Abstract Proceedings

Of

ISMCR2021

A VIRTUAL Topical Event of
Technical Committee on Measurement and Control of Robotics (TC17)
International Measurement Confederation (IMEKO)

Theme:
"Virtual Media Technologies for the Post COVID-19 era"

Friday, October 1, 2021

Event Coordinators:
Prof. Masahiko Inami/The University of Tokyo, Japan
Prof. Simone Keller Füchter/University of Estácio de Santa Catarina -Brazil

Logistic Host/Coordinator: IEEE Region 5 Galveston Bay Section

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Message from the coordinators


Prof Masahiko Inami
The University of Tokyo, Japan

Prof. Simone Keller Füchter
University of Estácio de Santa Catarina, Brazil

On behalf of the organizing committee, we welcome you to the International Symposium on Measurement and Control in Robotics, ISMCR2021. Reflecting on the challenges with physical travel in these pandemic times, we are hosting the symposium online at a globally accessible virtual venue this year. We hope that this opportunity to meet colleagues worldwide from the comfort of your homes will highlight the interdisciplinary and international nature of our field.
This event brings critical studies of virtual- tools at a time when their use is necessary: in a post-COVID era. High-quality research brings contributions to science and technology with presentations on different virtual media such as Virtual Reality, Augmented Reality, Mixed Reality (VR, AR, MR), Telepresence, 360-degree media, and haptic displays as wearable Technologies, among others. The use of these technologies allows incredible advances in Engineering Methodology, Education and Training, Entertainment, Health, Marketing, Aviation, and a wide variety of other Industries.
In this symposium, we will encounter research that looks to a future beyond the current pandemic and explores how Virtual Media Technologies can support humanity in such a time. We hope that this session will inspire further research, which looks to when the current situation becomes the norm
Our event features a keynote by Prof. Hiroyuki Shinoda of the University of Tokyo. His presentation topic is "Materialized graphics as an extended robot to measure and drive humans." We also have added a Virtual video Laboratory tour of the University of Tokyo.

Logistic Host/Coordinator
Dr Zafar Taqvi, TC17 Chair

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PROGRAM

6:00AM-11:00AM US-Central, 8:00AM-01:00PM Brazil, 1:00PM-6:00 PM Central Europe, 4:30 PM-9:30 PM India, 8:00PM-1:00AM Japan

6:00 AM **US-Central**	**Welcome** **TC-17 Chair**: Dr Zafar Taqvi **Event Coordinators:** Prof. Masahiko Inami and Prof Simone Keller Füchter
6:05 AM	**Keynote Speaker:** Hiroyuki Shinoda, Professor, The University of Tokyo **Presentation**: Materialized graphics as an extended robot to measure and drive humans
	VR/ AR and Other Virtual Medias: Human – Computer Interface
6:35 AM	**1-Motor Point Search for Electrical Muscle Stimulation Using Electrodes Array** Seito Matsubara, Taiga Suzuki, Sohei Wakisaka, Kazuma Aoyama, Masahiko Inami The University of Tokyo, Japan [inami@star.rcast.u-tokyo.ac.jp]
6:50 AM	**2-Virtual reality simulation for human factors identification** Ivan de Souza Rehder, Edmar Thomaz da Silva, Emilia Villani, Instituto Tecnológico de Aeronáutica – ITA,Brazil: ivan.rehder@ccm-ita.org.br, edmar.thomaz@ccm-ita.org.br, emilia.villani@ccm-ita.org.br
7:05 AM	**3-Augmented Reality in Science Days: an interactive tool on different human-computer interfaces** Jefferson Michaelis, KSC International Academy, USA : jm@michaelisfoundation.org
7 :20 AM	**4-Augmented Touching Surfaces with Deep Learning and RGB-D Sensing** Fujian Yan ; Hongsheng He, Wichita State University, USA: fxyan@shockers.wichita.edu,hongsheng.he@wichita.edu
7:35 AM	**5-Effects of Thermal Presentation According to the Other's Gaze in Remote Communication** Sosuke Ichihashi, Arata Horie, Zendai Kashino, Shigeo Yoshida, Masahiko Inami The University of Tokyo, Japan [kashino@star.rcast.u-tokyo.ac.jp]
	Virtual / Augmented Reality/Telepresence: Engineering and applications
8:00 AM	**6-Towards augmented reality for aircraft maintenance** Gabriel de Oliveira Cruz do Prado, Ezequiel Roberto Zorzal, ICT/UNIFESP, Instituto de Ciência e Tecnologia, Universidade Federal de São Paulo, Brazil: prado.ime@gmail.com, ezorzal@unifesp.br
8:15 AM	**7-Methods and steps to interface Lab VIEW with Arduino for two tank water level monitoring system** Aishwarya Patted, VTU Basaveshwar Engineering College Bagalkot, India : aishwaryapatted8@gmail.com
8:30 AM	8-**Field Research with the T-Leap Wearable Telepresence System in Shibuya, Tokyo: Findings and Future** Tomoya Hirata, Daisuke Uriu, Takeru Yazaki, Zendai Kashino, I-Hsin Chen, Sheng-Wen Kuo, Kang-Yi Liu, Yi-Ya Liao, Ju-Chun Ko, Chien-Hsu Chen, Masahiko Inami The University of Tokyo, Japan
8:45 AM	**9-Experiment Assisting System with Local Augmented Body (EASY-LAB) for the post COVID-19 era**

