DESIGN OF A VIBROTACTILE FEEDBACK VIRTUAL TESTBED

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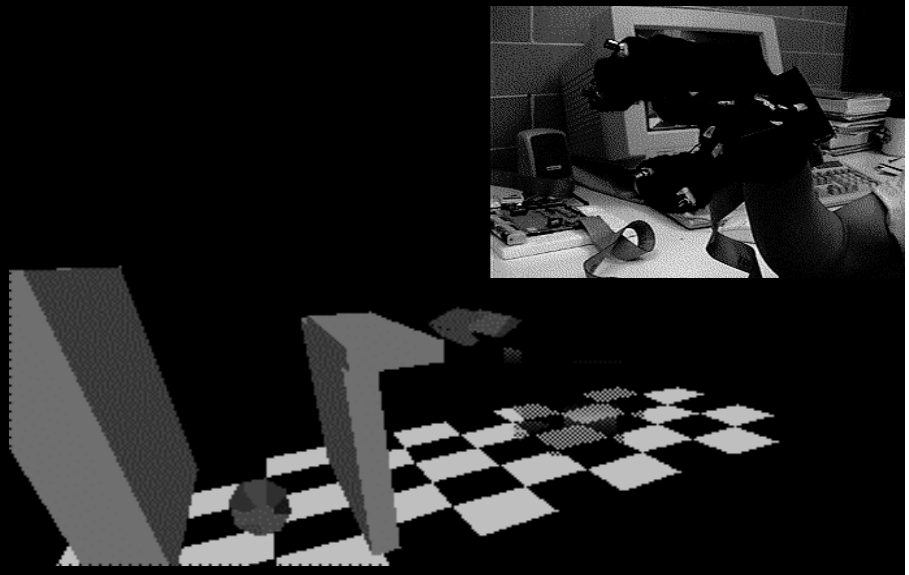


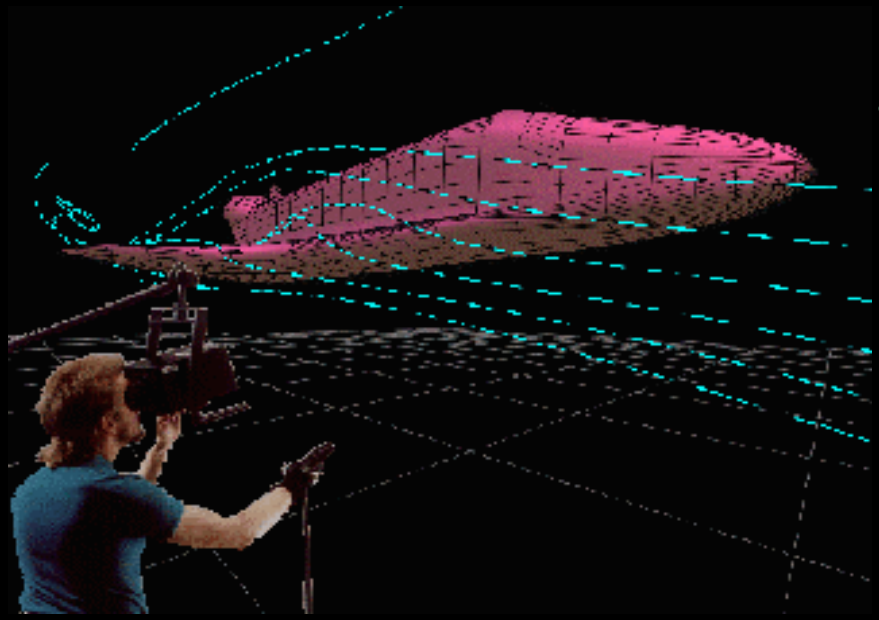
May 26, 1997 - CCEC

Outline

- Introduction
- Experimental Design
- System Requirements & Constraints
- Architecture & Component Selection
- Software Implementation
- Performance

Introduction

- **Virtual Reality (VR)**
  - interactive, 3D, multimedia environment
- **Vibration feedback substituting for force**
  - easily produced, sensed, and controlled



- **Objective:**
  - present underlying software architecture to implement virtual grasping experiment

Experimental Design

- **Experimental Goal:**
  - evaluate vibrotactile, visual, and audio feedback
  - metrics: completion time and degree of damage
- **Task:**
  - "pick and place" fragile grape in virtual environment
- **Feedback modes:**
  - vibration, colour, and sound
- **Participants:**
  - control group (12), vibration group (12)
  - practice + 6 trials over 3 sessions in one week

