Human-Centered Computing
and Extended Reality

FAU

Augmented Reality Assisted Flight Planning

I. General Info

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***Abstract*—As a special feature, aeronautical charts must indicate vertical information about airspaces in addition to horizontal structures. On paper or on 2D screens, this is indicated by corresponding markings in horizontal and vertical direction, but it has to be mentally transformed into a 3D space by the viewer. This is difficult for flight students and can be supported by augmented reality and machine learning or computer vision. Therefore, the goal of this master thesis is the development and evaluation of an app that automatically recognizes height structures from aeronautical charts and visualizes them via look-through augmented reality. The benefit of this solution will be evaluated in a concluding user study with stakeholders in the context of a flight planning.**

***Index Terms*—Augmented reality, assembly instructions, machine learning, computer vision**

II. Background and Motivation

Using augmented reality (AR) on a smartphone or tablet is nowadays not uncommon (e.g., IKEA or Pokémon apps) and there are established frameworks that make the development of such content relatively easy to access. In most cases, particularly concise optical markers are used to spatially locate digital content. In image processing, several methods are known that can recognize and locate specific structures in an image. For this master thesis, existing work and approaches can be built upon on both sides.

III. State-of-the-Art

AR's benefits for aviation are well known [7], for exmaple to visulize in-flight information [4] or provide 3D visualizations of air traffic control sectors [6, 3, 1]. There are survey papers that review the current state of the art for AR in aviation [9, 8]. There is also an approach that renders 3D

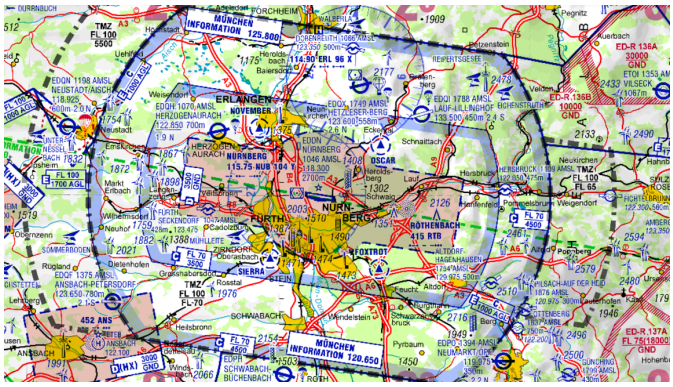

Fig. 1: 2D Aeronautical chart for airspace over Nuremberg. The different air spaces are indicated by altitude ranges and contour lines, e.g. right Charlie (C) from 4500 feet to FL07 (i.e., approx. 7000 feet).

Fig. 2: 3D rendering of for air space sectors over Las Vegas over 2D map [1]. Within the scope of this master thesis, this 3D visualization in AR is to be determined from the 2D map automatically.

landscapes on aviation maps [2]. However, this approach using a marker does not interpret the individual contour lines on the fly, but provides an evaluation in a user study.

More generally, there are frameworks for marker-based Augmented Realty using video see-through devices, e.g., *ARFoundation* or *Vuforia*). Different markers (2D textures) can be recognized in space via computer vision and virtual content can be placed in relation to them. With machine learning and filtering the camera input, this localization (and segmentation, respectively) can also be adapted for specific images and textures, e.g., using YOLO [5] or other approaches in the field of computer vision and machine learning.

IV. Student Task Description

Initially, a thorough literature search will provide information on which computer vision and AR rendering approaches can be used for text and contour-based detection of airspaces. Subsequently, an approach will be prioritized and prototypically implemented in an AR app. Finally, this approach will be evaluated against a classic paper map in a user study in a flight planning task.

V. Technical Prerequisites

Initial hands-on experience with computer vision and machine learning and/or hands-on experience with AR development in Unity is recommended.

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