Introducing MBOX

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ABSTRACT: MBOX is a proof-of-concept Multimodal Learning Analytics Internet of Things (IoT) system with multiple sensors that collect data on how small groups of people interact when performing collaborative tasks. These tasks include learning, organizational activities, and engineering tasks (physical computing). MBOX system comprises camera sensors, audio microphone arrays, biometric signals (EEG, HRV, and EDA) that connect to small single-board computers that process data on the edge and stream the meta-data to the cloud. The project aims to help support how people collaborate by providing feedback on physical interactions (body positions, gaze directions, hand motions), voice diarization (amount of talking for each person), physiological feedback, and affective measures (emotional qualities of face and voice).

Keywords: multimodal learning analytics, IoT, edge computing, fog, multi-layered architecture

1 MBOX

This paper presents MBOX, an IoT-based system for capturing multimodal learning analytics data with lightweight systems. The aim is to move away from a centralized system to an IoT approach that allows different sensors to be deployed depending on the learning scenario and computational resources needed. We utilize a multi-layered architecture following the edge-cloud pattern (Portelli and Anagnostopoulos, 2017). This approach integrates all possible computing layers, including Cloud, Fog, and Edge platforms. It has two main advantages: 1) being scalable to collect data from supplementary physical and digital data sources, which is very important for continuous improvement and future evolution of learning settings. Moreover, 2) supporting a de-centralized approach building up from the IoT systems. With MBOX the aim is to promote an adaptation to different learning environments and enable a better scaling of computational resources used within the learning context.

The resulting Architecture for MBOX (see Fig. 1) is edge-fog-cloud-driven approach. The edge part comprises small computation units (single board computers and microcontrollers) and data entry points being sensors, wide-angle camera, microphone array, and biosensors (HRV, EEG, EDA). We are using Timeflux (Clisson et al., 2019), an open-source framework for the acquisition and real-time processing of biosignals that send time-series data to InfluxData[1] that is currently visualized with Grafana[2] hosted in Google Cloud Computing Services[3]. The initial minimum viable prototypes have been deployed. We are now working on the next step, the signal synchronization and data fusion, to investigate the different collaboration patterns (see figure 1).

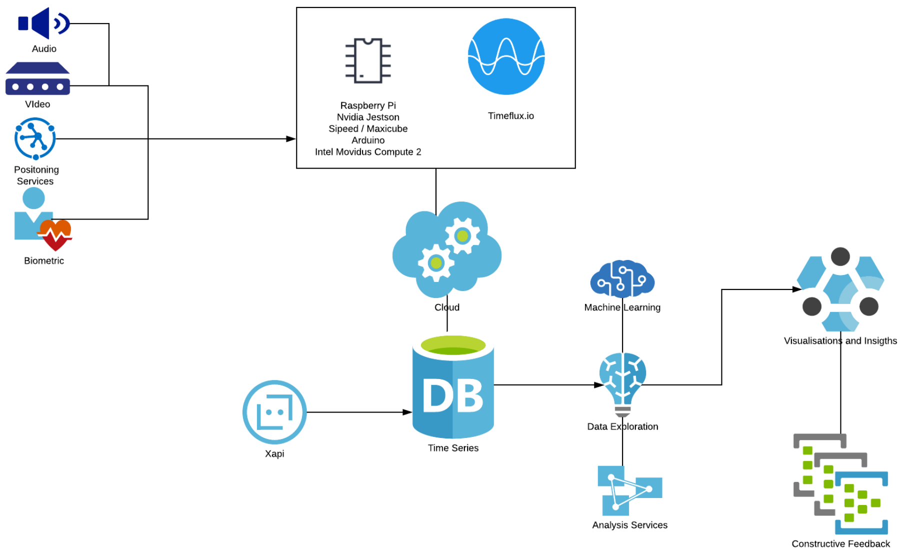

Figure 1: Conceptual Architecture of MBOX

2 VIDEO DEMOSTRATION

The video demonstration will illustrate some parts of the proposed approach with some basic working aspects of the different sensors and the streaming of meta-data to the cloud. Additionally, various edge services that provide essential computer vision and audio operations.

REFERENCES

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Portelli and C. Anagnostopoulos, “Leveraging edge computing through collaborative machine learning,” in *Proceedings - 2017 5th International Conference on Future Internet of Things and Cloud Workshops, W-FiCloud 2017*, 2017

[1] https://www.influxdata.com/

[2] https://grafana.com/

[3] https://cloud.google.com/