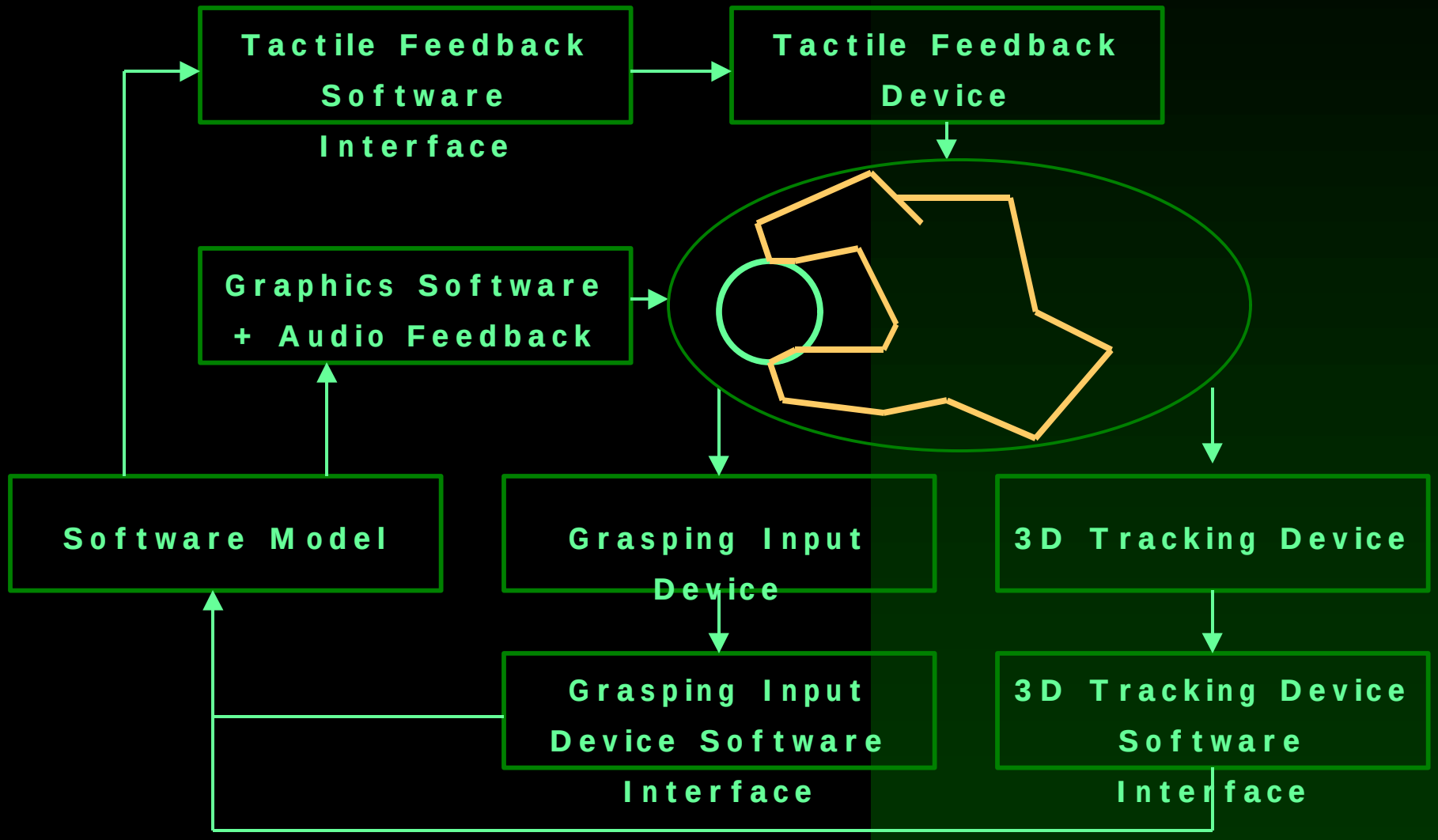
System Requirements & Constraints

Hardware		Software	
3D Tracking	monitor hand position	Graphics	visual feedback
Grasping Input	measure finger flexion	Audio	audio feedback
Tactile Feedback	vibration ~ pressure	Model	modeling & recording
Visual/Audio	visual/audio cues		

