Interactive Virtual Fishing with Rendering Continuous Reel Weight and Line Slack

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Figure 1: Our Virtual Fishing System. (a) System Overview. (b) View in a Virtual Environment. (c) The Fishing Rod Device. (d) The Configuration of The Grounded device.

Abstract

This paper presents an interactive virtual fishing system that offers continuous reel weight and line slack using a fishing rod-type device and a grounded device. We detect the rotation of the reel and the pulling force of the fishing rod with a current sensor from a hand-crank generator and a load cell, respectively. To render the reel weight, we leveraged a phenomenon of the resistive rotational force change due to the electrical resistance of a hand-crank generator. Also, our system provided the slack of the fishing line by the electromagnets connected to the grounded device. We demonstrate a tug-of-war game between an angler and a fish using our technology. The angler uses our system to catch the fish; the fish escapes from the angler by moving their legs.

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CCS Concepts

• **Human-centered computing → Haptic devices**; **Virtual reality**.

Keywords

fishing, virtual reality, haptics, resistive torque, abrupt force loss

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1 Introduction

Fishing is a popular activity and many virtual reality (VR) fishing applications have been developed. The VR fishing applications let a user experience fishing with a rod-type controller. However, such applications lack haptic feedback, which reduces immersivity. Therefore, there are attempts to introduce haptic feedback by exerting continuous and impulsive translational force between a

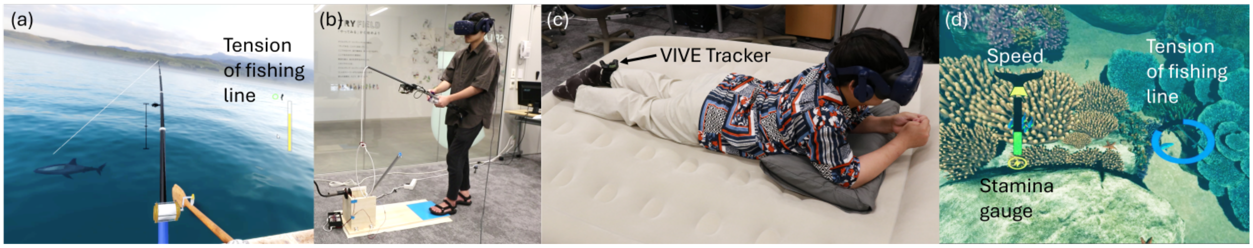

Figure 2: Our demonstration. (a) The Angler Player's View. (b) The Angler Player. (c) The Fish Player. (d) The Fish Player's View.

pair of VR controllers with motors [Wei et al. 2020] and rendering resistive torque with magnetorheological fluids [Heo et al. 2022]. However, the presentable torque of the previous study [Heo et al. 2022] was small ($< 2.4 N \cdot cm$) and the previous studies did not involve abrupt force loss when a fish comes out of the sea or a fishing line is broken.

We present an interactive virtual fishing system that offers the reel weight and line slack (Fig. 1 a, b). To enhance the fishing experience, we detect the user's movements (the reel rotation and the pull-out force) and provide force (resistive rotational force to the hand and instant force loss from the fishing line).

2 Virtual Fishing System

Our system consists of a fishing rod device and a grounded device. The fishing rod device was developed with a hand-crank generator (Artec 8503 AT Hand Crank Power Generator), an electromagnet (uxcell Holding Electromagnetic Solenoid), a Joy-Con, a current sensor (INA219 DC Current Sensor Breakout), a single board computer (Raspberry Pi 4B), and a mobile battery (Anker PowerCore 10000 PD Redux 25W) (Fig. 1 c). The grounded device was configured with an electromagnet, a metal weight, an weight, a load cell (Sensorcon SC133-20kg), a rail, and an HX711 amplifier module (Fig. 1 d). The fishing rod device detected the reel movements by measuring the current produced by the hand-crank generator. The fishing rod device exerted resistive torque with the hand-crank generator. The resistive torque is altered by the resistive value connected to the poles of the generator when we generate electrical power with a hand-crank generator (Fig. 3). We switched the electrical resistors of the generator to 0.1Ω, 3.3Ω, 5.0Ω, 17.0Ω, and 51.0Ω using MOSFETs, thereby presenting five level of resistive torque. The grounded device measured the pull-out force exerted by the user with the load cell. Also, by turning off the electromagnets and separating the fishing rod device from the grounded device, the grounded device provided abrupt force loss when a fish was caught and the line was broken. In breaking the line, the electromagnet of the grounded device was turned off; when the user caught a fish, the electromagnet of the fishing rod device was turned off. Our device is capable of running for around 16 hours.

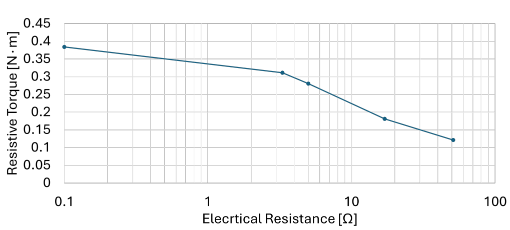

Figure 3: Resistive Torque of a Hand-Crank Generator.

3 Demonstration

Using our system, we demonstrate a tug-of-war game between two participants that play the roles of an angler and a fish (Fig. 2). The angler player uses our system to catch a fish; the fish player escapes from the angler player. At first, the angler player holds the fishing rod device and wears a Head-Mounted Display (HMD) and the fish player lays on an airbed and wears a tracker on their ankle. Then, each player does a tutorial; the angler player throws bait, casts the fishing rod device, and reels the fish; the fish player moves forward by moving their leg like swimming. After the tutorial, the angler player throws a bait. Once the fish player reaches the bait, a tug-of-war game begins. The angler player pulls up the fish player by rotating the hand crank, being careful not to break the line. The fish player moves their legs to break the fishing line and escape, caring not to run out of stamina. The line tension was affected by the reel rotation, the pull-out force, and the fish's speed. If the stamina runs out, the fish player cannot move for a while. If the angler player finishes to reel the fish player, the angler player wins; if the fishing line is broken, the fish player wins. Our demonstration can be experienced by either the angler or the fish player alone.

4 Conclusion

We presented an interactive virtual fishing system that detected the reel rotation and the pull-out force, and offered resistive torque and abrupt force loss. To detect the user's motion and provide force feedback, we implemented a fishing rod device and a grounded device. Our system allows the user to experience virtual fishing with high interactivity. In our demonstration, participants experience a tug-of-war game between an angler and a fish using our system.

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