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Remote Biomedical Services Support Program

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Abstract— **The Biomedical Engineering team at the University of Ottawa Heart Institute (UOHI) encountered challenges in seeking support from medical equipment vendors' service experts during the COVID-19 pandemic, primarily due to travel restrictions. Given that most vendors and their support teams are not based in Ottawa, the necessity for travel to address equipment issues at UOHI became a cumbersome, time-consuming, costly, and often impractical task, especially during pandemic conditions. The absence of the option for Remote Service Support resulted in decreased equipment uptime, limited collaboration between the Biomedical Engineering team and vendors, and escalated costs.**

This paper outlines the creation of a novel Remote Service Support program for the Biomedical Engineering department at UOHI. The program aims to streamline and expedite the process of obtaining assistance from vendors by establishing a remote connection between Biomedical Engineering Technologists (BMETs) and the medical equipment's service experts through live, real-time calls. This innovative approach enables BMETs to conduct hands-free maintenance, while the remote expert can provide assistance and share documents or screenshots simultaneously. The implemented use cases in this project demonstrate the program's alignment with existing processes in the Biomedical Engineering department, presenting a pioneering strategy in the realm of Biomedical Services.

Keywords— **Smart glasses, Remote Support, Telehealth Technology, Real-Time Care, Health Information Technology, Augmented Reality**

I. Introduction

Over recent years, there has been significant interest in the realm of Health Information Technology (HIT) within healthcare, presenting opportunities for cost reduction, enhanced patient care, and increased efficiency among healthcare professionals. An exemplar in this domain is mobile health (mHealth), utilizing mobile phones to augment clinical medicine. While smartphones and tablets have demonstrated effectiveness in reducing costs and improving efficiency, they suffer from underutilization and practical limitations, notably their reliance on manual input, impeding usability.

A transformative addition to mHealth in recent years has been smart glasses, wearable Internet of Things (IoT) devices with ample computing power to operate independent apps and facilitate Augmented Reality (AR) interactions. Essentially, smart glasses function as web-connected, wearable computers shaped like glasses, addressing the challenge of manual input by offering hands-free operation controlled through audio commands. These devices can present data on their lenses and capture images or videos through a front-facing camera.

Healthcare organizations have increasingly recognized the potential of smart glasses, with Google Glasses serving as a significant catalyst for the development of applications and hardware in this domain. Initially employed to streamline interactions with Electronic Health Records and enhance resident teaching by broadcasting surgeries, smart glasses now find applications in various healthcare contexts, including telemedicine, acute clinical care, remote information access, Biomedical Engineering, and remote support [2].

This project specifically focuses on TeleVU glasses and their applications in Biomedical Engineering departments. TeleVU, a Canadian company, provides user-friendly communication solutions for smart glasses, facilitating audio-visual connections between parties, such as clinicians and remote experts. A noteworthy development is a partnership between Vuzix Corporation, a New York-based smart glasses and AR technologies company, and TeleVU, announced in June 2021 for M400 smart glasses. These smart glasses enable users to collect and stream audio/video information through the device's camera while receiving information through the AR screen.

II. Method

A. *TeleVU Glasses*

TeleVU glasses are intelligent eyewear integrated with the uSee application, connecting to the TeleVU iSee web portal to facilitate remote medical assistance through audio/video, Augmented Reality (AR), and Augmented Intelligence (AI).

This advanced technology is designed to benefit health organizations, clinicians, and, most importantly, patients. The TeleVU iSee web portal enables AR collaboration and comprehensive control over smart glasses functionalities. With an intuitive interface, user-friendly functionality, and secure connectivity, these glasses make remote medical and technical assistance effortlessly accessible, representing the epitome of Virtual Care [2]. Equipped with a transmissive display positioned above the wearer's dominant eye, TeleVU glasses collect AR information without being intrusive or obstructing the user's vision during procedures.

At the University of Ottawa Heart Institute (UOHI), BMETs and engineers are responsible for installing and maintaining all medical technology used for diagnosis, treatment, rehabilitation, and research. Collaborating closely with vendors, they ensure the smooth functioning of equipment. However, challenges arise when vendors cannot be physically present due to unpredictable conditions like travel restrictions during the 2020-2021 pandemic. Traditional video calls and sending videos for assistance are not always effective in real-time, and Biomedical Technologists face limitations in working hands-free.

The implementation of TeleVU glasses in this project aims to:

a) Provide real-time assistance to Biomedical Technologists.
b) Allow Biomedical Technologists to work hands-free.
c) Enhance the maintenance experience for both vendors and the Biomedical Engineering Department.
d) Save time and money by eliminating unnecessary travel.
e) Expedite and improve the training process for Biomedical Technologists.

