

# INVISIBLE - The Shadow Chaser -

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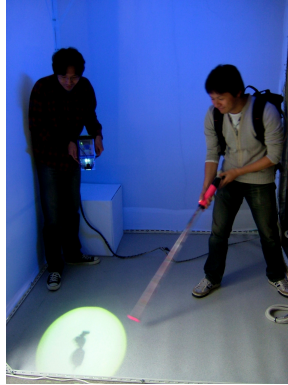


Figure 1: Play image

## Abstract

This project presents an interactive game which makes you feel unseen existences through only indirect information such as their shadows, sounds and weights. In this game, "INVISIBLE" goblins are sneaking around and you can only see their shadows. Your mission is to capture them with a special vacuum, chasing their shadows.

**Keywords:** Entertainment , Indirect Information , Motion tracking, Weight representation, Shadow representation

## 1 Introduction

This project aims the representation of feeling that a user can feel the existence of unseen objects through their indirect information. In this project, direct information of virtual objects is defined as description of their appearances such as a stereoscopic image in the scene. Indirect information is defined as incidental information which they may cause in the environment around them, for example, shadows, sounds, and weights etc. Under this concept, we produce the game of "INVISIBLE". In this game, goblins are invisible and moving in the cubic game space and only their shadows can be seen on the floor. And their footsteps can be heard from speakers. Players have to estimate their position from the shadows and sounds, catch them. Goblin's shadow is projected from projector. The position and shape of the shadow is calculated from

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position and orientation of the projector and goblins. When a user catch a goblin, the weight of the goblin captured in a backpack is represented by transportation of fluid(water) into the backpack.



Figure 2: Goblin

## 2 Exposition

### 2.1 System to obtain the 3D information (position and orientation) of the projector

For natural projection of the shadow shapes, we need to obtain the 3D position and orientation of the projector in player's hands in real-time. Two infrared LEDs and a 3DOF (degrees of freedom) tracker are attached on the projecting device. We realized high-speed positioning system by following simple method.

(1) 3 angles (roll, pitch, yaw) of the projector is obtained from 3DOF tracker. (2) Infrared LEDs are used to obtain their distance from a camera with IR transmission filter. The 3D position of the projector can be calculated by this distance and the 3 angles.

Thus, the combination of the 3DOF tracker and the two LEDs enables high-speed tracking and measuring the position and orientation of the projector device.

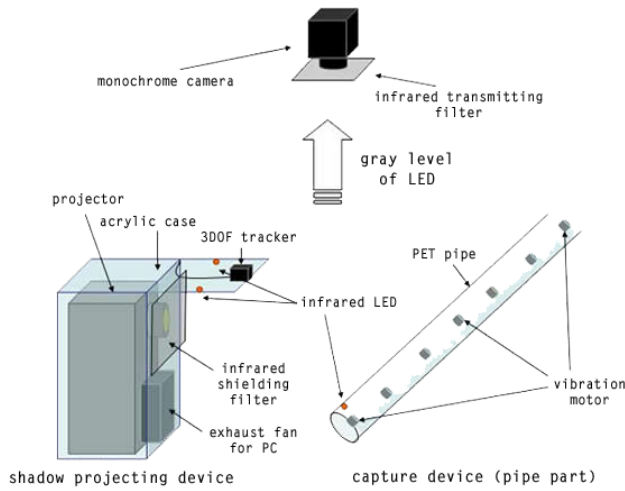


Figure 3: System to obtain the 3D information.

## 2.2 System to present indirect information (shadows, sounds)

To make players feel goblin's existence, we provide indirect information such as the shadows and sounds of goblins instead of a stereoscopic image.

### 2.2.1 Shadow projector

Each goblin's position is controlled and placed in a virtual space which is equivalent model of the real room space. To make a shadow image projected from the device, based on the position and posture of the projector, rendering view point is set to the projector in the real world. For rendering of goblin's shadow, the material color of goblin is set black and the reflectivity is set none. Rendered image is masked so as to make an actual spotlight shape. Dynamic image is projected by the projector, and goblin's shadow is shown properly in the real world.

### 2.2.2 Sounds

When goblins move, players can hear their footsteps. The volume of the speakers changes depending on the goblins' position on the floor. In addition, when players capture goblins, they hear goblins' scream and vacuuming sounds. These sounds give players better sense of reality.

## 2.3 Capture device

Our work is an interactive game in which players capture goblins by a vacuum-like device, so the responses from the goblins are very important. Player feels a sense of capture through the vibration and the change of the weight. A number of small vibrating motors are fixed in the hose of the device. When players capture goblin,

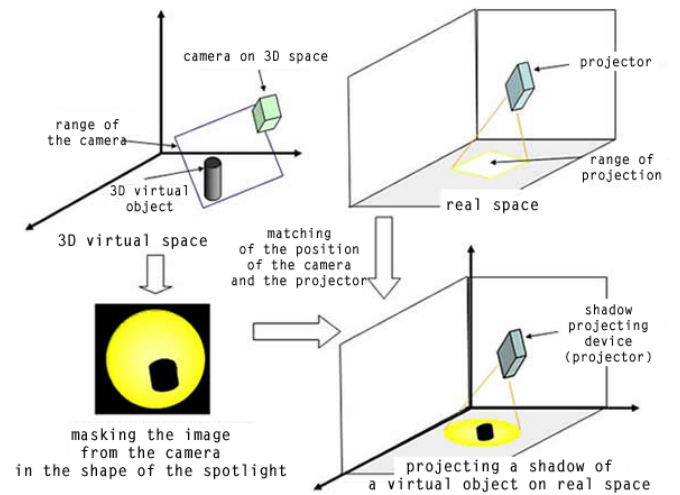


Figure 4: Projecting a shadow

these motors vibrate sequentially from the nozzle toward the handle. Then a large vibrating motor equipped in the backpack is used to present a sense that captured goblin is struggling. At the same time, water is moved from a tank on the ground to another tank in the backpack. Thus, the player can feel increase of the weight by the captured goblins.

## 3 Conclusion

The concept of this project is to give a presence of virtual object in a real space by representing only indirect information, such as sounds and shadows, weights. Based on this concept, we produced an interactive game, "INVISIBLE". And our game enabled users to feel the existence of virtual object in a real space by representing only indirect information instead of direct information.

Furthermore, we proposed new system for perception of weights of virtual objects by transportation of fluid. And users feel the weights of goblins in our system.

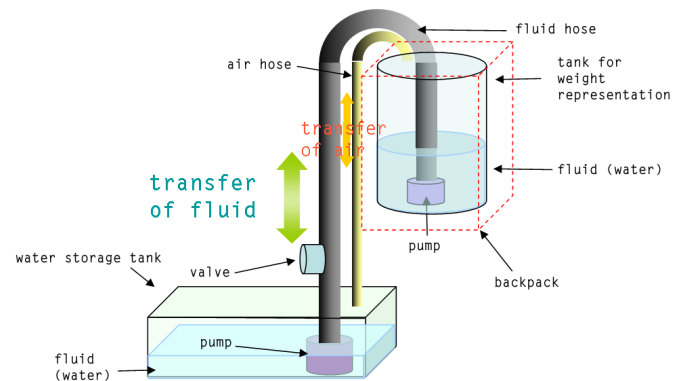


Figure 5: The System of Capture device