# Design

This chapter will give an overview of the design of the system implemented to give a general overview of the system's architecture. The components will be further discussed in detail in Chapter 5.

## Overview

The augmented reality application can be divided into four separate parts. The first part is the data extraction process, where data is collected for training both for the augmented reality side of the application, as well as for the recommendation process. The second part involves feature extraction, where relevant features are extracted and fed to the implemented or applied model for training. The third phase is building a suitable user-query model for user recommendation. The last part is implementing the trained data within the custom-built user interface to provide an user-friendly augmented reality experience.

## Data Handling

The data extraction process can be further divided into three phases. The first phase is gathering relevant images of the area around the workplace. The images taken should be as clear as possible capturing every bit of detail within the office building. The next phase is building 3D models of chosen markers for the Augmented Reality. The 3D models must capture as much detail as possible of the actual marker. The following images and 3D models are then fed to the Vuforia's Library for training. The last phase is gathering data from a good number of previous users who rated the application when they performed a task. The reason behind this, is to perform collaborative filtering techniques using a set of machine learning algorithms and probabilistic methods to achieve a set of user preference recommendations. The results achieved will be later combined with the content-based similarity matrices.

## Feature Extraction

As explained in [15], feature extraction can be decomposed in two steps: feature construction and feature selection. In this project feature extraction is done on images, 3D models and previous user ratings. Firstly, feature extraction on images is done using Vuforia's Sift [23] and Surf [8] algorithms. The Vuforia library does not disclose any information on which algorithm exactly they make use of. However, the algorithms used to detect image targets is a natural based feature selection technique which is similar to the two latter algorithms mentioned in the following library's page [2]. The next step is to pass the 3D models to Vuforia's model target generation [1] which makes use of the library deep learning techniques. For the collaborative filter techniques, the KNN model makes of the rating and the user-task id as features.

## User-Query Model

There will exist two forms of user query models. The first one will be that of the intern. Every intern goes through a strict process on their first day of their job. Since this is a prototype, it was decided to only provide such feature implementation for the user. The intern will have the option of choosing whether they prefer the following for augmentation, toilets, games room, and kitchen. Then the next part will be to allow the intern to first find the secretary, then the human resources' office and finally the manager's office. For each task, the system will be queried considering the preferred options the user queried for and the office they wish to visit. The second form of user query model is that of the visitor querying the augmented reality system. To the contrary the visitor is presented with the top 3 recommendations according to which task they would need to accomplish when visiting the office. The tasks shall be of three types: a delivery, an interview and a visitation. Once the user picks the relevant task and they choose the appropriate recommendation which falls under their preference, they are presented with relevant augmentation. For both the intern's and visitor's query, the system also considers the rooms and offices which the user will pass whilst visiting a office in particular. Therefore, it not only considers what the user prefers based on previous users' preferences but also what they might require. Hence, the user query model makes use of both collaborative and content-based filtering techniques.

## User Interface

The user interface will need to be as user-friendly as possible. It will need to provide the user with several options for them of what information they are interested in. The user shall be presented with a main menu allowing them to either augment information about the coffee machine, the offices while wandering around or to locate an office in particular. The coffee machine interface will be augmented once the coffee machine is recognized, allowing the user to learn how to make a cappuccino as well as showing them an augmented video of how to make it. The offices information interface will spring up once the user's phone recognizes the correct marker allowing them to view details about the office or locate a particular office from their current location. Navigation is not provided through an artificially intelligent algorithm and it is not within this research's scope to implement it. The navigation provided is through a 3D sketch giving an idea to where the visitor or intern need to go to find the office within their interest.

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