Final Measurement and Verification Report for I&T Trial Project

CAVE Training Simulators about BIM-AM for Hong Kong Children's Hospital

I&T Project No. : P-0026
I&T Wish No. : W-0045
I&T Solution No. : S-0079

E&M InnoPortal

EMSD

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Purpose of the Project and Target Deliverables

CAVE (Cave Automatic Virtual Environment) is a virtual reality environment consisting of large, fixed screens to display 3D models to provide users immersive experience. On the other hand, EMSD had been developing Building Information Modelling-Asset Management (BIM-AM) as a unify platform for up-to-date static and dynamic information of Electrical & Mechanical (E&M) installations such that EMSD frontline O&M staff could respond faster to incidents and emergencies, especially at mission critical venues such as hospitals. In light of the advantages to Electrical & Mechanical (E&M) O&M by CAVE and BIM-AM, this project integrated both technologies into a Training Simulator for EMSD Technician Trainees (TTs) and in-service staff.

Project Description

In this project, 5-side LED immersive CAVE system was implemented for providing Electrical & Mechanical (E&M) training. The simulator would provide an immersive experience of the state-of-art hybrid catheterization laboratory. Within the simulator, the user can learn how to make use of BIM-AM to read the real-time operation data of every equipment, such as the pressure drop of the HEPA filter, which could identify the healthiness of the filter. The storyline related to the replacement of HEPA filter in an operation theatre at Hong Kong Children Hospital was developed for the training.

Trial Site

The trial site is at E&M Innozone, 4/F of EMSD Headquarters.

Type of Equipment/ Installation/ Technology Adopted

The inner and outer dimension of the 5-side LED CAVE are approximately 4160mm (W) x 3410mm (D) x 2880mm (H) and 5760mm (W) x 4630mm (D) x 3400mm (H) respectively. The VirCube system is the core operation software for the CAVE deployed in this trial. The hardware and software deployed in the trial is listed in table below.

Equipment list	Quantity
A) Immersive VR VirCube LED Display ◆ Supply and install LED Panels • 5-side screen with 2 curved vertical sides • 3 x Walls, 1 x Floor and 1 x Ceiling • Pixel pitch: P2.5 (2.5mm); P3 (3mm) OR P4 (4mm) • 1 x Floor LED Screen: P2.5 / P4 panel special floor treatment to support at least 500kg on each panel (500mm x 500mm / panel) • Brightness: at least 1000-2000 nits • Resolution:P2.5 (***dots/sqm); P3 (102,400 dots/sqm) OR P4 (62,500 dots/sqm) • Support active 3D stereo, 2D compatible as well • Controllers, 3D processors, connection and accessories included	1-set
B) VR Image Generator/Master Server Engine • CPU: Intel Core i7-7700 or higher • RAM: 32GB or higher • Storage: 512GB SATA SSD or above • Accessories: keyboard, mouse, 22” monitor, power supplies and all connection cables • Operation platform: Windows 10 Professional 64 bits license (LTSB) • Pre-installed software supports: - Unlimited 360 panoramic video, 3D content and Virtual Reality and Mixed Reality programmes interaction and visualisation - Support 3D real-time rendering - Support immersive simulated environment generation - Perspective, motion and object tracking • VirCube Permanent License • 60 Frame rate supported	2-set

Equipment list	Quantity
C) Optical Tracking System • Optical Tracking Camera - 8 x optical tracking camera - Infrared Optical 6 degrees of freedom - Tracking range: 4.5m or longer - 2 X hub: 480Mb/s U - 3 x wireless wand retroreflective tracker affixed to controller - 3 x wireless head retroreflective tracker affixed to 3D stereo glasses - 1 x demo set of head and wand tracker - Integration and calibration with VR server engine	1-set
D) Sound System • 5.1 surround system speaker and amplifier	1-set
E) 3D Stereo Glasses • Stereoscopic contrast: 1200:1 • Field of view(H x V): 178° x 115° • Battery (Rechargeable): 30 hours continuous operation after fully charged (auto-off)	15-pair

Trial Timeframe

The trial timeframe was 1 year from 1 Aug 2018.

