A Demonstration of ALTRUIST for Conducting QoE Subjective Tests in Immersive Systems

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***Abstract*—Subjective Quality of Experience (QoE) studies often require setting up complex lab environments to study users' perceptions of the application or service under controlled test conditions. These lab environments must control applications and devices to generate the required test conditions accurately, reliably, repeatedly, and error-free under study. Further, the data collection should be performed on many devices, such as clients and servers, often in real-time, and correctly labelled according to each test condition. To circumvent the complex task of configuring the lab environment and the laborious and error-prone work of data collection, we demonstrate ALTRUIST, a multi-platform tool to conduct subjective tests efficiently. In particular, we present the use of ALTRUIST in two lab setups involving immersive applications such as mobile cloud gaming and virtual reality gaming.**

***Index Terms*—Subjective tests, Quality of Experience, Toolkit, Multimedia, Games, Extended Reality, Cloud Gaming**

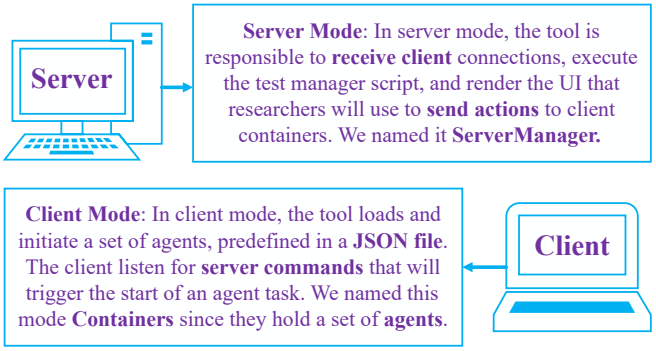

Fig. 1: Describes ALTRUIST server/client architecture.

I. Introduction

Quality of Experience (QoE) assessment for immersive multimedia applications (e.g., PC/Mobile/Extended Reality games, cloud gaming, and audio/video streaming) via objective and subjective studies requires the establishment of controlled laboratory settings to investigate how several contextual factors such as delay, jitter, packet loss, bitrate, resolution and location affect the users' perception of any application or service [1]. The experimenter will often encounter many challenges in conducting these tests, such as the following:

1) Dealing with heterogeneous devices and operating systems in the laboratory environment for replicating real-world test settings for device, application, and human-centred context factors.
2) Different data files must be collected and synchronized for each user test, including logs, questionnaires, application usage, network traffic, and device usage, among other things. These logs can be generated on any device.
3) For data analysis, the logs must be correctly catalogued by including attributes such as the test identification number, tested condition, date and time.
4) Performing repetitive, laborious and critical tasks such as setting the devices and applications with the correct factor settings to generate the test conditions on which the users will be tested.

Conducting subjective tests manually may increase the chances of human errors, leading to experimental data loss or reduced data quality and fidelity. To minimize data collection errors and optimize testing time, we developed ALTRUIST [2] - a multi-platform tool to automate routine and repetitive tasks necessary to conduct subjective tests. ALTRUIST supports the most common platforms, allowing it to be deployed to all devices in the lab environment. It supports communication between each deployed application (done via computer networks) since the tool was built following a server/client architecture. The tool contains several different agents encompassing scripts that can be executed simultaneously on each device to perform various tasks (e.g., copy files, start a process, benchmark, external application configurations) automatically. ALTRUIST is also customizable and is offered to the research community as open-source software[1]. ALTRUIST has already been used to create models in [3] and is part of recent activities within ITU-T SG 12 [4].

In this demo paper and at the conference, we demonstrate how the tool can be configured to assist in two different testing scenarios for VR and mobile technologies, and how it supports QoE research for multimedia applications.

II. ALTRUIST System

ALTRUIST is a portable and distributed platform to perform tasks on different laboratory devices. Communication between each deployed application follows a server/client architecture and is described in Fig. 1. Containers can be customized by

[1]https://github.com/hsr-research/ALTRUIST

TABLE I: ALTRUIST system agents and their tasks.

