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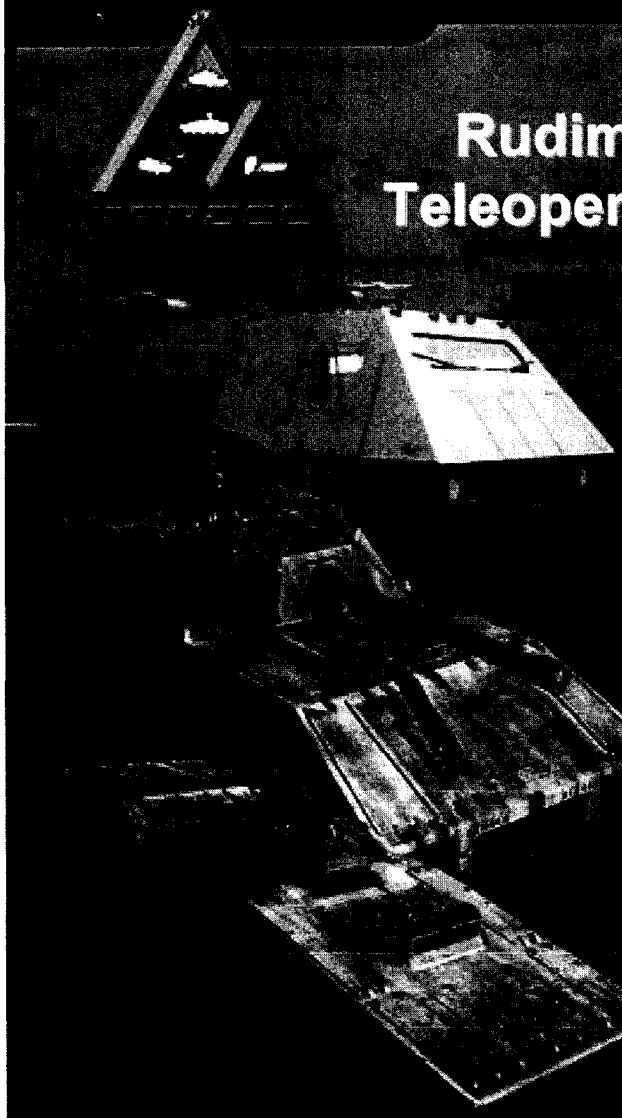

Rudimentary Force Feedback for Safe Guarded Teleoperation of Unmanned Vehicles: A Simulations and Training Approach

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17th Annual GVSS Conference

29 March 2006

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U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

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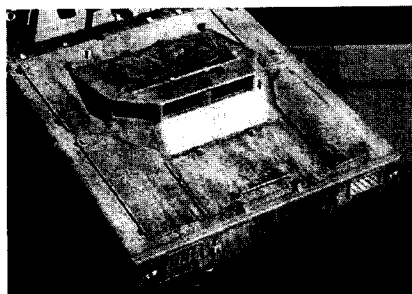
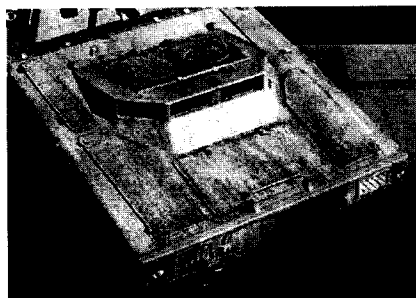


Briefing Agenda

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

- Guarded Teleoperation Concepts
- Current Research
  - Objectives
  - Simulation Environments
  - Example Application
- Future Collaboration
- Conclusion



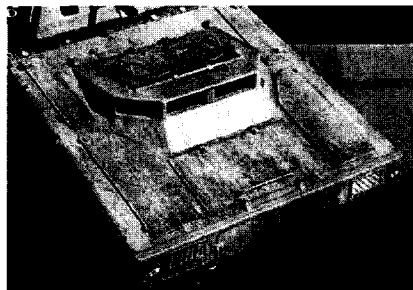
Guarded Teleoperation Concepts

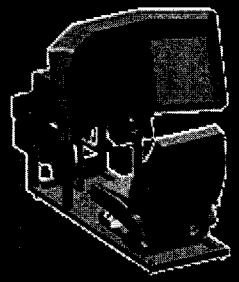
SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

- Enhancing soldier situational awareness through feedback from unmanned vehicles
- Mitigating risks of Teleoperation
- Mitigating risks of Indirect Vision Driving
- Use of multi-modal interfaces; visual, audio, tactile (haptics)

Guarded Teleoperation Concepts (cont.)

SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY



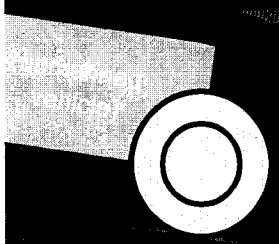


Human-in-the-Loop
UV Control Station

Unmanned Vehicle Control/Data Link

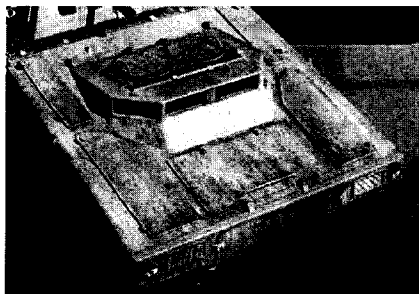
(sensor)

- Use of haptic displays to guide unmanned vehicles
- Feedback allows human to sense proximity of obstacles and take corrective measure and/or replan route to continue mission
- Mitigates risks



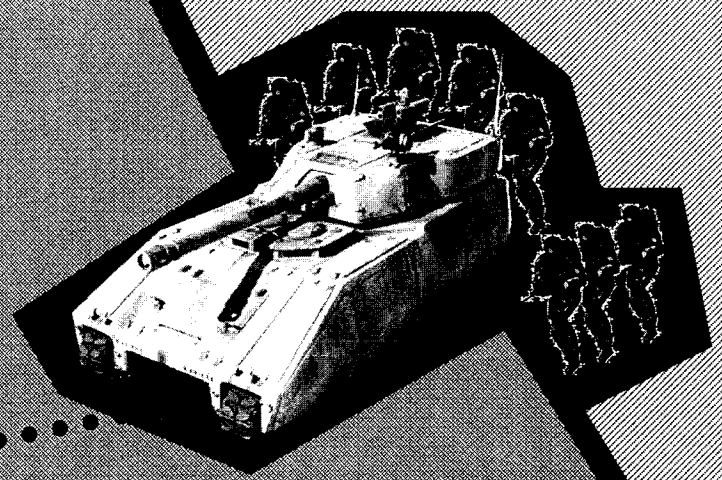
(terrain)

(obstacle)



Indirect Vision Driving (IVD) Safety

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**



SAFE DRIVE ZONE

UNSAFE DRIVE ZONE

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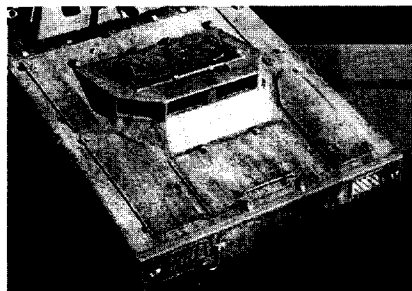
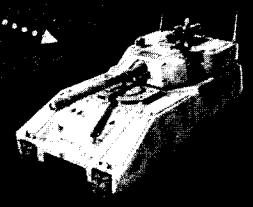
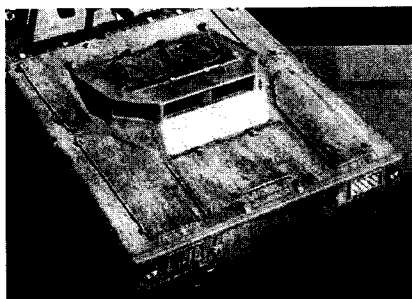