Name and Background of I&T Solution Provider

Motive Force Technology Limited

Motive Force Technology Limited is a HKSTP partner company & LEAP member who specializes in R&D and commercialization of immersive VR technology. Founded in 2016, Motive Force developed its own patent-pending immersive VR and MR enabler, VirCube. Since the first launch in 2017, VirCube systems have been successfully implemented in K-12 schools, special schools, tertiary education institutions, Non- governmental Organisations (NGO) and government body clients. Applications include but not limited to vocational training, BIM-AM, academic and curriculum education, rehabilitation and healthy ageing.

Details of Implemented Trials

I. Methodology and Applicable Standards

The turnkey solution of 5-side LED immersive CAVE system comprises components including immersive visual space, motion sensing system and Virtual Reality (VR) experience software platform. The 3D experience space (Cave Automatic Virtual Environment, CAVE) with a few square metres uses different audio-visual equipment to create a realistic environment. With motion sensing system, the users wearing specialised 3D glasses and using various tools can interact with the scene and items projected in the space.

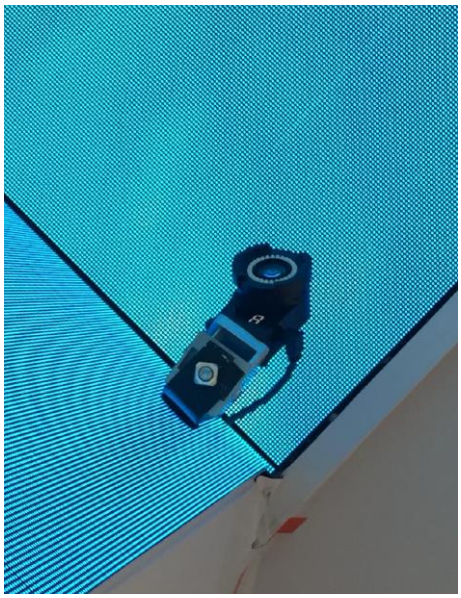

Figure 1 Optical Tracking Camera

Figure 2 - Joystick

II. Measurement and Verification Activity Details

The solution had been demonstrated to guests visiting to 4/F inno zone and operated for training during the trial period. Free of Head Mounted Device, the solution allows shared VR experience in 1:1 scale for multi-users. Paired with lightweight 3D stereo glasses, users can maintain eye contact and allow face-to-face communication at all time. The system comes with perpetual VirCube enabler license which is compatible with infrared optical motion tracking system and supports unlimited import of 360 panoramic content, 3D content, 3D model, VR and MR programmes without neither third party software processing nor manual touch up while fully responsive to operators' or trainees' perspective and natural movements. EMSD staff was provided with Operation and Maintenance (O&M) manual for operating the CAVE system. Feedback were provided for the solution provider to simplify the operation procedures.

Summary Results and Analysis

I. Pre and Post-installation Comparison

The CAVE system in this trial consists of 5-side large, fixed LED displays allowing a small group of users to collaboratively view and manipulate 3D models. The advantage of a 5-side CAVE is that the ceiling E&M equipment can be viewed providing a fully immersive experience for the users.

II. Analysis of M&V Results to Address the Target Deliverables

The CAVE system in this trial was implemented with a master server engine with VR enabler embedded, 8 optical tracking cameras and 5.1 channel audio system. VirCube generates the centralized 3D virtual building model that can be imported directly and presented interchangeably. Therefore, it can be used for BIM model collaboration for other venues without the need for file format conversion or further software development.

With its real-time 3D generation and motion tracking function, operators and trainees are allowed to share the building information in 1:1 simulated environment with better data and design visualization, as well as enhancing communication and overall productivity. The BIM model and application can be easily accessed, managed and interacted in Vir-Cube system with the one-hand wand controller or supported wearable devices, allowing team members to collaborate in a more accurate and efficient way.

Conclusion and Way Forward

The CAVE solution and its applications have been proven in the trial in EMSD. The integration of CAVE and BIM-AM were being explored to support future BIM-AM training and BIM collaboration for other EMSD venues. It is suggested the solution to be further enhanced in terms of the LED hardware resolution as well as supporting more motion control (i.e via tablet) for better user experience.

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Digitalisation & Technology Division

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