UNIVERSITY OF BIELEFELD

BACHELOR THESIS

Efficient Target Identification during Haptic Search in a Three-dimensional Environment

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Declaration of Authorship

I, Julian Nowainski, declare that this thesis titled, "Efficient Target Identification during Haptic Search in a Three-dimensional Environment" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
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- I have acknowledged all main sources of help.
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Abstract

Faculty of Technology
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Bachelor of Science

Efficient Target Identification during Haptic Search in a Three-dimensional Environment

by Julian Nowainski

Contents

Chapter 1

Introduction

Hier eine Introduction mit der zugrunde liegenden Motivation und den daraus abgeleiteten Zielen für meine Bachelorarbeit

1.1 Motivation

1.2 Goals

Chapter 2

Haptic Search Experiment

2.1 Haptic Search Experiment

Include small introduction to haptic search here

2.1.1 Experimental Setup

The Modular Haptic Stimuli Board (MHSB) makes up the core part of the experiment. It is a setting with two wooden frames that hold stimuli objects. These objects are 3 x 3 cm big wooden blocks, which have a primitive three-dimensional shape on top of it or are just plane. The whole set consists of 360 blocks with 55 different shapes.
The first wooden frame can fit 25 objects and is used for learning a target object whereas the second frame has a capacity of 100 objects and is used for searching target objects. The stimuli are statically installed in the frames and not manipulable to allow a focus on just the search task itself [See figure of setting with both frames].

For this experiment, a subset of stimuli was chosen, consisting of 5 different shapes and plane ones [See fig. XXX -> picture of the shapes]. The target consists of one object and is placed central in the small frame with the rest of the space consisting of plane stimuli. The big frame contains the rest of this subset, where each shape exist 4 to 5 times, including the target. The objects were distributed mostly equally and kept the same rotation throughout the experiment. Only the distribution and the target were changed with each trial.

2.1.2 Execution

For this experiment, 7 participants were invited and asked to solve a haptic search task while being blindfolded. The participants were 23 to 28 years old and included both genders. All participants were right-handed and have never seen the stimuli objects, so that during the task they never knew how the set of objects looked like and their perception was purely based on the haptic features.
Each participant performed on maximal 5 trials, where after each trial, the target was exchanged and the distribution of the stimuli on the big frame was changed. Before the beginning, there were 2 rehearsals to accustom the subjects to the setting. No participant had the same target twice or more and the task was done with just the right hand, while wearing a glove to record relevant data [see section Hardware].

For the procedure, each participant was given a description of the task [see appendix]. The task consisted of two parts.
The first task was to explore the target object on the small frame and remembering it

just by its haptic features. When collected enough information about the target stimulus, the subject should proceed to the big frame and search for the learned target. The only goal in this part was to remember the approximate position of the target and not saying that it was found or pointing at it, so the recorded data would not contain pauses or pointing postures.
It was not necessary to find every target shape in the big frame, just as many as one could. The time was limited to 30 seconds to guarantee that the focus lies only on the salient features. An acoustic signal by the examiner determined the start- and endpoint of the experiment.
The second part of the experiment was to figure out if the subjects found the target object between the non-target objects, called distractors, and how well they could remember the approximate position on the frame. Again an acoustic signal determined start and end of the trial. For the second part, the subjects had just 10 seconds left to find the targets and point on them. The short period of time was set to prevent the subjects from exploring too much of the frame and focusing only on the smallest set of haptic features that were sufficient enough to differentiate between target and distractor.

2.2 Hardware

2.2.1 Glove

2.2.2 Vicon

2.2.3 Setting

Chapter 3

Data Generation and Analysis

Dieses Kapitel beinhaltet den größten Teil meiner Arbeit. Alles zum Nachbearbeiten der Daten kommt in dieses Kapitel. Frage zur Struktur, den Forderungen, das Aufnehmen mit MSS und ROS, posptrocessing von Vicon, Synchronisiserung der Vicon Daten mit ROS und das halb-automatische Generieren von labeln sowie eine erste Analyse der fertigen Daten.

3.1 Data Structure and Requirements

3.2 Recording

3.3 Postprocessing Vicon Data

3.4 Synchronizing Data and Generating Labels

3.4.1 Synchronizing Glove Data and Vicon Data

3.4.2 Generating Labels

3.5 Analyzing the Data

Chapter 4

Model and Training

Hier muss ich mir noch Gedanken über das Model machen, auch was das Preprocessing angeht. In diesem Kapitel wird wahrscheinlich noch einiges umgebaut

4.1 Model

4.2 Preprocessing

4.3 Training

Chapter 5

Evaluation

Evaluation der Ergebnisse vom Training mit Visualisiserung

Chapter 6

Discussion

Weiterführende Diskusion und Fazit über die Studie