# Design

This chapter will give an overview of the design of the system implemented. The components will be further discussed in detail in Chapter 5.

## Overview

The augmented reality application is 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 is further divided into three phases. The first phase is gathering relevant images of the area around the workplace. The second 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 images and 3D models are then fed to the Vuforia’s Library for training. The third 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 are then combined with the item similarity-based matrix.

1. Image extraction process of the workplace
2. Building 3D models of the markers chosen from the images extracted
3. Building a user-task rating dataset of the previous system used

## 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 natural based feature selection technique [2] which is similar to the ones used in Sift[24] and Surf[8] algorithms. 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 SVD model makes use of the rating and the user-task id as 15 features.

## User-Query Model

Two forms of user query models shall be created. The first one will be that of the intern. Every intern goes through a similar process of integration on their first day of their job. Since this is a prototype, it was decided to provide a step by step process as feature implementation for the intern, furthermore they will have the option of choosing whether they prefer the following for augmentation; the games room, the toilet rooms, 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 had previously 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 system must accommodate visitors with the following tasks: 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 in front of, whilst visiting a office. Therefore, it not only considers what the user prefers based on previous users’ preferences but also what they might require based on the location they are in. Hence, the user query model for the visitor makes use of both collaborative and item similarity-based filtering techniques.

## User Interface

The user interface must be as user-friendly as possible. It needs to provide the user with several options for them of what information they are interested in. The user shall 17 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. The coffee machine interface is augmented once the coffee machine is recognized, allowing the user to learn how to make a cappuccino via an augmented video and text. The offices information interface is augmented once the user’s phone recognizes the correct marker allowing them to view details about the office or locate a particular office from where they are. 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 sketched holographic map giving an idea to where the visitor or intern need to go to find the office within their interest.

## Conclusion

In this chapter, the methods have been custom designed in applying the workplace assistant augmented reality, also taking into consideration previous implementations and methods applied using Augmented Reality in similar areas. In the following chapter, the methods designed shall be further detailed in how they were implemented and applied.

# References

[1] Model target generator user guide.

[2] Optimizing target detection and tracking stability.

[3] Advances in computer vision. Advances in Intelligent Systems and Computing, 2020.

[4] Gediminas Adomavicius and Alexander Tuzhilin. Context-Aware Recommender Systems, pages 217–253. Springer US, Boston, MA, 2011.

[5] Omer Akgul, H. Ibrahim Penekli, and Yakup Genc. Applying deep learning in augmented reality tracking. 2016 12th International Conference on Signal-Image Technology Internet-Based Systems (SITIS), pages 47–54, 2016.

[6] Hassan Alhaija, Siva Mustikovela, Lars Mescheder, Andreas Geiger, and Carsten Rother. Augmented reality meets computer vision : Eﬃcient data generation for urban driving scenes. International Journal of Computer Vision, 08 2017.

[7] Nader Barzegar and Shahroz Farjad. A study on the impact of on the job training courses on the staﬀ performance (a case study). Procedia - Social and Behavioral Sciences, 29:1942 – 1949, 2011. The 2nd International Conference on Education and Educational Psychology 2011.

[8] Herbert Bay, Tinne Tuytelaars, and Luc Van Gool. Surf: Speeded up robust features. volume 3951, pages 404–417, 07 2006.

[9] Gaurav Bhorkar. A survey of augmented reality navigation. ArXiv, abs/1708.05006, 2017.

[10] Carlos Plaza de Miguel. Arlodge : Context-aware recommender system based on augmented reality to assist on the accommodation search process. 2014.

[11] Nevin Deniz, Aral Noyan, and ¨Oznur Gu¨len Ertosun. Linking person-job ﬁt to job stress: The mediating eﬀect of perceived person-organization ﬁt. Procedia - Social and Behavioral Sciences, 207:369 – 376, 2015. 11th International Strategic Management Conference.

[12] James Ford and Tobias Ho¨llerer. Augmented reality: Information for workplace decision-makers, managers, workers and researchers. 02 2020.

[13] Mathieu Garon and Jean-Fran¸cois Lalonde. Deep 6-DOF tracking. IEEE Transactions on Visualization and Computer Graphics, 23(11), 2017.

[14] Ivar Grahn. The vuforia sdk and unity3d game engine : Evaluating performance on android devices. 2017.