	Ahmed AlSereidi, Yukiko Iwasaki, Joi Oh, Takumi Handa, Vitvasin Vimolmongkolporn, Fumihiro Kato, Hiroyasu Iwata Waseda University, Japan
9:00 AM	**10-A new mask for a new normal** Zendai Kashino, Daisuke Uriu, Masahiko Inami, The University of Tokyo, Japan
	Virtual / Augmented Reality and Education
9:20AM	**11-Standards and Affordances of 21 st Century Digital Learning: Using ARLEM and xAPI to Track Bodily Engagement and Learning in XR (VR, AR, MR)** Karen Alexander , Jennifer Rogers, XRconnectED, USA : Karen@XRconnectED.com
9:35 AM	**12-An Approach to Smart Stores to tackle post-pandemic challenges** Nalin Saxena, Shrilaxmi Bhat, PES University Bangalore, India: nalinsaxena@pesu.pes.edu, shrilaxmi.bhat@gmail.com
9:50 AM	**13-Augmented Reality to Enhance Learning in Secondary Education During COVID-19 through Open Schooling** Eliane Pozzebon , Josete Mazon , Iane Franceschet De Sousa, Julio Augusto da Rosa Carraro, Alexandre Marino Costa, Alexandra Okada- Federal University of Santa Catarina,Brazil and Open University, United Kingdom : eliane.pozzebon@ufsc.br, josete.mazon@ufsc.br , ianefran@gmail.com , julio.carraro@outlook.com , rmarinocad@gmail.com , alexandra.okada@gmail.com
10:05AM	**14-AREL - Augmented Reality - Based Enriched Learning Experience** V Geetha, Dr. T. Mala, Anna University, India : geethu15@gmail.com, mala@auist.net
10:20 AM	**15-Digital Tools in the Post-COVID-19 Age as a Part of Robotic System for Adaptive Joining of Objects** Zuzana Kovarikova, Frantisek Duchon, Andrej Babinec, Dusan Labat, Slovakia : andrej.babinec@stuba.sk dusan.labat@outlook.sk, kovarikova@vuez.sk, frantisek.duchon@stuba.sk
10:35 AM	**16-VIRTUAL Video Lab Tour, The University of Tokyo Japan**
11:00 AM	**Concluding Remarks**

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Keynote Presentation:
Materialized graphics as an extended robot to measure and drive humans

SPEAKER: Professor Hiroyuki Shinoda, The University of Tokyo.

Presentation: In the early stage of the midair ultrasonic tactile display, which began in 2008, it was only able to produce weak, specific, and somewhat strange tactile sensations as a tiny subset of haptic sensations. However, as research progresses, it is becoming a universal tactile display that can freely produce various tactile sensations. Materialized graphics is a challenge to create a sensory substance based on such versatile tactile display. It extends the mechanical robot to fully computational existence, enables the non-invasive and seamless connection between humans and computers, and provides a medium to measure and drive humans, including their minds. This talk will introduce the latest achievements and challenges of the materialized graphics and discuss the future.

Speaker Bio: Hiroyuki Shinoda is a professor in the Graduate School of Frontier Sciences, the University of Tokyo. He received Ph.D. in Engineering from the University of Tokyo in 1995 and started his laboratory at Tokyo University of Agriculture and Technology. After research projects on haptic sensors and displays, ultrasound devices, and two-dimensional communication, his group developed the world's first non-contact ultrasound tactile display to create a tactile sensation on bare skins.

VR/ AR and Other Virtual Medias: Human – Computer Interface

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1-Motor Point Search for Electrical Muscle Stimulation Using Electrodes Array

Seito Matsubara, Taiga Suzuki, Sohei Wakisaka, Kazuma Aoyama, Masahiko Inami
The University of Tokyo

Electrical muscle stimulation (EMS) has been an effective option for rehabilitation and haptic display. Especially in the post covid-19 era, EMS is expected to be applied as a solution for haptic displays in telecommunication and virtual reality, and also as basic technology for human augmentation which creates cognitive and physical improvement. For example, EMS can be used to transmit handshake motion in a teleconference or to assist human movements. When we use EMS, it is important to stimulate a site called a motor point (MP). MP is defined as a site on the muscle to which the stimulation causes muscle contraction effectively with a lower electric current compared to the surrounding area. Stimulation with low current can reduce pain and discomfort. Therefore, identifying the position of MP is important for EMS because pain and discomfort prevent users' motion itself. However, manual identification of the MP positions takes time and effort because it needs millimeter-level electrodes which are smaller than previous research. Making electrodes larger could be a solution to cover MP with rough position identification. However, in that case, current could flow in areas other than the MP, and the amount of current will increase. Then, the intensity of EMS is increased.

To solve this problem, we constructed 8 rows by 5 columns electrodes array with a diameter of 2 mm and a pitch of 2.54 mm using photo MOS relays to switch electrodes. Then, we created a spatial map on the skin of the threshold to induce muscle contraction using the device (i.e., threshold map). Referring to this threshold map, we can derive a strategy for the MP search method.
As a result, we observed a continuous gradient on each participants' threshold map with the bottom at estimated MP (n = 3). The relationship between the electrode size and threshold is also investigated. With these results, we propose the MP search method. Since the gradient was observed on the threshold map, we propose a faster MP search using a method that calculates the gradient by measuring the area around a point and moves the electrodes in the direction of the calculated gradient than exhaustive search.

One of the prospects is to track the MP that moves with users' posture. First, we investigate the current thresholds for various postures. Then, we select electrodes according to users' postures. Using these processes, the motor points can be stimulated accurately even in the situation where users' postures change dynamically. If EMS under sensory thresholds in all postures by improving the MP search method is developed in the future, we can construct a system that can automatically search for MP without the user noticing. This method is expected to provide basic knowledge for EMS-based motion transmission and assisting the human movement. Then, this MP search method can lead to virtual media technologies for post covid-19 era.