B. Advantages of TeleVU Glasses

BMETs play a crucial role in maintaining and troubleshooting medical equipment, conducting tests, calibrations, and installations. TeleVU glasses offer numerous advantages in the field of biomedical services, including:

a) Enabling hands-free maintenance through audio commands.
b) Providing freedom of movement for effective job performance.
c) Offering user-friendly and easily learnable features.
d) Supporting multitasking and enhancing concentration during work.
e) Featuring a lightweight frame with a small, adjustable camera that does not obstruct the user's eyes.
f) Facilitating vendors' remote service support, eliminating the need for unnecessary travel and saving time and money.
g) Speeding up service support with real-time connections that enable the sharing of documents.

C. Experiments Executed at UOHI

For this project, TeleVU glasses and a floating license were procured. Based on UOHI's Biomedical Engineering Department's needs, a floating license was purchased for the BMETs. A floating license allows the BMETs to assign the isee web portal's username and password to each company they work with. After the work is done and before working with another company's service support staff, the password is changed due to security reasons. Several experiments were done to test the effectiveness of TeleVU glasses for biomedical services. The efficiency of these glasses was evaluated in several use cases. A few of these use cases are explained below.

a) The first investigation on the effectiveness of TeleVU glasses in biomedical services involved collaboration between a Siemens Healthineers remote service expert and a Biomedical Equipment Technologist (BMET) at The University of Ottawa Heart Institute.

The cyclotron, a crucial particle accelerator utilized for generating medical isotopes essential for PET scans [3], is provided by Siemens Healthineers at UOHI. As their Service Support is based in the United States, physical presence for support at the Heart Institute becomes challenging. In addressing a specific challenge at the Radiochemistry lab at UOHI, TeleVU glasses were employed. The problem identified was a malfunction in the cyclotron's vacuum system, requiring technical assistance to replenish the oil level. Through remote technical support, the issue was promptly and efficiently resolved.

b) In the subsequent use case, a senior BMET endeavored to instruct a novice BMET in performing Preventive Maintenance (PM) on the Cardiolab system situated at the Electrophysiology lab (EP). The Cardiolab system serves as an EP recording system crucial for aiding physicians in diagnosing and treating cardiac diseases. The experienced BMET accessed the isee web portal via his personal computer, while the new BMET configured the glasses and proceeded to the EP lab. A live call was established between the two technologists, facilitating real-time communication. The PM task was executed swiftly and efficiently, enhancing the training process as the new BMET actively performed each step of the PM under the guidance of the senior BMET, rather than merely observing the procedure. This approach resulted in a more streamlined and effective training experience.

c) In a different scenario, an issue arose with the compressor of the animal PET/CT system in the Research Department. The CT scan results from the equipment were inverted due to a malfunction in the compressor, which was jammed and not operating correctly, leading to inaccurate CT scans. The PET/CT scanner in question is supplied by MR Solutions, and their service support experts are headquartered in Toronto. In a critical situation demanding immediate resolution for the research test results of students, the BMET from the Research department initiated a call with the service support technician from MR Solutions using TeleVU glasses. This enabled them to address the problem promptly and maintain the functionality of the equipment for the students' tests. Figure 1 illustrates the BMET working on the PET/CT equipment with the remote service support expert utilizing TeleVU glasses.

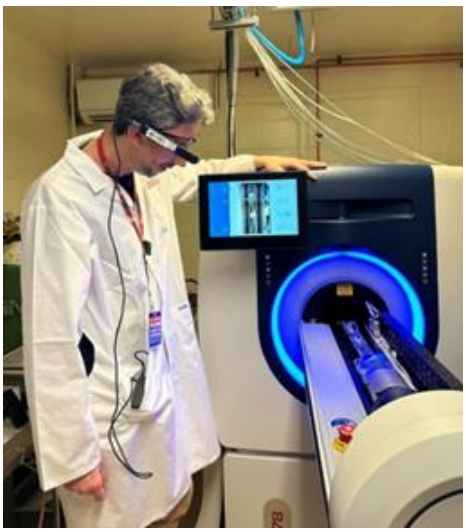


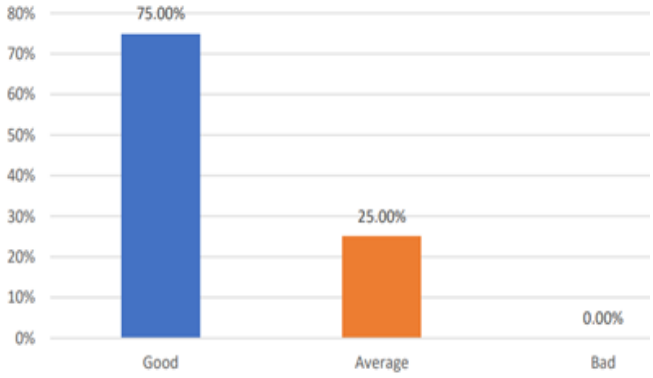
Fig. 1 Troubleshooting PET/CT scan equipment using TeleVU glasses