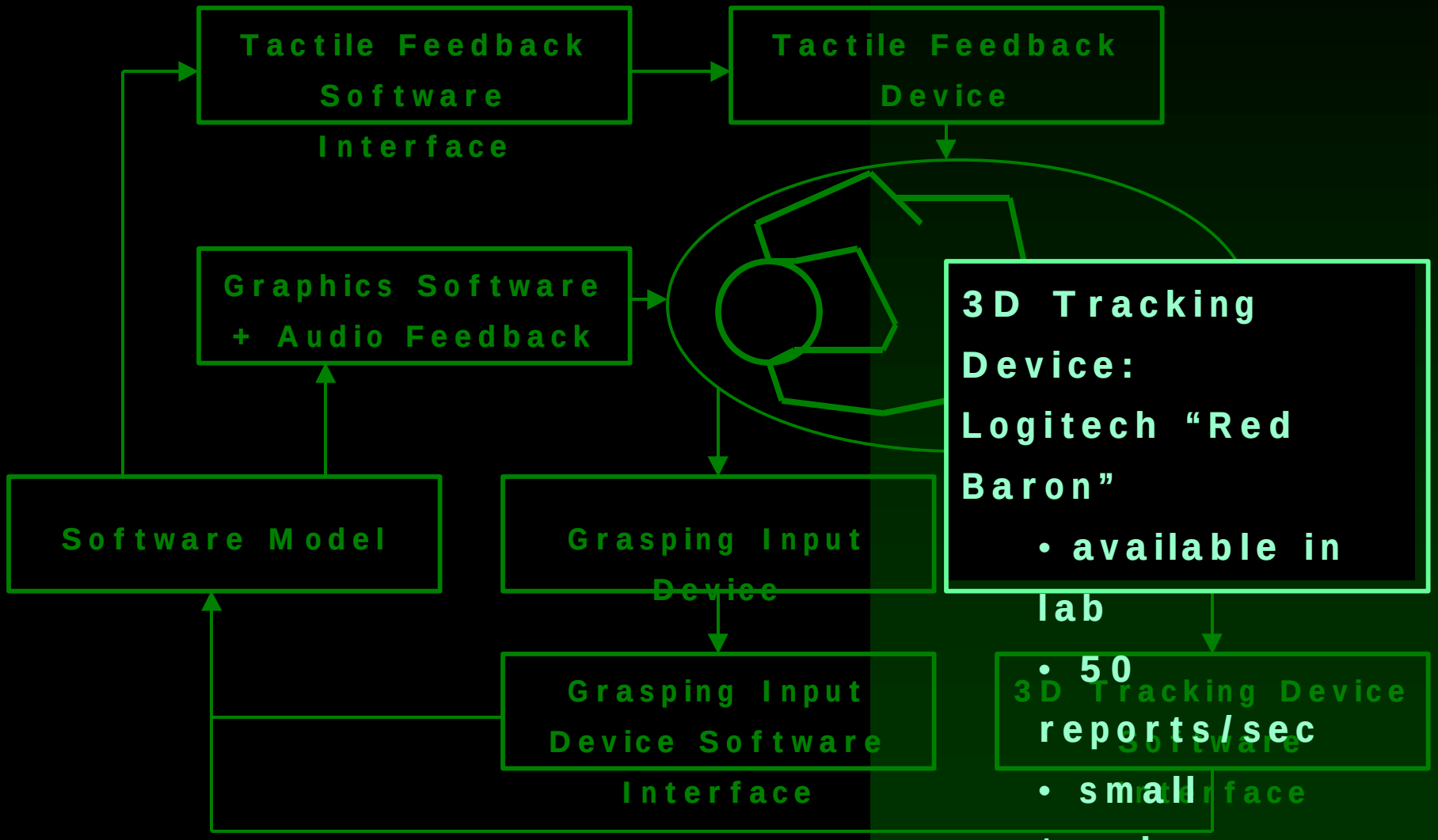
Constraint Drivers

- Minimize price
- Maximize Comfort
- Minimize Implementation Time
- Maximize System Performance

