


# An Integrated Remote Control-Based Human-Robot Interface for Education Application

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## ABSTRACT

Portable interfaced robot arms equipped with mobile user interactions are significantly being utilized in the modern world. The application of teaching robotics is being used in the challenging pandemic situation, but it is still challenging due to mathematical formulation. This article utilizes the augmented reality (AR) concept for remote control-based human-robot interaction using the Bluetooth correspondence. The proposed framework incorporates different modules like a robot arm control, a regulator module, and a distant portable smartphone application for envisioning the robot arm points for its real-time relevance. This novel approach fuses AR innovation into portable application, which permits the continuous virtual coordination with actual physical platform. The simulation yields effective outcomes with 96.94% accuracy for testing stage while maintaining error and loss values of 0.194 and 0.183, respectively. The proposed interface gives consistent results for teaching application in real-time changing environment by outperforming existing methods with an accuracy improvement of 13.4.

## KEYWORDS

Augmented Reality, Human-Robot Interaction, Portable Interface, Real-Time Changing Environment, Real-Time Relevance, Virtual Coordination, Virtual Reality

## INTRODUCTION

In the current era of information technology progression, the appearance widely used remote innovation for portable correspondence is presently being utilized frequently in the modern education system and numerous other advancing areas. The versatile frameworks are being utilized these days for the computerization and education development (Dahir et al., 2016). There are a few uses of modern robotization in different areas like reconnaissance in armed force (Yan and Hu, 2017; Akçayır et al., 2016), distinctive mechanization industry (Madhayan, 2010), other mechanical areas and modern education system (Sukla and Karki, 2013; Lazăr et al., 2020). The advancement in the traditional teaching methodology has improves the learning experience by enhancing the intellectual level of

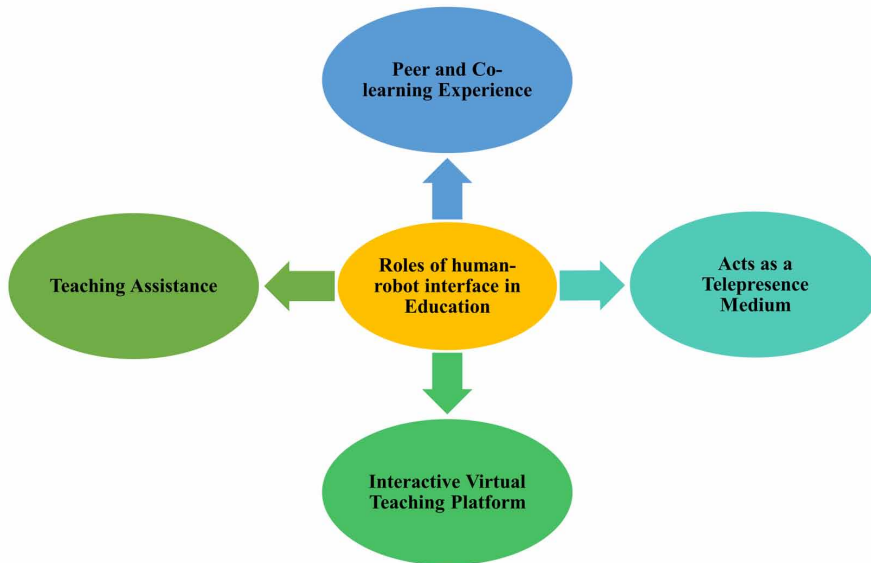
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individuals. With the growth in the usage of tablets and mobile phone, the technological evolution can be seen in the development of Augmented Reality (AR) in the teaching domain (Stavinoha et al., 2014). This technology has removed the barrier between the real and the virtual world objects and this can be used in many equipment, like mobile phones, computers and many other. The various scenarios of roles of human-robot interface in the modern education system are shown in Figure 1.

Figure 1. Roles of human-robot interface in the modern education system



The modern education system includes the role of robotics in different domains like these technological advents provides the teaching assistance, indulge in peer learning experience, provides a telepresence platform for student interaction even when the teachers are not present physically and it builds an interactive virtual environment for human-robot interactivity. The teaching scenario has also been affected by the pandemic situation prevailing around the world. Thus, the e-learning scenario provides better interactivity which is further enhanced by the virtual interaction using robot interface. The e-learning platform is improved involving robotics and the adaptability for flexible working of human robot collaboration. In case of emergency, the platform built using AR or VR technology provides promising outcomes for communication between teachers and students. The enrichment of this technology can be enhanced using various personal computers, mobile phones and smartphone devices as they are portable. This can enrich the application domain of e-learning platform by providing an improved teaching-learning experience for the classroom as well as laboratory scenario by creating a 3D perception for robotics implementation. This enables much understandable educational platform that is more interactive and technology friendly.

Apart from education system, different areas using the advanced robotics in everyday application are surveillance applications, pipeline health monitoring, automation in industry, modern education and many more (Anisi et al., 2010; Dhiman et al., 2021). These domains significantly utilize the human-robot based interaction for creating an interactive platform for various applications. The utilization of mechanical robotics technology in the modern research areas demonstrates that the education system makes use of robots in the current scenario. For usage of robots in gas checking and oil pipeline, tiny robot systems are utilized which can easily fit inside the pipelines and move

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