Survivability Applications

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

INCOMING THREAT DETECTION

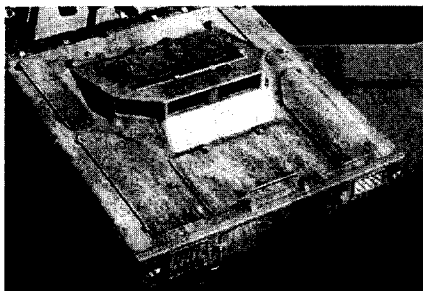




In-house Research Objectives

SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY

- To generate initial capability to develop and test guarded teleoperation and IVD safety concepts
- To support current research activities in the areas applicable to Human Robotics Interface (HRI)
  - Use of multi-modal interfaces?
  - Why haptics? Are there better or more efficient methods to present this data?

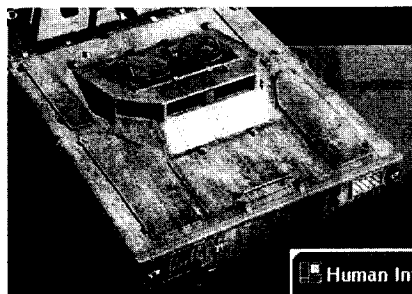


Simulation Environments

SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY

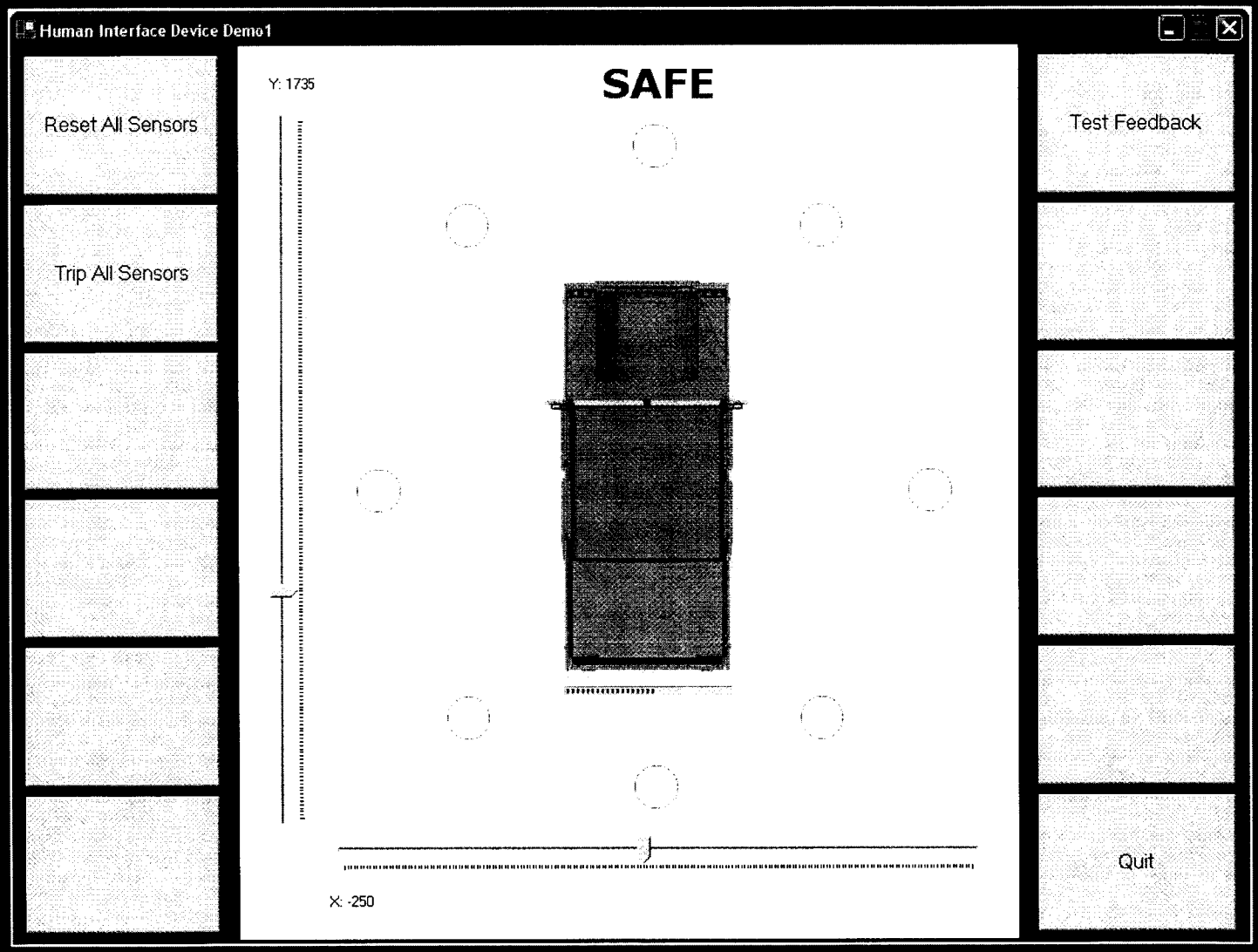
- Initial capabilities using game engine / low-fidelity model representation platforms