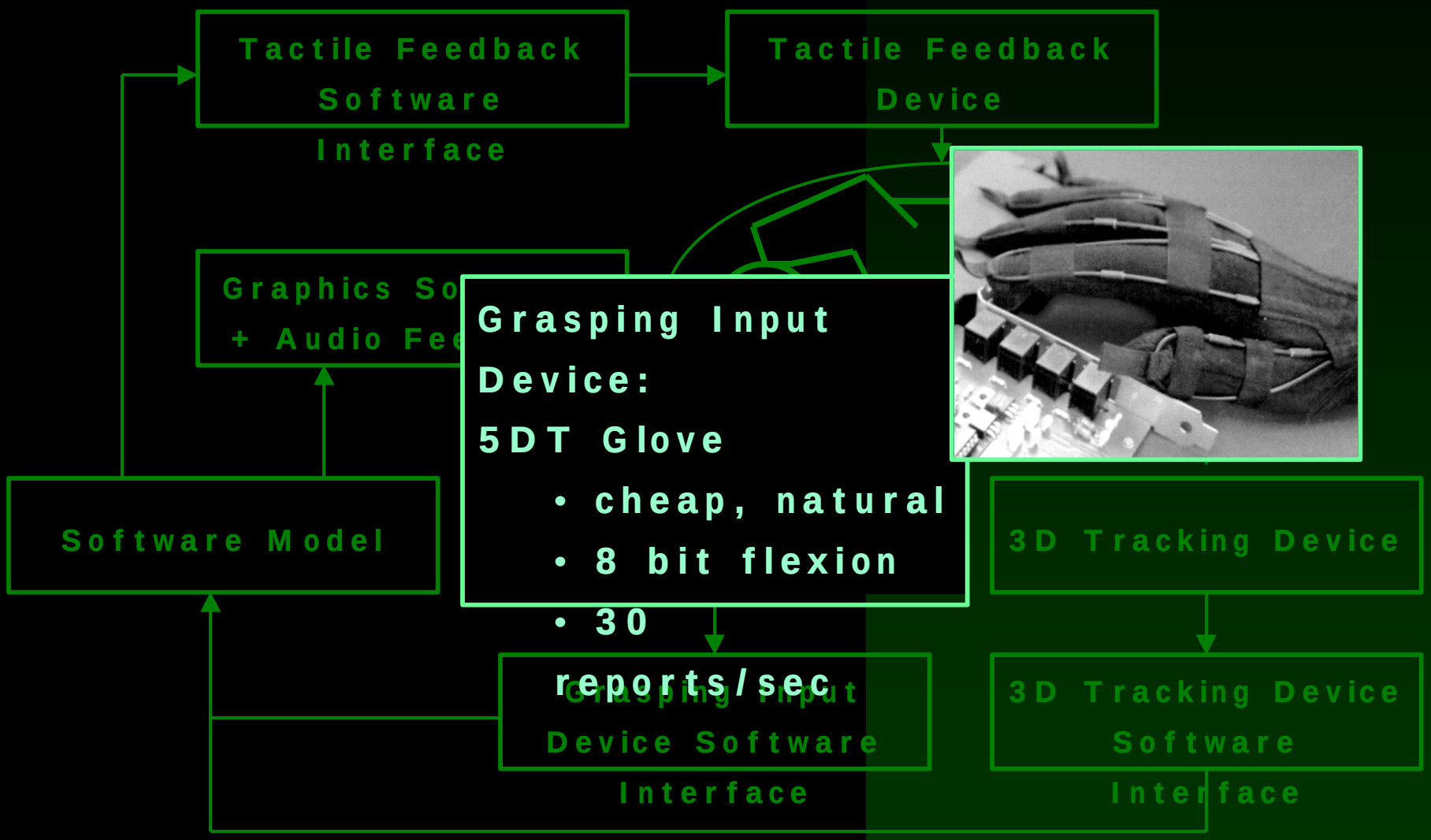
Architecture & Component Selection



Architecture & Component Selection



Architecture & Component Selection