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2-Virtual reality simulation for human factors identification

Ivan de Souza Rehder, Edmar Thomaz da Silva , Emilia Villani
Instituto Tecnológico de Aeronáutica, 12228-900 São José dos Campos, Brazil

The society has reached technology to create autonomous vehicles and to connect different devices and machinery to each other in order to exchange data and to optimize production efficiency. With this technology, soon it will be possible to achieve better methods to guide blind and visually impaired (BVI) users in their daily activities. The products currently available in the market have a number of limitations and do not satisfy BVI users. We believe that one of the reasons behind this problem is the lack of involvement of BVI users in the development of these products. The lack of an efficient solution for BVI users navigation became even larger with the SARS-CoV2 pandemic, in which people had to avoid contact with each other and not touch other surfaces. The purpose of this paper is to propose a method for the evaluation of design options of BVI products based on the concept of Virtual Reality (VR). The idea is to use the VR as a testing ground where a BVI user can try different assistives solutions in different scenarios. By doing so, the user becomes part of the product design and evaluation, resulting in better and more user-friendly products.

The proposed method includes not only the setup of the virtual environment but also the use of physiological sensors and subjective tests in order to assess the mental workload and situational awareness in different situations and/or using different versions of product under development . In order to illustrate the proposed method, we use as case study the BVI navigation in a hospital submitted to COVID-19 protocols. This case study is chosen due to the current undergoing the SARS-CoV-2 pandemic and the criticality of this kind of scenario for BVI people. The scene was made using Unity3D, a widely used development platform for virtual reality applications. The VR device was the Tobii Eye Tracking VR, a head-mounted display for virtual reality developed using the HTC VIVE. The VR device is used for defining the position and orientation of the user in a virtual environment in Unity.

Based on the current situation in the virtual environment, inputs are provided to the user using aural and haptics devices. In order to assess the mental workload, physiological sensors, from TEA Captiv T-Sens, are used. Among them, are an electrocardiogram sensor (ECG), to gather heart-rate and heart-rate variance data using, and a galvanic skin reaction sensor (GSR) to collect skin conductance. Beside these sensors, the users are also expected to answer NASA-TLX mental workload assessment test and situation awareness questionnaires. Among the expected benefits of the proposed method is the flexibility and agility to create different scenarios, as well as the possibility to test all of them in the same physical room. This could not only speed the design of new solutions but also improve the overall quality of the products.

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3-Augmented Reality in Science Days: an interactive tool on different human-computer interfaces

Jefferson Michaelis, KSC International Academy, USA

The use of digital tools has enabled a great leap in the scalability of humans-being in interactions with virtual engineering equipment, educational objects and aircraft training among others. Virtual media, such as Augmented Reality (AR), exhibit a massification of information, images, interactions that provide the user with increasingly complex, intuitive and realistic human-computer interfaces. This study presents the use of Augmented Reality in different interfaces such as tablets, smartphones, TV screens and projectors using large LED screens with webcam.

These different devices were tested in different editions of the Science Days event promoted by KSC International Academy between 2019 and 2020 in the cities of Rio de Janeiro, Araçatuba, Sorocaba and São José dos Campos, in Brazil with 1.000 young participants. The object of interaction presented in these experiments was Rover Curiosity, developed at JPL – NASA and which is currently active on planet Mars. Its structure, functions, appearance, types of mobility movements, image capture system (snapshots) and rock breaking system were presented by means of AR to the young participants. Different ready-made applications were used and tested with the young participants of the event and new applications were developed on the Unity 3D platform by using PTC Vuforia technology for the inclusion of AR.

The methodology used was Human-centered-Design, including observation and semi-structured interviews for the evaluation of the different methods used with the participants. As results, different "pros and cons" were found for each interface, even when the virtual object was the same. With the arrival of the COVID-19 pandemic, the Science Days event had to be adapted to a virtual environment and no longer with the physical presence of its audience and now, more than ever, it is necessary to rethink the ways of using virtual media for this very purpose: to make these groups of Science Days participants use Augmented Reality in a post-covid era. For this purpose, even more intuitive interfaces and tools are presented

with the user works better individually or even collectively with social distancing. In terms of event organization, computers can be replaced with self-help totems with support teams no longer required, for example.
How the post-COVID era will be is not exactly known but certainly the presence of technologies involving virtual media such as Virtual Reality / Augmented / Mixed, 360-degree videos, haptics and wearable technologies will be increasingly common.

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4- Augmented Touching Surfaces with Deep Learning and RGB-D Sensing

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Touch screen devices such as iPhone have transformed and changed our daily lives by directly interacting. In this work, surfaces are augmented into interactive surfaces by the proposed system. The object's name and definition are projected on the surface to form human-readable illustrations by a projector. The interactive surface is approximated by acquired depth information from an RGB-D sensor. With the detected user's intention (touching) and human-readable illustrations, the common reality of the context is constructed. In particular, what devices have perceived of the context is superimposed on the reality of humans. User's fear of devices due to uncertainty is eliminated by sharing the common reality of context. Furthermore, Fingertips are detected and recognized by a convolutional neural network with obtained images from an RGB-D sensor. The designed system enables users to interact with devices directly. An immersive environment is provided by the propose method to allow users to collaborate with devices intuitively. Compared with programming, operating with finger touching is more natural for users. Thus, the massive training can be reduced by the proposed system.

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5-Effects of Thermal Presentation According to the Other's Gaze in Remote Communication

Sosuke Ichihashi, Arata Horie, Zendai Kashino, Shigeo Yoshida, Masahiko Inami
The University of Tokyo

With the diversification of living and working styles, remote communication is becoming more and more important. However, conventional remote

communication relies on limited audiovisual information, which makes it difficult to communicate intuitively as in face-to-face communication.
One of the missing elements in remote communication is the ease of gaze recognition. In interpersonal communication, various effects of direct and averted gazes have been suggested, and gaze recognition can be considered as an important non-verbal factor. However, it is hard to recognize other’s gaze only with a visual information on a flat monitor.

