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VR On-Board Fishing with Motion Haptic Feedback

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***Abstract*—This study presents a virtual reality (VR) on-board fishing with motion haptic feedback. The proposed system consists of a magnetorheological fluid (MRF)-based rotary haptic module, a motion platform, and a fishing game in the virtual environment. The MRF-based haptic module provides variable resistive torque for reel-toque interaction, while the motion platform delivers dynamically kinesthetic feedback to simulate deck-motion of a boat. By combining these modalities, the system offers immersive haptic interaction by generating kinesthetic feedback to both the user's hand and body.**

I. Introduction

With the advancement of virtual reality (VR) technology, people are able to enjoy various leisure activities indoors without constraints of external environmental factors [1, 2]. Furthermore, to express leisure activities that require kinesthetic feedback (e.g., fishing), VR systems have been evolving beyond vibration-based tactile feedback to deliver kinesthetic feedback with visual and auditory cues, enabling more immersive and realistic interactions [3, 4]. Although these systems provide users with rich kinesthetic feedback, they primarily deliver haptic information to the hands. As a result, the range of applicable scenarios is limited, making it challenging to simulate a broader variety of situations (e.g., on-board fishing). To overcome these limitations, we propose a haptic interaction system that provides kinesthetic haptic information to both the user's body and hand for deck-motion and reel-toque interactions. Also, we developed VR fishing application to demonstrate the usability of the proposed system.

II. Method

The proposed system consists of a rotary haptic module based on magnetorheological fluid (MRF, Lord Corp.), a motion platform (INNOSIMULATION Co.), and a virtual environment, as shown in Fig. 1(a). MRF is a material whose viscosity changes in response to a magnetic field, generating stronger resistive torque compared to conventional DC motors [5]. This MRF-based rotary haptic module provides users with resistive torque of varying intensity (Fig. 1(b)). The motion platform provides kinesthetic feedback to the user by adjusting the height and tilt of the its actuating plate (Fig. 1(c)).

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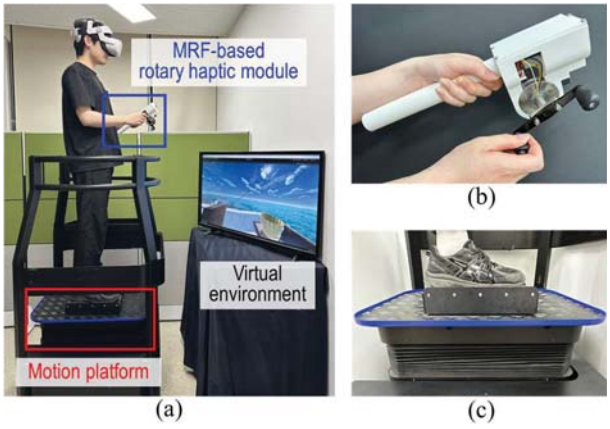

Fig. 1. (a) Components of the proposed system, (b) MRF-based rotary haptic module, (c) Motion platform

We also developed the virtual environment for the on-board fishing game by using the game engine (Unity).

III. Conlcusion

We developed haptic interface based on motion platform and MRF-based rotary haptic module for deck-motion and reel-torque interactions. We also developed the virtual environment about fishing game, and integrated it with fabricated haptic interface. We expect that the proposed system will enhance the realism and immersion of VR fishing leisure activity by providing kinesthetic feedback to both user's hand and body.

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