[15] Isabelle Guyon and Andr´e Elisseeﬀ. An Introduction to Feature Extraction, volume 207, pages 1–25. 11 2008.

[16] T. Haritos and N. D. Macchiarella. A mobile application of augmented reality for aerospace maintenance training. In 24th Digital Avionics Systems Conference, volume 1, pages 5.B.3–5.1, Oct 2005.

[17] Alexandro Simonetti Ib´an˜ez and Josep Paredes Figueras. Vuforia v1.5 sdk: Analysis and evaluation of capabilities. 2013.

[18] Sumitkumar Kanoje, Sheetal Girase, and Debajyoti Mukhopadhyay. User proﬁling trends, techniques and applications. ArXiv, abs/1503.07474, 2015.

[19] Sumitkumar Kanoje, Debajyoti Mukhopadhyay, and Sheetal Girase. User proﬁling for university recommender system using automatic information retrieval. Procedia Computer Science, 78:5 – 12, 2016. 1st International Conference on Information Security Privacy 2015.

[20] Sneha kasetty sudarshan. AUGMENTED REALITY IN MOBILE DEVICES. PhD thesis, 05 2017.

[21] Stan Kurkovsky, Ranjana Koshy, Vivian Novak, and Peter Szul. Current issues in handheld augmented reality. pages 68–72, 06 2012.

[22] Andy Lee. Comparing deep neural networks and traditional vision algorithms in mobile robotics. 2016.

[23] Vincent Lepetit. On computer vision for augmented reality. pages 13 – 16, 08 2008.

[24] David Lowe. Distinctive image features from scale-invariant keypoints. International Journal of Computer Vision, 60:91–110, 11 2004.

[25] Paramjinang Moita. Adjustment to the work place by new recruits in libraries. Vol.5(2):71–85, 04 2015.

[26] Jonathan Pedoeem and Rachel Huang. YOLO-LITE: A real-time object detection algorithm optimized for non-gpu computers. CoRR, abs/1811.05588, 2018.

[27] David Proch´azka, Ondˇrej Popelka, Tomas Koubek, Jaromir Landa, and Jan Kolomaznik. Hybrid surf-golay marker detection method for augmented reality applications. Journal of WSCG, 20:197–204, 01 2012.

[28] Francesco Ricci, Lior Rokach, and Bracha Shapira. Recommender Systems Handbook, volume 1-35, pages 1–35. 10 2010.

[29] M. Romilly. 12 Best Augmented Reality SDKs. (2019, Jan 25).

[30] Edward Rosten and Tom Drummond. Machine learning for high-speed corner detection. In Aleˇs Leonardis, Horst Bischof, and Axel Pinz, editors, Computer Vision – ECCV 2006, pages 430–443, Berlin, Heidelberg, 2006. Springer Berlin Heidelberg.

[31] S. R. R. Sanches, M. Oizumi, C. Oliveira, E. F. Damasceno, and A. C. Sementille. Aspects of user proﬁles that can improve mobile augmented reality usage. In 2017 19th Symposium on Virtual and Augmented Reality (SVR), pages 236–242, Nov 2017.

[32] Rodrigo Silva, Jauvane Oliveira, and G. Giraldi. Introduction to augmented reality. 01 2003.

[33] Simon Taylor and Tom Drummond. Binary histogrammed intensity patches for eﬃcient and robust matching. International Journal of Computer Vision, 94(2):241–265, Sep 2011.

[34] Mathangi Vijayan. Impact of job stress on employees’ job performance in aavin, coimbatore. 06 2018.

[35] Manolis Vozalis, Angelos Markos, and Konstantinos G. Margaritis. Evaluation of standard svd-based techniques for collaborative ﬁltering. 01 2009.

[36] Hongzhi Yin, Yizhou Sun, Bin Cui, Zhiting Hu, and Ling Chen. Lcars: a locationcontent-aware recommender system. pages 221–229, 08 2013.

[37] Zhuo Zhang, Shang Shang, Sanjeev R. Kulkarni, and Pan Hui. Improving augmented reality using recommender systems. In Proceedings of the 7th ACM Conference on Recommender Systems, RecSys ’13, page 173–176, New York, NY, USA, 2013. Association for Computing Machinery.

# Appendix