To solve this problem, various gaze presentation methods have been proposed for remote communication. For example, an eyeball-type 3D display to represent remote participant ’s gaze direction was proposed. Yet, they have not been able to achieve the face-to-face experience of intuitively recognizing gazes while looking at the other person because the user cannot see the other person on the monitor while looking at the add-on display.

Thermal presentation has been reported to have an effect on communication similar to that of direct and averted gazes. Therefore, there is a possibility that gaze can be intuitively perceived through thermal presentation according to gaze.

In this paper, we propose a system that presents temperature according to the gaze of the other person in remote communication. The user perceives a stronger thermal stimulus when the gaze of the other person is directed toward the user, that is, when the visual attention of the other person is closer to the center of their monitor. To represent gaze with thermal stimuli, it is necessary to control thermal presentation intensities with high responsiveness. Thus, we propose a method to control infrared radiant intensities on human skin using an infrared source and shutter mechanism. As such, we realize a gaze-based thermal presentation system, which does not disturb visual experiences of the users in remote communication.

From the user feedback, it is suggested that the proposed system can realize remote communication with intimacy and presence similar to face-to-face communication, while it also brings about a different means of communication and experience from face-to-face. Therefore, it is expected that remote communication using a gaze-based thermal presentation will realize new ways of communication that is neither conventional remote communication nor face-to-face communication. Future studies should investigate the applications and effects of the proposed method in group communications because audiovisual information for each individual is even more limited in remote communication with a group.

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Virtual / Augmented Reality/Telepresence: Engineering and application

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6-Towards augmented reality for aircraft maintenance

Gabriel de Oliveira Cruz do Prado, Ezequiel Roberto Zorzal
ICT/UNIFESP, Instituto de Ciência e Tecnologia, Universidade Federal de São Paulo, Brazil

In recent years, the aircraft maintenance market has faced a shortage of mechanics specialized in performing these activities (Siebenmark, 2018). Among the most sought-after jobs by young Americans, this category is not on the most wanted list (Team, 2020).

Some people may associate the activities of an aircraft mechanic with an automotive mechanic and view it as an activity that is not related to new technologies. On the other hand, the search for jobs related to new technologies has been growing every year (Manyika, 2017). Thus, this labor market is suffering from the lack of new labor to meet the demand for aircraft maintenance, which has only grown due to the aging of aircraft that need maintenance and modernization (IATA, 2018).

Most of today's aircraft mechanics are already closer to retirement (Wyman, 2017). That is, they are senior mechanics who are used to traditional maintenance procedures that are performed even today. The fact that the maintenance market is seen as an environment of few innovations also makes it challenging to attract a younger generation to work with these activities. It is also important to highlight that a part of the older generation may have a specific prejudice, or difficulties (University, 2018), in using new technologies.

Aircraft service centers for Maintenance, Repair, Overhaul, which are specialized places for aircraft maintenance, are seeking to bring new technologies to this maintenance environment (Esposito et al., 2019). Among these new technologies is the use of Augmented Reality (AR). AR allows digital information and virtual objects to be overlaid in the real world (Azuma, 1997). Users can use technology through AR headsets or handheld devices and can still interact and see what is going on in front of them. The benefits of AR are multiple and diverse. Moreover, AR applications are becoming ever more affordable, thanks to more powerful hardware, including processors, headsets, and smaller form-factors such as smartphones (Martins et al., 2021).

AR technology aims to bring benefits to the execution of activities carried out in aircraft maintenance hangars. Among them, it is possible to describe the possibility of guiding the mechanic to a specific point on the aircraft that needs maintenance, in addition to bringing greater agility in the execution of procedures, as the information in the manuals can be displayed to the mechanic intuitively, assisting him with the step-by-step display for performing the activity (Eschen et al., 2017).

Also, AR can be used as a remote support tool to connect a more experienced mechanic to assist a novice technician in performing a task (Utzig et al., 2019). This last solution may be a good solution to support maintenance activities during this COVID-19 pandemic period. In general, AR in aircraft maintenance can reduce task execution time and, consequently, reduce aircraft maintenance time on the ground.

However, there are still some technological limitations (Palmarini et al., 2018) that are being addressed to help increase the use of AR in these maintenance environments. Currently, it is possible to mention the user's difficulty in interacting with virtual objects (Whitlock et al., 2018), and new techniques are being developed to replicate these types of interactions more likely (Sakamoto et al., 2020).

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7-Methods and steps to interface Lab VIEW with Arduino for two tank water level monitoring system

Aishwarya Patted,
VTU Basaveshwar Engineering College Bagalkot. /INDIA

This paper proposes methods and steps to interface LabVIEW with Arduino for two tank water level monitoring system. Two methods of Arduino interfacing with LabVIEW proc presented. Further, using Arduino, two tank water level monitoring system is implemented using ultrasonic sensor and verified it's functioning and operation by realizing it in LabVIEW. D on the sensor reading the pump on/off operations helps to monitor and control the water level in both the upper and lower tank. Comparison of the real time two tank water level monitor output is compared with the model simulated in the LabVIEW. Keywords: Water level monitoring, Ultrasonic sensor, LabVIEW, Arduino.

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8-Field Research with the T-Leap Wearable Telepresence System in Shibuya, Tokyo: Findings and Future Prospects

Tomoya Hirata, Daisuke Uriu, Takeru Yazaki, Zendai Kashino, I-Hsin Chen,
Sheng-Wen Kuo, Kang-Yi Liu, Yi-Ya Liao, Ju-Chun Ko, Chien-Hsu Chen, Masahiko Inami
The University of Tokyo

In this presentation, we present a wearable telepresence system "T-Leap," and field research we have conducted with it. T-Leap consists of multiple "Nodes" and a single Viewer. The Nodes wear T-Leap modules (each including a 360-degree camera and a set of sound equipment) and explore the outdoors. The Viewer

remotely connects with Nodes and is able to communicate with any of the Nodes via the 360-degree sight and voices.

