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Robotics Using Mix Reality

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Abstract: *It combines the virtual and physical worlds. People can engage with computers and the environment in new ways thanks to the combination of the physical and digital worlds. Simply put, it gives users the ability to create a new environment in which actual and virtual items interact. Applications for MR are always growing, ranging from giving construction workers remote assistance to helping developers test their software virtually. One of the most well-known justifications for the necessity for MR is healthcare. In this area, MR can be used by surgeons to carry out operations and acquire improved data visualisations without compromising human life. Another use of MR that lowers the cost of resource acquisition is as a key tool for rendering real-world physical objects as 3D holograms lowering the cost of resource acquisition and usage. Mixed Reality is an effective tool instrument for research and development in robotics. In this paper, we clarify the idea of mixed reality to enable for a variety of physical and virtual settings that allow for seamless interaction between real-world and virtual items. This research paper describes the idea that by enabling algorithms to be prototyped on a mix of real and virtual objects, such as robots, sensors, and people, mixed reality may close the gap between simulation and implementation. Robots can have virtual capabilities added to them, and they can communicate with people while not moving at the same physical rate. Using Leap Motion and HoloLens, the operator may remotely control a robot within a mixed reality environment, improving the operational experience.*

Keywords: Extreme Machine Learning, Microsoft Hololens, Mixed Reality, Mixed Reality in Robotics, Robotics.

I. INTRODUCTION

The most cutting-edge technology, mixed reality (MR), is utilised by today's virtual reality (VR) systems. It is a branch of computer science that deals with data produced both manually and artificially. Real-time blending of computer-generated graphic objects with the outside world and vice versa. The physical and virtual worlds are combined to create mixed reality, where virtual information is introduced into the physical world and vice versa. A mixed reality system's main purpose is the computer-based synchronisation of real and virtual scene coordination systems and the merging of virtual and real visuals. The first mixed reality platform was created by the Armstrong Laboratories of the US Air Force in 1992. created the first mixed reality platform, virtual devices. This experiment gave users a clear view of how virtual objects could encroach on the actual world. Currently, enhanced reality and/or increased virtuality are two ways that can be used to generate mixed reality, artificial reality (AR).

II. MIXED REALITY

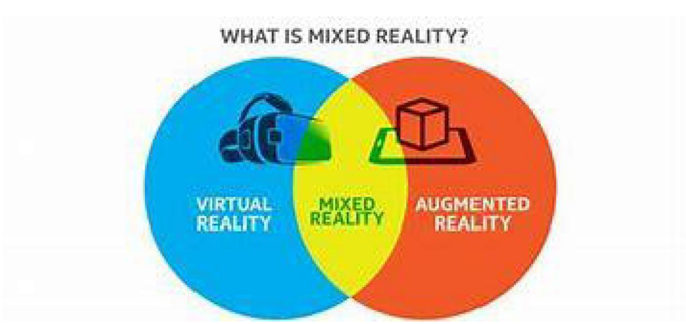

Figure 1: Mixed Reality

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Similar to augmented reality, the idea of augmented virtuality exists. AV follows a different course of action than AR. The majority of the shown scene is created virtually utilising AV equipment, with real objects added to the scene. Just like embedded real objects, when a user is embedded in a scene, it is dynamically integrated into the AV system. You can interact with both virtual and actual objects in the scene in real time. A robot teleoperation system based on mixed reality is developed in this research paper. The device. Fall within the category of mixed reality when used in conjunction with the previous statement. Mixed reality encompasses bothaugmented reality and enhanced virtuality. It is a system that aims to combine the real world and the virtual world in a fresh setting and presentation where actual objects and virtual (synthesised) objects coexist and engage in real-time interactions. The connection between mixed reality, augmented reality, enhanced virtuality, and the actual world is shown in Figure 1. An expanded continuum is referred to as actual reality, amplified reality, mediated reality, and virtualized reality.

III. LATEST DEVELOPMENT

Figure 2 from this study illustrates the proposed robot teleoperation system. A human operator, a Leap Motion controller, a slave robotic arm, and a Microsoft HoloLens are the four parts of the system. With HoloLens and a live mixed reality environment, the human operator can see the slave robot's motions. Leap Motion allows the human operator to control the slave robot remotely and finish the task.