- Delta3D
  - OpenSceneGraph/OpenDynamicsEngine
  - OpenFlight terrain database
  - Simulated sensor capability
  - DirectX for interfacing to Haptics devices



Example Application

SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY



Example Application (continued)

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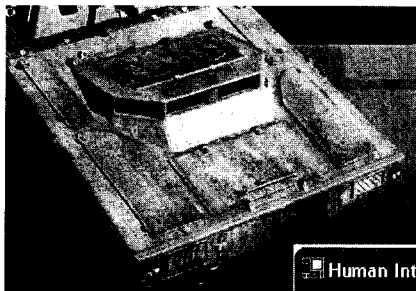
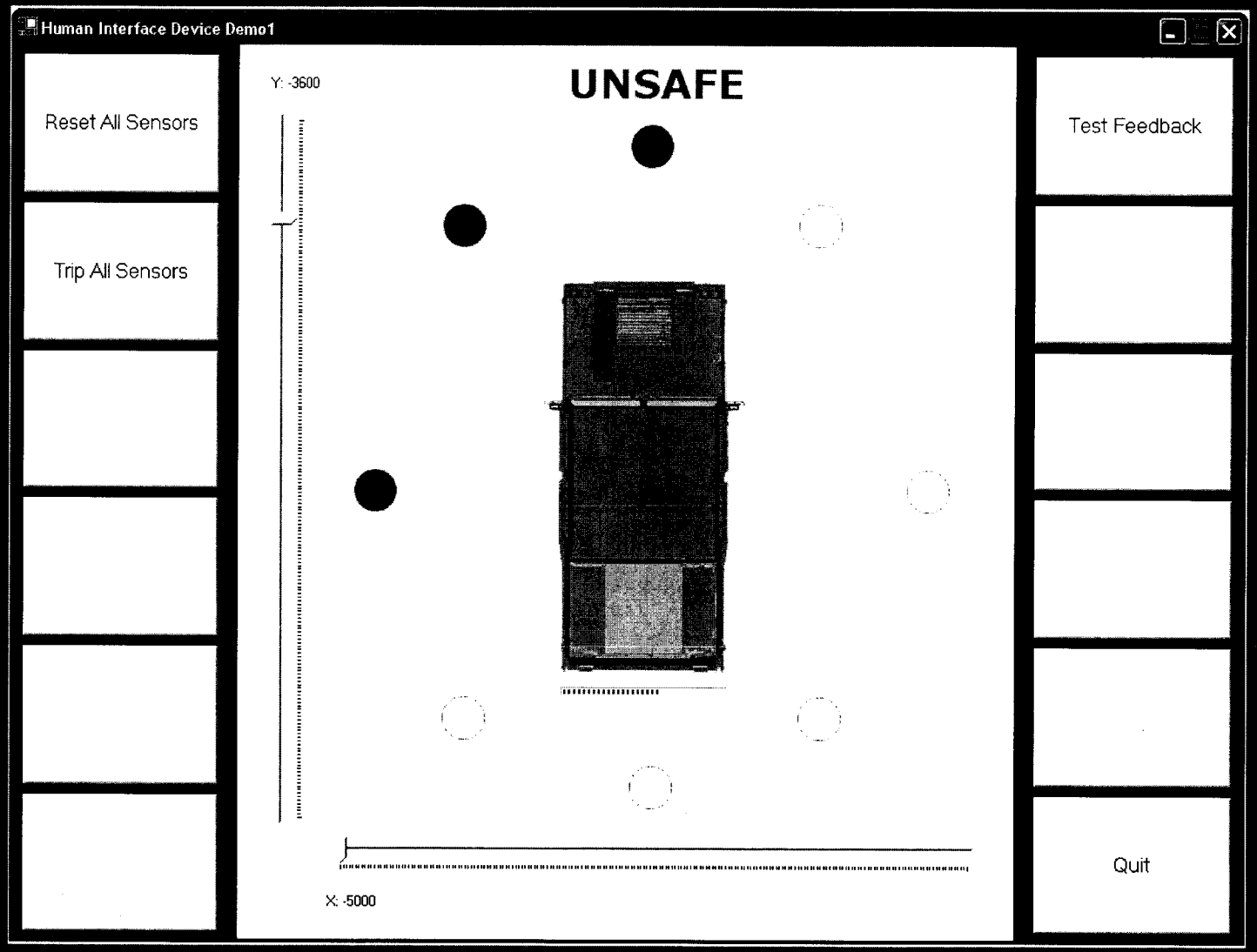
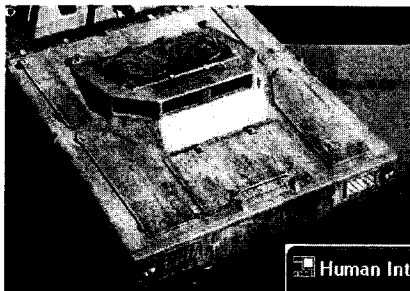
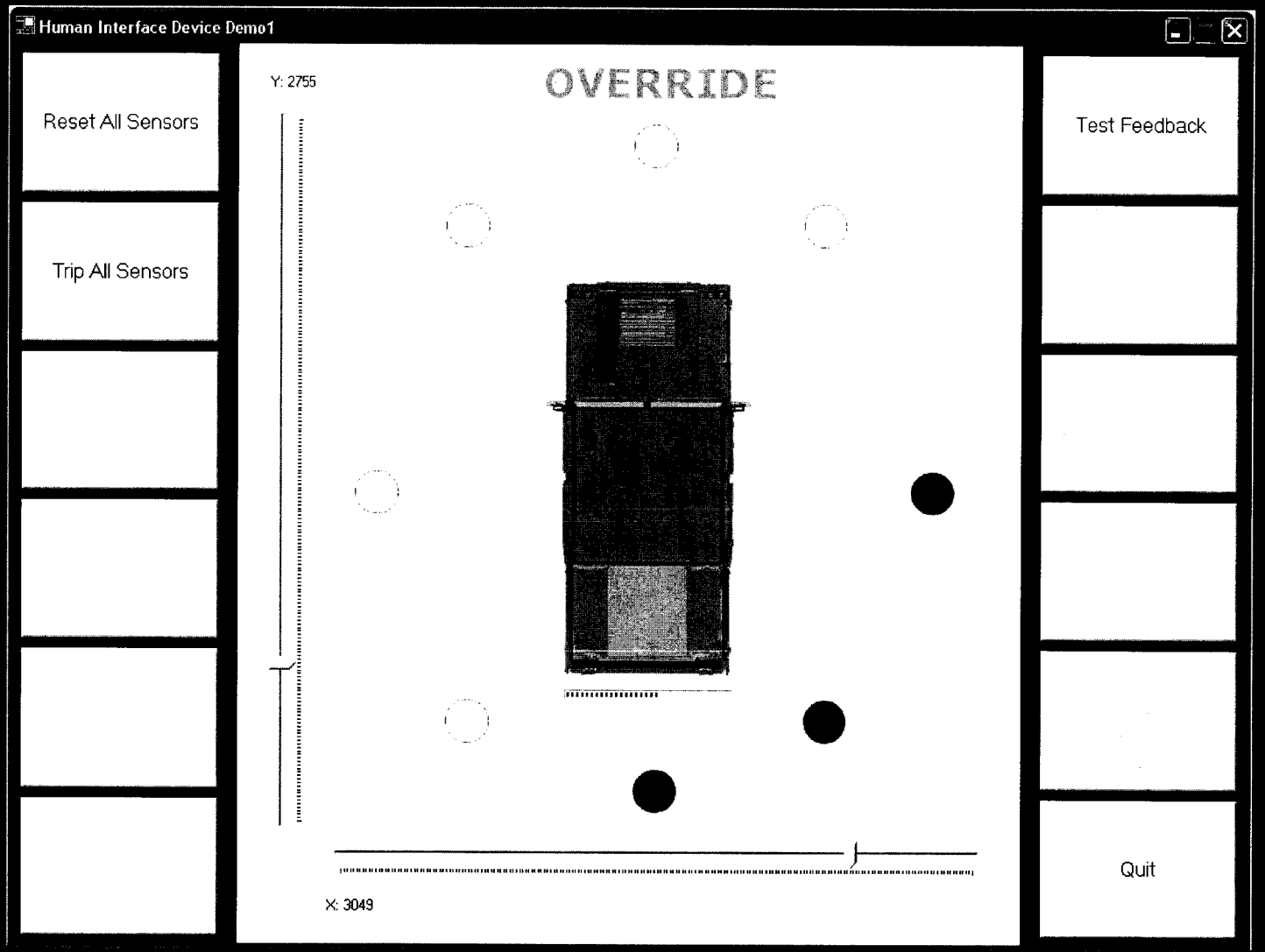




