HTBLuVA Wiener Neustadt
Höhere Lehranstalt für Informatik

DIPLOMARBEIT

Autonomous universal Mapping and Navigation

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Wiener Neustadt, am July 4, 2020/21

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Chapter 1

Eidestattliche Erklärung

Hiermit erkläre ich an Eides statt, dass ich die vorliegende Arbeit selbstständig und ohne fremde Hilfe verfasst und keine anderen als die im Literaturverzeichnis angegeben Quellen und Hilfsmittel verwendet habe. Insbesondere versichere ich, dass ich alle wörtlichen und sinngemäßen Übernahmen aus anderen Werken als solche kenntlich gemacht habe.

Wiener Neustadt am July 4, 2020/21

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Introduction

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5.1 The Evolution of Robotics

Robotic research has always utilized concepts, processes, and methods of different scientific disciplines such as physics, mathematics, and biology to improve application and aid human needs. Because of this industrial, medical and even agricultural sectors have used technologies and products developed by researchers to improve workflows and alleviate employees from performing exhausting tasks. This relationship ranges back to the early ages of information technology in the 1950s and 1960s in which many developments on production robots and Artificial Intelligence (AI) have been made. Between 1970 and 1990 the public interest in automation and AI has decreased forcing the industry into the so-called AI winter. Despite this recession, research has been continued and the building blocks for another robot boom during the 1990s have been set. Since then the usage of robotic applications has broadened and the industry has proven itself to be a vital aspect of today's economy.

5.2 Robots with human interaction

Nowadays the utilization of robots in workplaces has broadened to almost every branch and is accepted by employees and workers. In countries like Japan, robots are no longer seen as a threat to jobs. Industrial robots are no longer used as simple construction tools, their safety and accuracy have improved so that collaborative robots (Cobots) are capable of working in close cooperation with humans. Surgery robots used in the medical sector not only allow for much more accurate procedures but also enable remote specialists to work on patients without having to be in the same hospital. In developed countries, educational robots are used at school or at home to teach children topics in a playful and interesting way.

[1] Malone, *George Devol: A Life Devoted to Invention, and Robots*

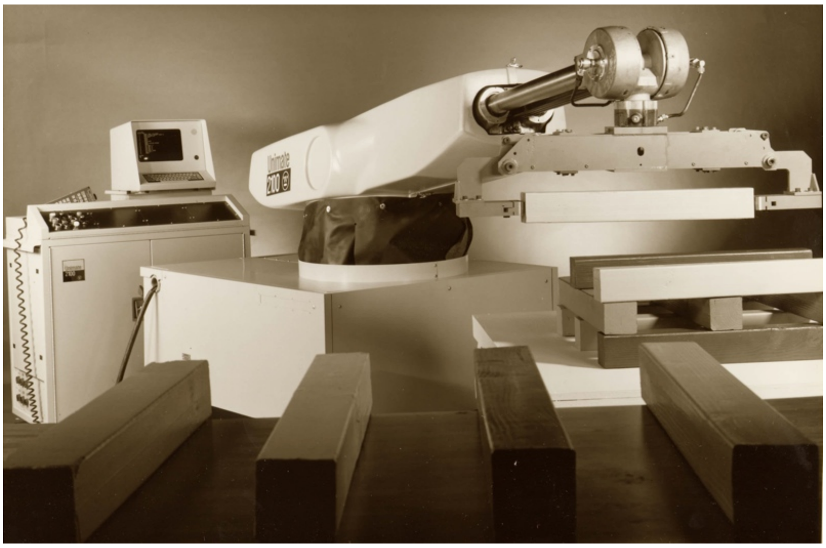

Figure 5.1: Picture of the first industrial robot. The Unimate developed by George Devol and Joseph Engelbert in 1961 was first used for hot die-casting and welding applications.[1]

5.3 Robots in hazardous environments

Robots do not only serve a purpose in a close-to-user work environment, they also ensure human safety by performing dangerous tasks in unsafe surroundings. Remotely controlled robots or drones can be used for inspecting mine shafts, collapsed buildings, pipelines, or overhead power poles. Other applications of such robots are bomb or mine defusion, fire extinction, or avalanche rescue.

5.4 Autonomous robots

Implementing an autonomous robot system is an intricate task that proposes many challenging problems for research or development teams. Autonomy requires a system to continuously work in a dynamic environment without external controlling inputs and utilize perceived information about its surroundings to adapt to environmental change.[2] Despite their complexity in development autonomous systems, mobile or stationary, immensely facilitate the execution of a job for the human user. Such robots can be used to navigate and organize warehouses, constructing parts in an assembly line, or map large areas for comprehensive calculations.

[2]Bekey, *Autonomous robots: from biological inspiration to implementation and control*.

Figure 5.2: Image of the Emesent Hovermap mapping a dangerous area within a mineshaft.[6]

5.5 3D Mapping

5.6 Autonomous 3D Mapping

While 3D Mapping is a well-established and growing economy most applications require human interaction at some point during the mapping process. Products such as the Emesent Hovermap[3] or Exyn Aero[4] utilize the spatial flexibility of drones and high-end light detection and ranging (LiDAR) Sensors to facilitate autonomous mapping in GPS-denied areas without being within sight of the drone pilot. These solutions can be used to explore hazardous environments such as mineshafts in a human-safe manner.

5.7 Goals

The project associated with this thesis aims to implement a 3D-Mapping system similar to the aforementioned solutions with limited financial, personnel as well as temporal resources. This goal forces the project team to primarily maintain an open-source approach during development.
The goal of this thesis is to document the challenges encountered and experiences gained by the project team during development to demonstrate how highly sophisticated industrial problems can be solved in a low-budget fashion.

5.8 Technical Objectives

[3]Emesent Hovermap, *Autonomy Level 2 for Emesent Hovermap*.
[4]Exyn Aero, *Exyn Aero - Aerial Mapping Drone*.
[6]Emesent, *Emesent_Hovermap.JPG (JPEG Image, 2018 × 910 pixels)*

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Emesent. *Emesent_Hovermap.JPG (JPEG Image, 2018 × 910 pixels)*. URL: https://www.emesent.io/wp-content/uploads/2020/07/DSC_3700-1finalcrop.jpg?id=7339 (visited on 07/04/2021).

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