates to guide the human.

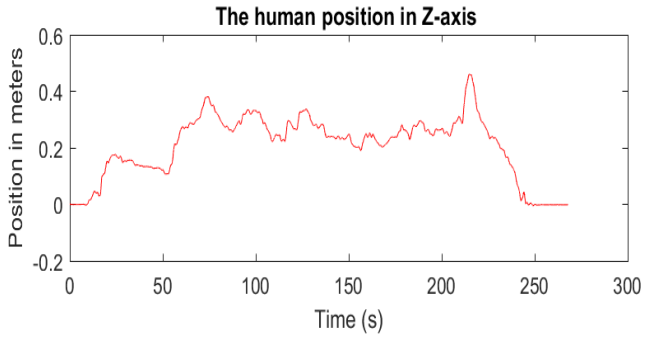
Subtask-3 Experiment (contd.)

- In this plot, the blue line shows the MI value throughout the experiment and the red line shows the nearest singularity of the robotic arm.

- During this experiment, when the participant reaches to the singularities of the robotic arm, the VT guides into highest manupability/capability space into admissible area







Thanking You