The field research was conducted in Shibuya, Tokyo using an improved version of the T-Leap module. This improved version is smaller, lighter, and more powerful than previous versions and sought to enhance usability, communication, and image processing capabilities of the module.

We chose Shibuya as the site of our field research for two reasons. The first was to investigate how the improved T-Leap module performs in a 5G environment and to verify whether the better bandwidth it provides enables high-quality images to be transmitted to the Viewer. The second was to investigate what kind of experience T-Leap can provide in sightseeing locations, commercial facilities, and crowded places.

In the field research, we conducted three studies (S1-S3). In each study, one Viewer was in a hotel room near Shibuya station, while three Nodes went outdoors. The Nodes were required to complete tasks given by the authors. In S1, Nodes who are familiar with the area around SHIBUYA 109, a shopping mall, remotely guided a Viewer around stores. In S2, a Viewer who was familiar with the same area guided Nodes to stores. S3 was conducted in Miyashita Park with neither the Viewer nor the Nodes being familiar with the area. Together, they searched for objects the authors selected in advance.

Through the studies we identified several aspects of T-Leap which require improvement. For example, we were not able to observe any image quality improvements compared with our previous studies. We additionally discovered that it was difficult to perform sound volume adjustments with the current setup. On the other hand, we did observe some unique experiences which T-Leap was able to provide to the participants. For example, there was a situation wherein a Node who is familiar with Shibuya remotely guided a Viewer. In another situation, a Viewer who is familiar with Shibuya was able to make effective use of the 360-degree field of view and the ability to switch between Nodes to simultaneously guide all Nodes.

Through this field research, we discovered that our system has issues which need to be resolved to enable effective voice communication in noisy downtown areas like Shibuya. Namely, we identified our sound equipment and sound-related interaction design to be a major point needing revision in future work. We intend to carry out iterative development of the system, continue field studies, similar to this study' settings, and explore other uses and situations when/where T-Leap can be effective. Given our current system, we believe that T-Leap could be used to realize a remote tourist guiding service in the downtown area.

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9-Experiment Assisting System with Local Augmented Body (EASY-LAB) for the post COVID-19 era

Ahmed AlSereidi, Yukiko Iwasaki, Joi Oh, Takumi Handa, Vitvasin Vimolmongkolporn, Fumihiro Kato, Hiroyasu Iwata; Waseda University; Japan

Experiments that require a research participant are difficult to be conducted when the experimenter and participant are not allowed to work together in the same space. Researchers and engineers often require a participant to test a tool they developed, observe the participant, and evaluate the usability. In some cases, precise instructions to the participant given vocally are not sufficient to relay the experimenter's intention. A certain example is during the COVID-19 pandemic, these active observations and physical interventions are difficult, because the experimenter and the participant are not allowed in the same place. Therefore, we aim to develop a new system that enables the experimenter to observe and physically intervene with the participant as if the experimenter was beside him.

In recent years, video conferencing programs have widely spread due to the COVID-19 pandemic. These programs were the quickest available solution to resume work in real-time while maintaining social distancing. On the other hand, this solution of exchanging information was difficult to recommend for experiments that require physical interaction between two people. This resulted in miscommunication or loss of information. In the previous years, numerous researches on tele-operated robots with the objective of full-body immersion system have been conducted. However, these systems are inadequate for the majority to use because they were difficult to distribute, expensive, and usability from a remote location was unstable.

The system should be usable with minimum latency from a remote location, easy to set up in a small space, and cheap for consumers. To solve this, we developed the Experiment Assisting System with Local Augmented Body (EASY-LAB) to support experiments where a participant is required, the system's installation process is very simple and enables experimenters to observe and physically interact with the participants actively from a remote location. The experimenter uses any VR headset, while on the participant's side, a camera and a laser is linked to the HMD of the experimenter, is attached to a 6DOF robotic arm. The experiments have been divided into different categories depending on the required level of physical intervention needed. For this paper's prototype, Level 1 was used for evaluation and study its usability. The Level of the prototype is described as follows: Level 0 - Active observation; for cognitive task or psychophysical experiments which require observation of subjects. Level 1 - Active observation and intervention with pointing; for manual work with assembling or picking and placing something that requires direct pointing for precise instructions.

Level 2 (requires an additional 6 DOF to be added to the system) - Active observation and intervention with simple haptic robot hand and for wearables or instruments requiring fine-tuning.

Finally, the proposed system was evaluated by four subjects. The results found are as follow, in an experiment where the participant's pointing at a tiny object described by the experimenter, the mean pointing error was 1.1 cm, and the operation time was reduced by 60% compared with general video conferencing system. This result shows EASY-LAB's capability in tasks that require pointing and observation from various angles. The statistical study with more subjects will be conducted in the follow-up study.

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10- A New Mask for a New Normal

Zendai Kashino, Daisuke Uriu, Masahiko Inami; The University of Tokyo

The spread of COVID-19 has led to the introduction of a variety of infection prevention measures. Among them, wearing masks and maintaining distance (i.e., social distancing) are the most widespread. These measures were shown to be useful in the early stages of the spread of infection and have, in some regions, been incorporated into national policies.

While shown to be effective at slowing the spread of infection, both masks and social distancing have been reported to increase the psychological distance between people. Masks hide the face and mouth, making it difficult to see facial expressions and interfering with oral communication. Social distancing likewise has a negative impact on communication as it requires individuals to maintain a greater distance than humans are traditionally comfortable with. This hinderance to interpersonal communication had contributed to social issues in recent years and the desire to no longer need such measures continues to grow.

However, given that there is no timeline for the when COVID-19 will subside and/or become endemic, these infection prevention measures may remain in place for a while. While many efforts to facilitate safe face-to-face communication have been developed in the last few years, these often seek to bring face-to-face communication back to a pre-pandemic state. However, given that infection prevention measures may be the new normal, there is a need to explore new ways to conduct face-to-face communication that are not bound by pre-pandemic norms.