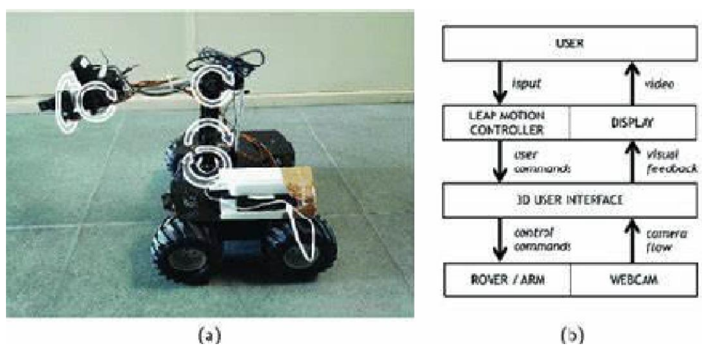

Figure 2: Robot Teleoperation System based on Mixed Reality

1] Leap Motion: In this tutorial, we use Leap Motion as the hand motion tracking tool. The Magic LEAP Company's Leap Motion is a USB gadget with three infrared LEDs and two depth sensors. The Leap Motion can track the user's palm position and finger positions with a variety of gadgets. Leap Motion is also utilised in conjunction with head-mounted displays like the Oculus Rift to improve the interface between people and computers.

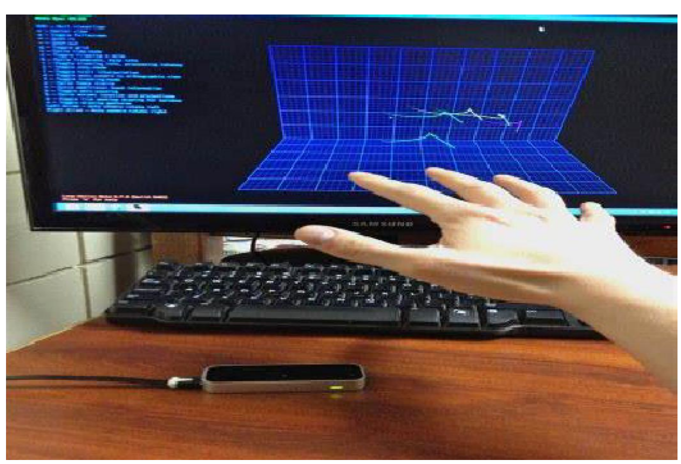
Figure 3: Leap Motion

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2] Microsoft HoloLense: Microsoft's HoloLens is a brand-new head-mounted display. Unlike other augmented reality devices, HoloLens lets the user physically explore the environment. Additionally, the user can engage with data and material in a natural way by using his or her voice, unprocessed data is not accessible due to patent restrictions. For the aforementioned reason, only the Microsoft API may be utilised.

Figure 4: Microsoft HoloLens3 the slave robot:

In our company, we use a 6-DOF industrial robot. Using the API provided by the company, we can control the robot by communicating the end effector position.

3] Unity

Unity is a multiplatform gaming engine by Unity Technologies. In our project, mixed reality sceneries are created using unity. Leap Motion components can be used to create a virtual display of hands in Unity. getting HoloLense and delivering it Unity's "Holographic Emulation" feature can also enable video streams. It should be emphasised that a camera's background must be black in order to produce the mixed reality effect. In addition, the "inspector" panel allows us to change the separation between virtual objects. To reduce the delay, the project's quality should also be "faster."

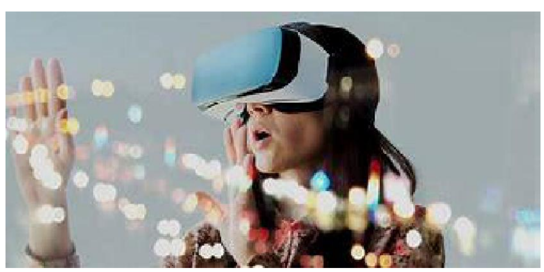

Figure 5: Unity

The robot teleoperation system's structural layout. In this study, we built a robot teleoperation system using the Leap Motion and C++ APIs from the robot arm. To give the robot the command in real time, we alsocreated a communication tool based on UDP. The following are the steps for implementation:

1. To capture user gesture data, utilise Leap Motion.
2. The palm's location is followed and recognised after determining whether or not it is closed.
3. Apply the conversion method outlined below to change the location of the palm into Cartesian slave robot coordinates.
4. Based on the results of the conversion process, create slave robot commands, and then send the commands over a UDP connection.

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Through HoloLens, the viewer can watch a slave robot move, and to increase engagement, Leap Motion's virtual representation of the hand is integrated into the scene.

IV. COORDINATE SYSTEM CONVERSION

This section focuses on developing a mixed reality-based robot teleoperation system. The transmission of the palm coordinates is essential. the salvage robot's Cartesian coordinates during the construction process so that the The manufacturer's palm can be kept intact by the salvage robot handler. We specifically created an algorithm for this issue's conversion.