Agent Name	Task	Agent Name	Task
Wireshark	Start/Stop Wireshark network traffic capture.	**NetEmulator**	Applies network conditions using NetEM.
Ping	Send ICMP packets and tracks RTT, PL, or Jitter.	**PortWatcher**	Watches or send UDP/TCP port messages.
FileTask	Copy, delete or rename files in the system.	**WinResources**	Tracks GPU,CPU, RAM of a proccess.
ProcessTask	Starts an application or kills a process.	**RconWatcher**	Reads/Sends Message to apps that supports RCON5.
QTnaireTask	Open/Close/Save Questionnaire answers	***...N***	New Features that can be added in the future by the QoE community

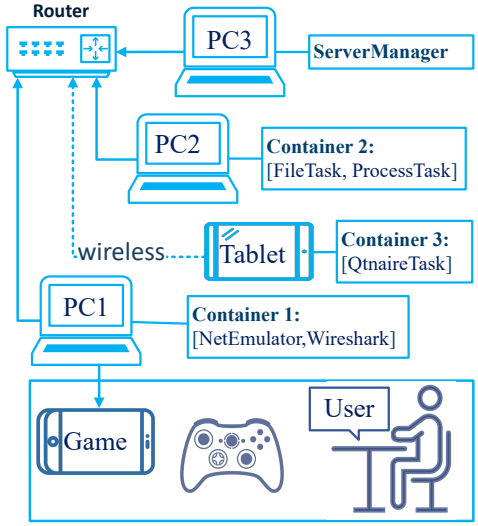

Fig. 2: Showcase 1: ALTRUIST configured to assist in performing MCG subjective tests.

creating or editing an existing JSON file. The file defines a single Container along with its list of agents and their settings. There is no limit to the number of agents a Container can execute. The full list of agents and their tasks is described in Table I. ALTRUIST is highly configurable and the set of agents it offers allows the tool to be an assistant in a variety of QoE subjective tests.

III. Cloud Gaming use cases scenarios

To demonstrate the versatility of ALTRUIST, we propose two showcases with varying degrees of difficulty for performing subjective tests in the context of cloud gaming and computer networks. The first case is mobile cloud gaming (MCG) described in Fig. 2, and is very similar to the lab setup proposed in [5]. In this setup, one computer is used to exclusively run ALTRUIST' ServerManager (PC3), one computer to host and stream the game (PC2), and one computer to emulate network conditions using NetEM[2] (PC1) that will affect the quality of both streaming and input via D-pad controller. Users would play the game on a smartphone and rate their opinions on the questionnaire on a tablet screen.

Fig. 3 illustrates a virtual reality cloud gaming (VRCG) setup that is analogous to the experimental setup proposed in [6]. In this case, the necessary changes were made to adapt

[2]NetEem webpage: https://wiki.linuxfoundation.org/networking/netem. Access date: 13 Oct. 2023

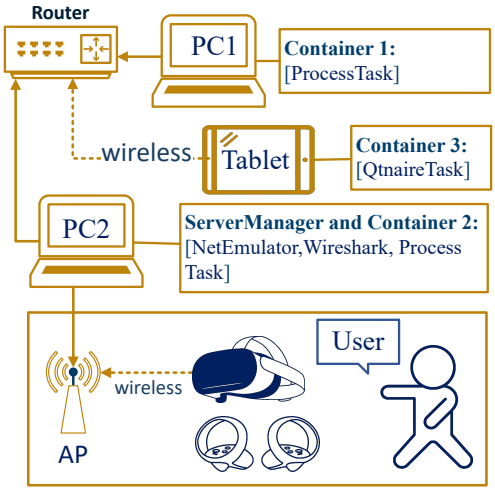

Fig. 3: Showcase 2: ALTRUIST configured to assist in performing VRCG subjective tests.

to VR technologies. The VR glasses connect wirelessly to an access point, which is connected via cable to PC2. This PC emulates network conditions via Container 2 and hosts the ServerMananager app. The VR game runs on PC1 and is streamed to the VR glasses. Users are expected to play a VR game using the glasses and, similarly to showcase 1, rate their opinion using a tablet.

IV. Demonstration and Conclusion

In the context of tools and methods for collecting subject data and conducting tests, we showcase the versatility of the ALTRUIST tool by proposing different setups to account for variability in immersive multimedia technologies and devices. As such, we welcome conference attendees to interact with both setups (VRCG and MCG) in the roles of both the experimenter and the subject, to understand the challenges of subjective tests and evaluate how ALTRUIST could help to address them.

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