Herein, we propose a vision of the future that is not bound by pre-pandemic norms. This vision assumes that infection prevention measures remain in place. Namely, all people continue to wear masks and it is socially desirable to keep distance from each other. We envision a future where virtual media technologies, specifically augmented reality technologies, are incorporated into facewear to both enhance safety and the quality of in-person communication. With this facewear, people will be able to change their appearances and how they see the world as they wish. Cities will be filled with people who sport expressive virtual faces despite donning masks and headsets to facilitate visual social communication. On the trains, people will be confronted with other commuters who appear larger or closer than they physically are to facilitate maintaining a distance.

This vision will form the basis of future work investigating the effects of augmented reality on interpersonal communication and distance. Namely, it forms the context in which we will carry out future investigations on how mixed reality experiences can assist with improving safety and quality of face-to-face communications. One of these avenues of investigation involves a virtual mask which is superimposed on faceware to give the impression of close proximity despite maintaining a physical distance.

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Virtual / Augmented Reality and Education

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11-Standards and Affordances of 21st Century Digital Learning: Using ARLEM and xAPI to Track Bodily Engagement and Learning in XR (VR, AR, MR)

Karen Alexander, PhD, and Jennifer Rogers, MS

As the delivery of learning has been increasingly digitized over the past few decades, the importance of standards such as SCORM, the Sharable Content Object Reference Model, have helped to ensure interoperability across Learning Management Systems (LMS). But the 21st century has brought new, powerful tools for learning that enable educational and training experiences far richer than those available via a desktop or laptop computer.

Virtual, Augmented, and Mixed Reality (VR, AR, MR) bring affordances to learning that far surpass what was previously available. Immersive, embodied learning in 3D environments, with interactive 3D objects and collaborative engagements with teachers or other learners, will revolutionize education and training as we know it. For these reasons, new standards that can aid in the capture of data about a learner's experience have arisen, notably ARLEM (the Augmented Reality Learning Experience Model) and xAPI (the Experience Application Programming Interface). With xAPI and ARLEM, specific learner behavior can be directly tracked and measured as it is shaped and/or changes in a specific interaction thus permitting predictions of transfer from knowledge to demonstrable skill. Adoption of these standards is key to avoiding silos of information and data around associated learner development and behavior change encoded in different systems and formats that make communication across them difficult.

Among the affordances of Virtual Reality that make it such an effective tool for learning is the way that it engages the senses of proprioception and presence while permitting movement and gesture as the learner interacts with the virtual world and content. Research has shown that large gestures and bodily movements enhance the acquisition and retention of knowledge, and VR is able to deliver experiences that allow such movement, unlike the small, hands-only interactions we have when using a computer keyboard interface for digital learning.

AR and MR deliver digital content within a real-world environment, and such content appears to the learner as present in space alongside them. The learner can modify the size of the virtual objects with which they are interacting or rotate them for a different view, walk around them, and experience the content in a fully embodied, present manner. Recent research shows that the combination of physical movement and a gaming element in learning experiences for children not only enhances their ability to learn, but in fact also enhances cognitive function.

This paper will detail the learning affordances of Virtual, Augmented, and Mixed Reality and explain why xAPI and ARLEM standards can maximize our understanding of the operation of those affordances. We will detail the learning design development process behind two educational XR products, presenting them as test cases for the incorporation of xAPI and a modified ARLEM standard that can capture the full range of bodily movements, interactions, and behaviors available within XR experiences and use of these standards for evaluating learning.

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12-An Approach to Smart Stores to tackle post-pandemic challenges

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This paper proposes ideas and discusses the need of research to implement effective in-store smart stores solutions to combat the spread of the novel Coronavirus . Coming out of this COVID-19 pandemic, urban resilience is of utmost importance. New consumer behavior formed by restrictions such as physical distancing has had astounding implications on how retailers operate. The colossal shift to all things contactless and digital has pushed retailers to redesign the experience they offer their customers, increasing the shopper’s comfort level amid heightened health concerns and beyond. Here an idea is proposed that can make the implementation of smart stores possible using technology like Augmented

Reality (AR), Computer Vision, Gesture Control. The proposal keeps in mind the challenges faced by smaller cities in India which are not connected by the online grocery shopping platforms where the people have to venture out and hence increasing the harm of being exposed to the virus. Augmented Reality (AR), a technology that superimposes a computer-generated image on a user's view of the real product is used, thus providing a composite view. This model provides a unique take with respect to examining a product. This method reduces the requirement of unnecessarily touching a product hence making the process of shopping contactless to a maximum extent possible.

The public kiosks which are present in fast-food restaurants, museums and airports have become a hub for disease transmission. Novel methods of human machine interaction are required for this purpose to ensure the safety of people using the common systems. One of such a method can be an approach using gesture recognition. Our proposal is an easy-yet cost-effective approach which can make these systems purely touchless and gesture-based.

The proposal in this method involves an Arduino Uno microcontroller and two SR-04 or ultrasonic sensors which are mounted on top of the kiosk desks. The data which is given by the ultrasonic sensors is used to map various actions such as navigation to the next page, going back to the previous page or even making a selection. To perform a simple proof of concept we have implemented a simple Arduino based hand gesture control where you can control few functions of your web browser like
switching between tabs, scrolling up and down in web pages, shift between tasks (applications), play or pause a video and increase or decrease the volume (in VLC Player) with the help of hand gestures.

Keywords: post pandemic challenges, contactless in-store shopping experience, Augmented Reality, Low cost Gesture Controlled Kiosks.

