

Internship Proposal 2019 – 2020

Topic: Realtime Visual Analytics for Augmented/Virtual Reality Applications.

Hosting team: AAAID Team at Nokia Bell Labs France (Nozay).

Mentors:

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Duration: 3 or 6 months

Expected starting date: March 2020

Keywords: Wireless Networks, Visual Analytics, Augmented Reality.

Description: Interactive media consumption mediums like Augmented and Virtual Reality (AR/VR) will play a key role in industrial automation environment [4, 5], providing means to display real time contextual information to the users of the architecture (humans or machines). Unfortunately, most existing AR/VR solutions (e.g., HoloLens [6] or Magic Leap [7]) are only capable of discerning the geometry of the environment but cannot perform more advanced visual analytics such as object detection and recognition. This is mainly because performing such analytics requires significant power and compute resources that can quickly drain the AR/VR headsets. One way to overcome this challenge is to offload the video frames to an edge compute unit that can perform the needed analysis. However, this will come at the cost of increasing delays to transmit the frames to the processing unit and wait for the analytics results. In the context of AR/VR solutions where the user's view is constantly changing, the visual analytics must be accomplished within 2 digits of milliseconds delay ensuring that the relayed contextual information is relevant to the user's field of view. Unfortunately, most existing state-of-the-art work [1, 2] on visual analytics for AR/VR solutions either require 400 ms of latency to perform the visual analytics or have only been tested in stationary scenarios with ideal wireless conditions. Hence, there exists no solution that can perform real-time visual analytics for AR/VR solutions in realistic network conditions.

The overarching objective of this project is to develop a system that enables mobile AR/VR agents to perform high-accuracy low-latency visual analytics tasks in real wireless network conditions. To achieve this, we aim to devise adaptive visual streams offloading solutions that can effectively measure and adjust to changes in the network. Designing such solutions requires us to answer several key research questions, such as: what frames to process locally? And which ones to drop or offload? At what bitrate to encode the offloaded frames? When to offload and when to hold-off?

The goal of this internship is to assist in the design and development of a system for real-time visual analytics for AR/VR solutions. The student will run experiments to collect network traces that will help us answer some of the above-mentioned questions. The student will help in analyzing the collected data, and in the implementation of strawman approaches to evaluate the performance of existing work in a mobile context. During the internship, the student should develop scientific skills on network systems design and development and wireless technologies as well as scientific writing and presentation. If the student is interested, there is a possibility of staying for the doctoral studies after the internship.

Candidate Requirements:

- The candidate should be a 2nd year Master of Science student or a 3rd year student of “*Cycle d'Ingénieur*”.
- Comfortable speaking English (French is not required).
- Proficiency in Python.
- Proficiency in using libraries for Deep Learning.
- Experience with simulation tools.

- Experience with video processing and analytics is a plus.

How to apply: Send an email to both francesco.bronzino@nokia-bell-labs.com and sara.ayoubi@nokia.com with the subject "Internship on Realtime Visual Analytics". Please include the following documentation: up to date CV, transcript of records (bachelor and masters), contact information of 2 recommenders, a short statement explaining why you would be interested working on the topic.

References

- [1] Chen, Tiffany Yu-Han, et al. "Glimpse: Continuous, real-time object recognition on mobile devices." *Proceedings of the 13th ACM Conference on Embedded Networked Sensor Systems*. ACM, 2015.
- [2] Ran, Xukan, et al. "Deepdecision: A mobile deep learning framework for edge video analytics." *IEEE INFOCOM 2018-IEEE Conference on Computer Communications*. IEEE, 2018.
- [3] Liu, Luyang, Hongyu Li, and Marco Gruteser. "Edge assisted real-time object detection for mobile augmented reality." *MobiCom*. ACM, 2019.
- [4] Merel, Tim. "The reality of VR/AR growth." *Tech Crunch*, January 11 (2017).
- [5] Navab, Nassir. "Developing killer apps for industrial augmented reality." *IEEE Computer Graphics and applications* 24.3 (2004): 16-20.
- [6] Microsoft HoloLens. <https://www.microsoft.com/en-us/hololens/>.
- [7] Magic Leap One. <https://www.magicleap.com/>