1] The coordinate framework of Leap Motion To convert the coordinate data from a Leap Motion Controller to a specified robot coordinate system. The Leap Motion coordinates are also in millimeters (mm). Where the palms are positioned (x, y, z), the positions of the palms must be x = +11 cm, y = 12 cm, and z = 13 cm. The device's top central region serves as the genesis of the Leap Motion coordinating system. In specifically, when the user's palm is in the top centre of Leap Motion, the palm position will be [0, 0, 0]. The issue described above results in significant inaccuracies and subpar performance of the slave robot because the Leap Motion data are used in our study directly to drive the slave robot. Rarely, this issue can endanger items located inside the robot's workspace.

2] Converting Algorithm

The slave-robot coordinate system must be changed. We created a conversion method for reading position information from a Leap Motion device. controller. Assume that the slave robot's coordinates are, the palm's coordinates in Leap Motion's field of view are, and that the, are occasionally t. The conversion relationship can be explained using the following criteria:

The fact that, as illustrated below, the coordinate system of the slave robot and that of the Leap Motion controller are different. After extensive testing, we chose C = (4, 2.7, 40) in this experiment to enhance teleoperation performance.

It's worth mentioning that the Leap Motion controller's position data will have significant changes, which can have a negative impact on the control. We also designed an appropriate filter to address this issue.

$\Delta xtLeap = 0, \Delta xtLeap \in (-\infty, -6) \cup (6, +\infty)$

$\Delta xtLeap = 0, \Delta xtLeap \in (-0.6, 0.6), +\infty)).6, +\infty)$

3] Slave robot workspace

Notably, the slave robot is shielded by software that forbids it from straying beyond the designated workspace. The robot will enter an emergency stop mode and the teleoperation procedure will be terminated if the software protection mechanism is activated. To solve this issue, we are working to design a workspace constraint for our teleoperation system. which is expressed as follows.

$\Delta ztLeap = 223.399, \ \Delta ztrobot \in (223.399 , \infty$

$\Delta ztrobot = 164, \Delta ztrobot \in (-\infty, 164)$

$\Delta xtrobot = 365, \ \Delta xtrobot \in (365 , \infty)$

$\Delta xtrobot = 224, \Delta xtrobot \in (-\infty, 224)$

$\Delta ytrobot = 60, \ \Delta ytrobot \in (60 , \infty)$

$\Delta ytrobot = -60, \Delta ytrobot \in (-\infty, -60)$

It is reasonable to assume that after the aforementioned conversion of a system coordinate by the co-ordinates of the palm, slave robot, and converting procedure are roughly in agreement. We can also confirm that the robot's software's safety feature does not cause the human operator to be mistreated at work.

V. RESULT

In this study, the operator dials the slave robot and instructs it to enter a single Chinese character to ensure the teleoperation system is functioning properly. The human operator, the Leap Motion controller, and a slave robot make up the robot teleoperation system, as was already explained. Thehuman operator can use the Leap Motion controller to remotely operate the slave robot. In order to get a real perspective, the operator can also use HoloLens. A mixed reality experience is delivered to the operator using Unity3D and HoloLens. HoloLens allows the operator to see a virtual hand model and the slave robot, which makes teleoperation seem more natural. Additionally, the operator can move his or her hand in relation to a virtual model via visual feedback from mixed reality, which simplifies the complexity of the slave robot.

VI. CONCLUSION

The main focus of this effort was the development of a mixed-reality robot system. The human operator, a Leap Motion controller, a Microsoft HoloLens, and a robotic slave arm make up the teleoperation system. Additionally, we provided a conversion strategy that transforms the Leap Motion, a master robot's coordinates system to the slave robot's coordinates system, in order to performance of teleoperation. The slave robot used a workspace restriction to climb above the operator's bad behavior The teleoperation system also gave the operator real-time visual input by building a mixed reality picture and showing it on the Microsoft HoloLens Head-mounted display. We also developed a straightforward assignment where a human operator remotely controlled a 6-DOF robotic arm to produce a straightforward Chinese character.The proposed teleoperation system can increase the effectiveness of the teleoperation process, according to experiments.

REFERENCES

[1] “A survey on teleoperation,” S. Lichiardopol, Technische University Eindhoven, DCT report, 2007.
[2] S. Livatino, F. Banno, and G. Muscato, “3d integration of robot vision and laser data witsemi- automatic calibration in augmented realitystereoscopic visual interface”
[3] R. Kumar, T. Oskiper, O. Naroditsky, S.Samarasekera, Z. Zhu, and J. Kim, “System and method for generating a mixed reality environment,”.
[4] H. F. Vargas and O. A. Vivas, “Gesturerecognition system for surgical robots manipulation,” in Symposium on image, signal rocessing and artificial vision, 2014.
[5] “Microsoft Hololens,” https://www.microsoft.com/en-us/hololens
[6] “Leap concepts, coordinate system,” https://developer.leapmotion.com/documentation/ v4/concepts.html
[7] “Leap coordinate mapping,” http://www.xionggf.com/articles/vr/leapmotion/leapmotion_coordination_and_transform.html.