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13-Augmented Reality to Enhance Learning in Secondary Education during Covid-19 through Open Schooling

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The COVID-19 pandemic has affected the education systems in many countries. In Brazil more than 24 millions of secondary students were affected due to school disclosure and social isolation. One of the key challenges of educational institutions is to provide remote teaching with online learning supported by digital technologies and engaging pedagogies. This qualitative study part of CONNECT

project led by Europe with partners in Brazil focused on open schooling approach and the use of Augmented Reality (AR)- the AR project (http://raescolas.ufsc.br). Participants were 25 eighth-grade students at an elementary school who explored 3D parts of Human Body to better understand the systems and cells and reflect about COVID-19 effects on health.

Open schooling is an approach that encourage the partnership between schools, universities and communities for students to solve real socio-scientific issues supported by teachers, scientists and families. The research question focused on "what is the value of the AR technology using open schooling approach for teachers to guide secondary students in the subject of Science supported by scientists? The methodological approach was qualitative analysis of data generated in workshops implemented by academic researchers with elementary school students and teachers using semin-structured questionnaires, observations and fieldwork notes. Findings revealed that most students felt motivated and satisfied. They found the experience meaningful and fun, willing its application in other disciplines.

Findings suggested that AR application supports the teaching-learning process through an engaging environment, contributing to the teaching-learning process. Open schooling with AR helped students with abstract acquisition of knowledge through and interactive visual and dialogic approach supported by teachers and scientists. This exploratory study indicates that visual interactions with meaningful discussions are useful for students to explore three dimensional human organs and cells, extend the real world with AR and discuss current socio-scientific issues related to COVID-19. However, this innovative approach requires planning, access to resources, mobile devices and pedagogical strategies supported by open schooling to promote meaningful immersive learning.

Keywords: Augmented reality, basic education, biology, educational technologies, immersive learning with fun, open schooling, CONNECT project.

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14- AREL - AUGMENTED REALITY- BASED ENRICHED LEARNING EXPERIENCE

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Within few months, the pandemic of coronavirus illness 2019 (COVID-19) caused by the novel virus SARS-CoV-2 has forced enormous changes in the way businesses and other sectors operate. According to World Economic Forum, 1.2 billion children in 186 countries were affected by school closures, as of March 2021.

Moreover, the new wave of cases in several regions of the world impacts the return towards normalcy. Herd immunity and vaccines provide only temporary relief to regions affected by the new virus strains. Thus, online learning has evolved into a viable alternative to traditional classroom-based learning, with instruction delivered remotely and using digital platforms.

Even before the COVID era, there is a steady increase in the growth rate and adoption of technology in education. According to GlobeNewswire, it is estimated that the online education market will reach $350 billion by 2025. In addition, concerning the response to COVID-19, several online education platforms such as DingTalk, have scaled their cloud services by more than 100,000 servers. Augmented and Virtual Reality (AR/VR), the emerging technology trend, has the ability to improve the online learning experience by increasing engagement and retention. VR headsets such as Google Cardboard (GC) have made the technology accessible to the majority of the world's population. VR and AR based online learning platforms offer experiential learning, where the students learn through experience rather than through traditional methods such as rote learning. Some of the benefits of experiential learning are - accelerated learning, engagement, understanding of complex concepts easily.

The proposed AREL system is a mobile AR-based learning platform in which students can scan the contents of their books to discover videos that appear magically over the pages, transforming a plain textbook into a book with dynamic information. AREL is made up of a collection of modules such as speech recognition system, image tracking and registration module that take advantage of mobile sensors and computational power. The application is developed using Unity Engine and Vuforia SDK. The mobile application interfaces with the Vuforia cloud target recognition system via a client-server architecture. To grab students' attention and increase their learning experience, the content in the book is enriched with augmented graphics, animations, and other edutainment features. The mobile camera is linked to the scene's virtual camera as soon as the program is launched. Once the target image is recognised with the help of the Vuforia image database, using pattern recognition algorithms, the corresponding output view is rendered using the display unit. As a result, the output view consists of virtual objects laid out over the real-time objects. The triggered audio output explains the concepts that are scanned, which in turn improves the experience of the learning. The learning module also consists of multiple-choice questions on the contents taught, in order to assess the understanding of the learned material. Based on the feedback received after the usage, it is observed that AREL positively improves the learning experience.

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15-Digital Tools in the Post-COVID-19 Age as a Part of Robotic System For Adaptive Joining of Objects

This presentation aims to demonstrate the utilization of digital tools as an effective way of sharing information within a team of workers who manage production carried out by a robotic system. The concerned production is characterized as highly variable and aimed at the joining of robot-positioned objects.

A prototype robotic system includes a system for automated robotic manipulation of to be welded parts taken from storage places (3D laser scanners and bin-picking application), manipulation robots with an automated quick-acting system of robotic grippers, an adaptive welding robot with the 2D laser scanner, a central control system, a safety system, a database containing data on welded parts, an HMI system, a data store, and a web portal.

Production optimization at the workplace is supported by digital technologies as early as in the preparatory stage when product design in its digital format is provided as input data for a tool simulating the robotic system. Digital twin simulation of the system contains information on machine parameters as well as on robotic system functionality. Variable inputs for the part characterizing the robotic system behavior are also CAD files for gripping the parts of different shapes and dimensions. The files differ for other robotic fingers. In the CAD files, information is provided on variable types of pallets for gripping the parts from storage places. In the simulation, in line with the digital twin concept, the functionality of the robotic system is verified. Implementation of simulation-verified algorithms results in shortening the time needed for workplace adaptation to various types of products. Simultaneously, the personal contacts of workers within the workplace are minimized. A set of required values includes, besides other things, welding process specifications dependent on the type of weld needed. Workers could propose and verify robotic system functionality from separated office rooms or their homes, so they were very effective during the COVID-19 pandemic. This fact brings efficiency in the process of development and testing even in the Post-COVID-19 Age.