Architecture & Component Selection

Tactile Feedback Software Interface

Tactile Feedback Device:
Custom Built
- no affordable devices

Graphics Software + Audio Feedback

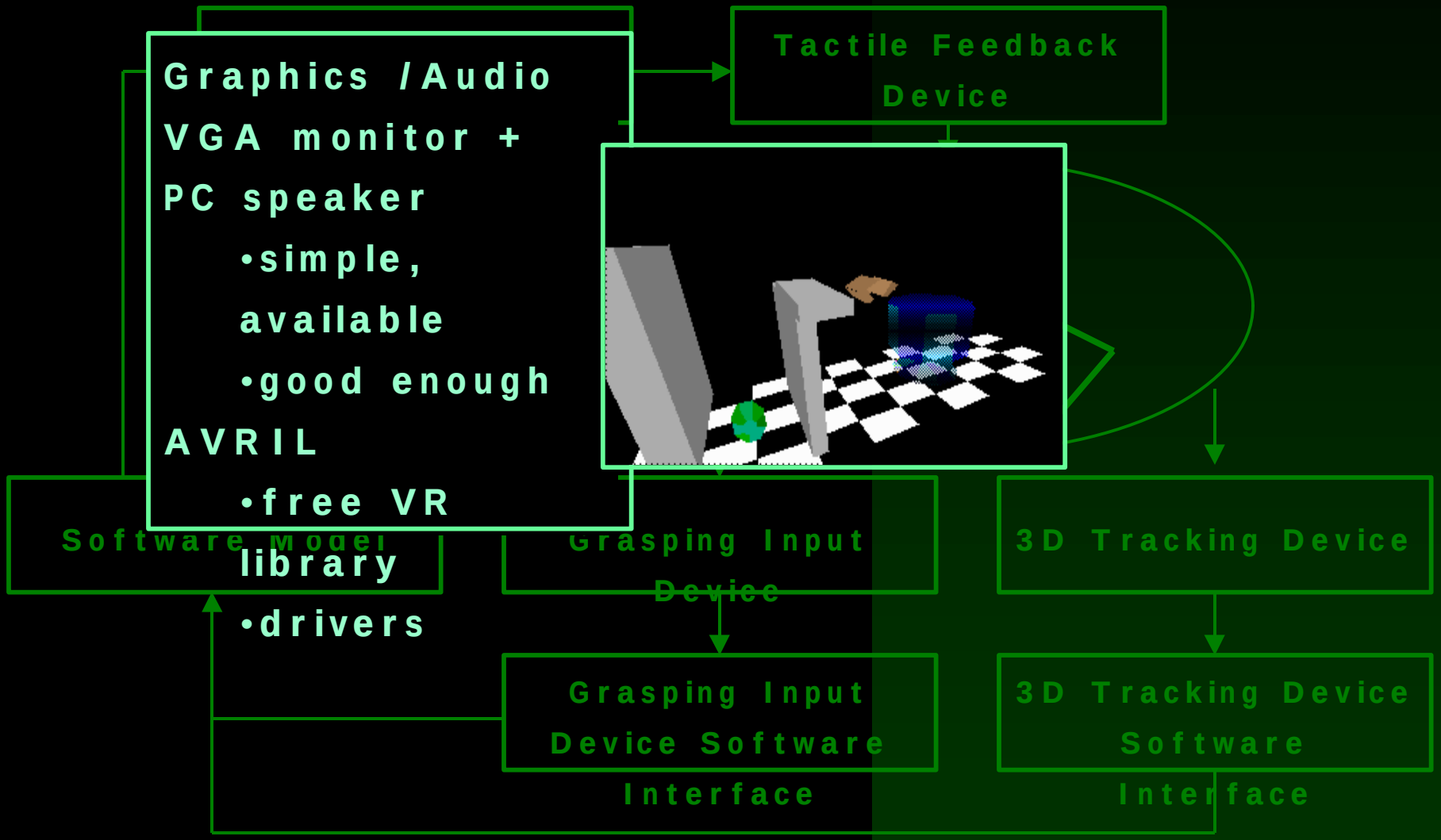
Software Model

Grasping Devic

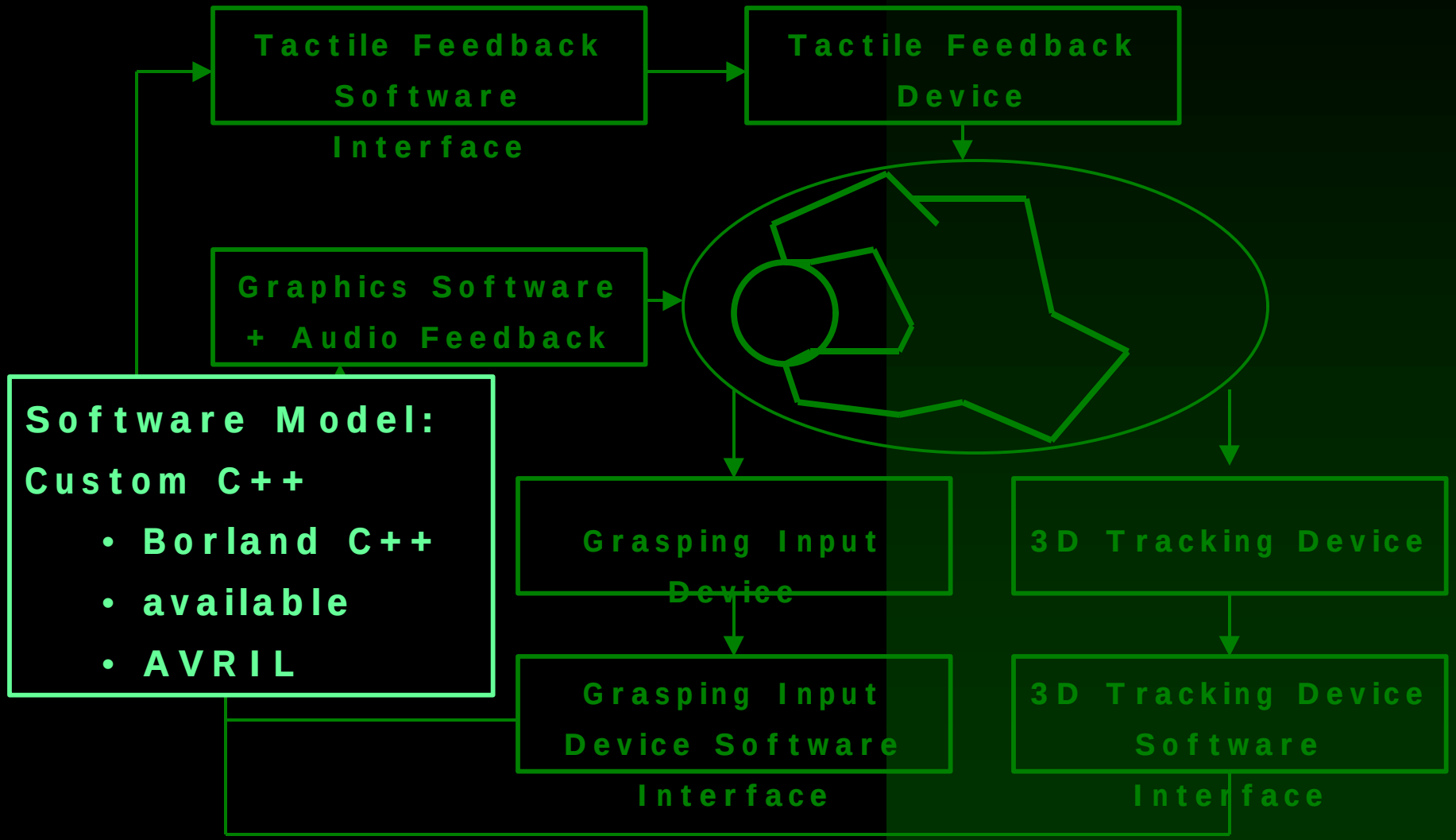
Grasping Input Device Software Interface