III. Results

A survey was formulated and distributed to users of TeleVU glasses on both the frontline and remote sides, aiming to assess the efficacy of these glasses in biomedical services. The survey encompassed inquiries regarding the glasses' effectiveness, implementation process, encountered issues during implementation, challenges faced, and recommendations. The subsequent section presents the outcomes of the survey.

As indicated by the survey findings, the TeleVU glasses exhibited a 100% effectiveness rating according to the feedback received. All users expressed a willingness to use TeleVU glasses again, and all respondents would recommend TeleVU glasses to their peers in the medical equipment support team. Table 1 further illustrates that the call quality was consistently rated as good in the majority of use cases.

Table 1 The quality of live call



IV. Limitations and Challenges

The following were observed during this project:

1. Network Coverage Limitations Impacting Call Quality: One of the primary challenges encountered in this project was the insufficient network coverage in certain areas of the UOHI. Reliable connectivity to secure Wi-Fi is crucial for devices like smart glasses. However, locations such as the Radiochemistry lab and the MRI room in the Research department experienced poor network connections, leading to call disconnections between the vendor and the BMET. Consequently, in some instances, repeated call initiations were necessary to proceed with the procedure.
2. Noise-related Issues: In specific hospital areas, the operational sounds of medical equipment created a noisy environment for smart glasses calls. Particularly, the Radiochemistry lab presented such high noise levels that the BMET struggled to hear the remote end of the call. To address this challenge, wireless headphones were employed. These headphones, connected to the TeleVU glasses via Bluetooth, significantly improved the BMET's ability to hear the remote technician despite the noisy conditions in the Radiochemistry lab. Hence, it is advisable to use wireless headphones in noisy hospital areas to enhance call quality.

3. Disconnection from the isee Web Portal: Occasionally, remote users lack access to PCs or laptops, necessitating call initiation or acceptance through mobile phones. In a specific project use case, the remote service support team member attempted to log in with his phone to test call effectiveness but encountered an issue. The problem arose from being simultaneously logged into the isee web portal with his PC. Consequently, initiating a live call with more than one portal login caused disruptions. It is recommended to use only one device per case to ensure a seamless call experience.

V. Conclusions

Biomedical Technologists at UOHI encounter numerous daily challenges associated with medical equipment. While they can independently address some equipment issues, others necessitate guidance from the vendors' service support team. However, logistical obstacles like travel constraints and time limitations often complicate the planning of service sessions with companies located outside Ottawa.

To address these challenges, TeleVU glasses emerged as a pivotal solution. The project involved various stages, starting with obtaining a quote from the TeleVU company, procuring the device, acquiring the appropriate licenses tailored to the department's requirements, and discussing the technology's benefits with different teams, including the Biomed and Clinical Engineering teams, as well as various vendors. Subsequently, multiple training sessions were conducted to familiarize BMETs with the device.

For each service support session, an email containing the isee web portal's username and password was shared with the vendors' service support team. After the session concluded, the password was changed for subsequent use. This project's objective was to simplify and expedite medical equipment maintenance, aiding the Biomed team in overcoming challenges associated with scheduling service sessions due to time constraints or travel limitations.

Moreover, the implementation of TeleVU glasses enables the Biomedical Engineering department at UOHI to promptly seek assistance from experts without the need for the service team to travel. Additionally, the glasses facilitate more effective training for new employees, as newly hired BMETs can follow the steps independently, rather than merely observing a procedure.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. S. Mitrasinovic et al., “Clinical and surgical applications of smart glasses,” Technology and Health Care, vol. 23, no. 4, pp. 381–401, Jul. 2015, doi: https://doi.org/10.3233/thc-150910.J. South and B. Blass, The future of modern genomics. London: Blackwell, 2001.
2. “TeleVU - Remote Patient Care - Remote Medical Assistance | TeleVU,” Jan. 04, 2021. https://televu.ca/DOI 10.10007/s002149800025
3. “The Cyclotron and Radiochemistry facility,” *The Neuro*. https://www.mcgill.ca/neuro/research/cyclotron-and-radiochemistry-facility