In addition to the digital tool for simulation of the robotic production process, digital tools are also used to visualize an entire robotic process in two levels: locally (HMI units directly on technological system screens) and through a network (access to data for external workers provided using a secure communication channel). In such a way, digital data needed to prepare robotic processes effectively and optimize their effectiveness throughout the lifetime of the robotic system can be shared by a whole team of specialists. Information shared in digital form also relates to a subsequent process of automated quality control of welds. Digitization of data on the described robotic system enabled creating of a digital twin of the production unit. The use of the digital twin concept increases the effectiveness of research and development. It results in increased intelligence of the entire robotic system, demonstrating the effectiveness of using features of intelligent reality.

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16-Video Lab Tour Description

The University of Tokyo is one of the premier universities in Japan. Of its five campuses, one houses the Research Center for Advanced Science and Technology (RCAST). This research center stands out in that it is highly interdisciplinary. Members of RCAST enjoy the company of colleagues specializing in a range of physical, life, and social sciences as well as interdisciplinary topics which span the three.

In this video tour, we introduce one laboratory which calls RCAST home. The Information Somatics Lab, headed by Prof. Masahiko Inami, builds upon a foundation of psychology, cognitive science, and physics to understand the mechanisms of the human body from a systems perspective. The insight acquired is then used to augment the human body's innate sensory, physical, and intellectual capabilities. This lab tour will introduce the lab's unique workspace, based on the living lab concept, as well as several current works on display.

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https://www.imeko.org/index.php/tc17-homepage/tc17-aims

The TC's main objective is to deal with all aspects relevant to robot sensors, both internal and external ones, such as force sensor, tactile sensor, distance sensor, visual sensor and others, employed in robot motion and navigation control-principle, methodology and applications. Communication sensors interfacing between man and robot are also include.

Sensors and Sensing

- Sensor and Sensing Systems for Vision, Audition and Haptics
- Sensors and Calibration Facilities; Traceability and QS in Robotics
- Sensor Systems in Robotics and Mechatronics
- Signal Processing and Data-Fusion

System Integration

- Robotics and Automation Techniques: Virtual Tools
- Telexistence: Virtual Reality in the real world, Advanced Human Interface
- Mobile Robotics: Locomotion, Actuation, Command and Control
- Multi-agent Robotic Systems

Applications

- Outdoor Applications (environmental surveillance, risky environments, rescue, agriculture, construction, space)
- Indoor Applications (education, entertainment, medical assistance, industry)

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https://www.imeko.org/index.php/tc17-homepage/tc17-members

Technical Committee Members

First name	Last Name	Country
Andrej	Babinec	Slovakia
Goekcen	Bas	Austria
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Ioan	Doroftei	Romania
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Zafar	Taqvi	USA
Jeromir	Volf	Czech Republic
Zi	Xue	China
Yanhe	Zhu	China

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TECHNICAL SUBCOMMITTEE ORGANIZATION OF TC-17

LISTING OF IMEKO/TC17 TECHNICAL SUBCOMMITTEES AND THEIR MEMBERS

DRAFT AS OF JANUARY, 2021

TC17-TSC1-Mobile Robot

Chair: Prof. Yvan Baudoin

Members:

Prof Ioan DOROFTEI
Prof Andrzej Maslowski
Prof. Lino Marques
Dr Geert De Cubber
Prof Andrej Babinec
Dr Grigory Panovko

TC17-TSC2-Virtual Reality

Chair: Prof. Masahiko Inami

Members:

Prof. Simone Keller Fuchter
Jagdish Shukla
Prof. Andrej Babinec

TC17-TSC3-Augmented Reality

Chair: Prof. **Simone Keller Fuchter**

Members:

Prof Susumu Tachi
Prof. Masahiko Inami

TC17-TSC4-Autonomous Systems/UAV/Drones

Chair: Prof. Balint Kiss/ Prof. Vimla Juliet

Members:

Prof Jurek Sasiadek
Prof. Giovanni Muscato

TC17-TSC5- Advance Control of Robots

Chair: Jagdish Shukla

Members:

Prof. Vimla Juliet
Prof Jaromir Volf

TC17-TSC6- Robotics Applicationin IOT/Smart Sensors

Chair: To be Added

Members:

Jagdish Shukla
Prof Balint Kiss

TC17-TSC7- Robotic Trends and Innovations

Chair: Prof. Jean-Guy Fontaine

Members:
Prof. Andrzej Maslowski
Prof. Andrej Babinec
Dr Geert De Cubber
Prof Yanhe Zhu
Prof Grigori Panovko

TC17-TSC8- Robotic ApplicatIons

Chair: Prof. Giovanni Muscato

Members:
Prof. Balint Kiss
Prof. Andrej Babinec
Prof. Giovanni Muscato
Prof. Lino Marques

TC17-TSC9- Robotic Information System/Intelligent Reality

Chair: Prof. Andrzej Maslowski

Members:
Prof. Simone Keller Fuchter
Dr Grigory Panovko

TC17-TSC10- Robotic Smart Sensing/Measurements

Chair: Prof. K. T. V. Grattan

Members:
Prof. Lino Marques
Prof. C. Ferrero
Dr. Xue Zi
Prof. Jaromir Volf

<u>TC17-TSC11- Robotic Calibration System</u>

Prof. C. Ferrero

Members:
Prof. Jaromir Volf
Dr. Xue Zi

<u>TC17-TSC12- Non-Linear Control of robots</u>

Chair: TO BE ADDED

Members:
:Prof Bálint Kiss

<u>TC17-TSC13- Robotic Management</u>

Chair: TO BE ADDED
Members
TO BE ADDED

<u>TC17-TSC14- Robotic Software</u>

Chair: TO BE ADDED
Members:
TO BE ADDED

<u>TC17-TSC15- Robotic Application in Process Automation</u>

Chair: Prof Andrej Babinec
Members:
Jagdish Shukla
Dr Grigory Panovko