3D Tracking Device Software Interface

Architecture & Component Selection



Architecture & Component Selection

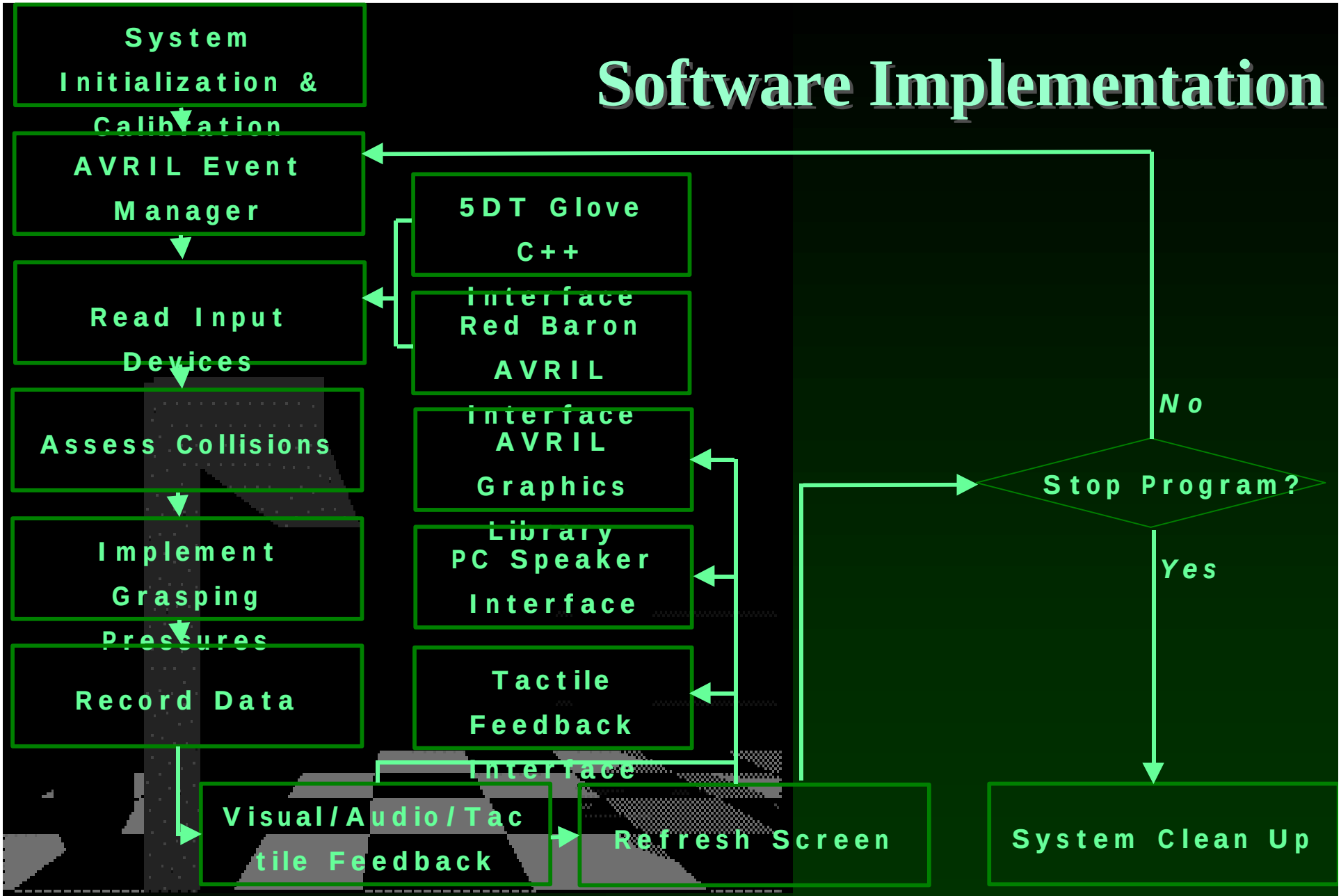


Software Implementation

- **Simplifying assumptions**
  - two-fingered gripper model
  - fixed side viewpoint
  - 2D plane motion

- **Hardware Interfacing**
  - encapsulating shipped routines
  - calibrating 5DT Glove
- **Graphics**
  - managed via AVRIL
- **Software Modeling**
  - interactions
  - recording data
  - simple physics