Example Application (continued)

SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY





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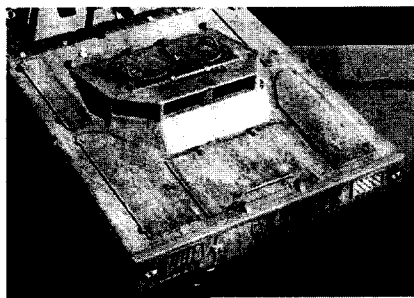

Example Application (continued)

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

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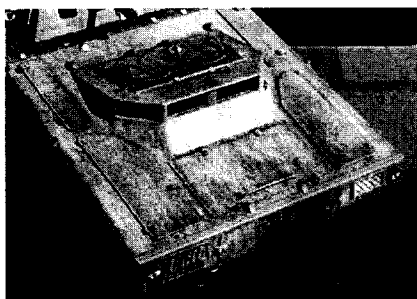
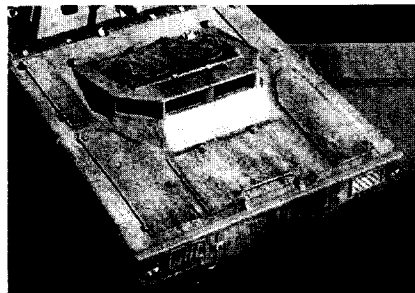


Future Collaboration

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

- Better integration with existing human-in-the-loop hardware
- Review of commercially available haptics devices (vests, belts, straps, etc.)
- Implementation of generic drivers to allow hardware usage from various computing platforms



Conclusion

SUPERIOR **TECHNOLOGY** FOR A SUPERIOR **ARMY**

- Continued in-house research in areas of safe teleoperation pertinent to FCS objectives
- Looking for program partnerships for concepts demonstrations and testing

Questions?