Software Implementation



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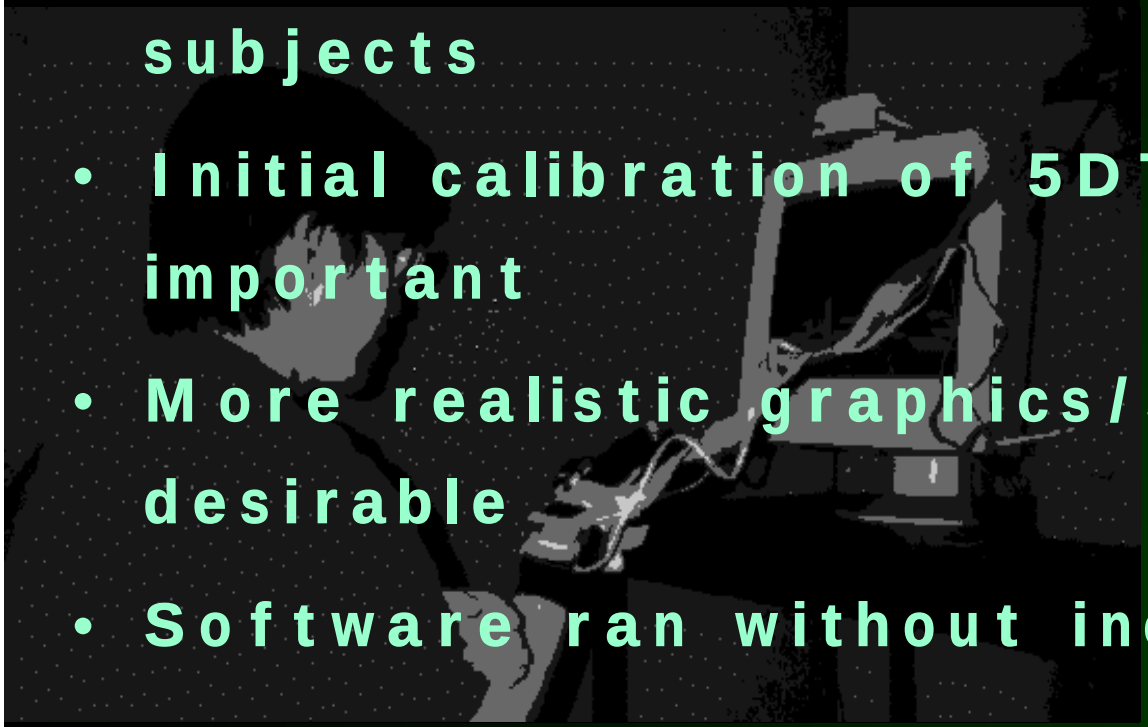
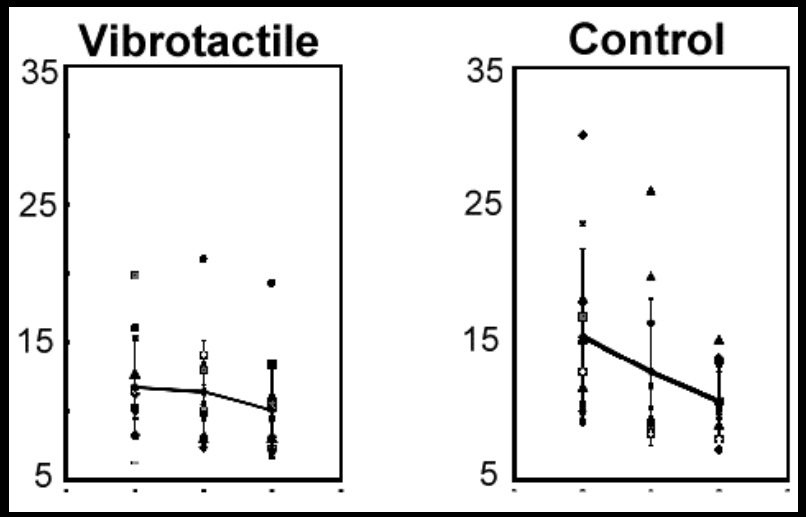
Performance

- Overall system was implemented and pre-tested
- Run for an experiment involving 24 subjects
- Initial calibration of 5DT Glove was important
- More realistic graphics/sound/VR desirable
- Software ran without incident

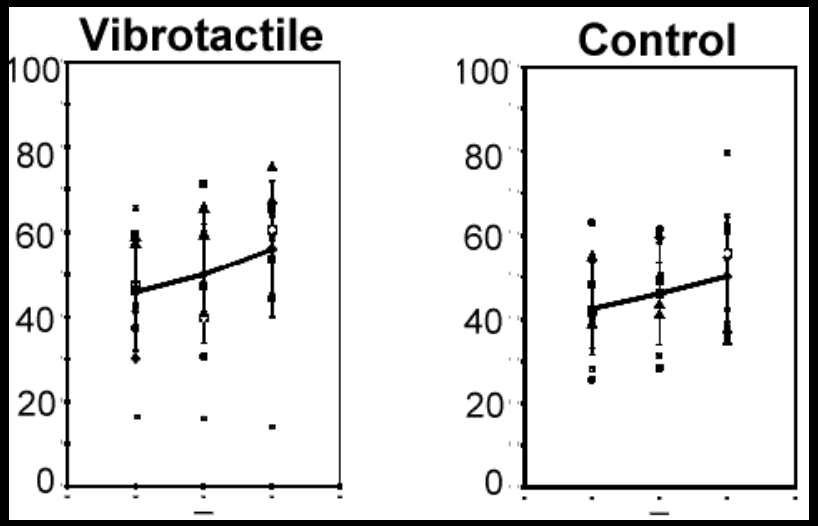


Performance

Completion time



Average Pressure (%)



Vibrotactile Feedback:

- better at beginning
- greater pressures
- training
- good for quick grasp not control