

# Universal Game based on Traditional Children's Outdoor Games

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**Abstract.** A universal game, *Daruma*, has been developed that can be played by both healthy people and people with physical limitations. It is based on the Japanese variation of the traditional outdoor children's game Red Light, Green Light. We devised two ways to play the game: one is by swinging an arm; the other is by tapping a desk with two fingers. Players can select either of these choices, enabling people with physical limitations to enjoy the game. We conducted experiments to verify their ease of play and to evaluate their degrees of enjoyment and utility. We found that both ways of playing were appropriate for the visually impaired and that healthy people also enjoyed playing *Daruma*.

**Keywords:** universal game, traditional children's plays, physical limitations, devises, "Red light, green light"

## 1 Introduction

Every generation of children enjoys playing games that require physical activity. The games rules or roles decide how each player should act. For example, the rules of "tag" state that the tagger, "it", runs after other players in order to touch one of them, who then becomes "it". Thus, there is an obvious relationship between roles and actions. Needless to say, this game is very basic, but it is this simplicity that makes it enjoyable. However, people who have physical limitations cannot enjoy playing it. However, if the rules are changed for their sake, it is difficult for all of the other players to enjoy it.

Recent years have seen changes in how we move our bodies to play games. For example, Wii Remote [1] or Kinect [2] are controlled by the whole of the player's body and do not require running. They use an instinctive interface and are new additions to the long list of games that require physical activity. However, if a player

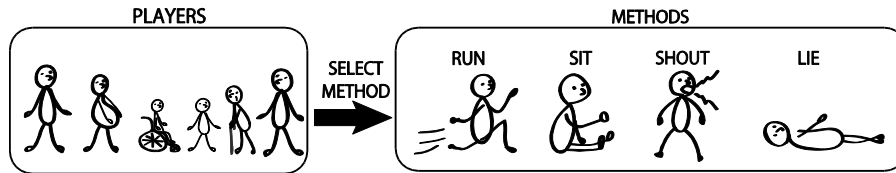


Fig. 1. Players can select methods for playing

has physical limitations, it is not easy for him or her to enjoy these games fully. Therefore, if a game has roles that require certain physical actions these players cannot do, it is not easy for them to enjoy playing it. Thus, we believe that, in some games, players can overcome physical limitations if they can select a different method of playing, as shown in Figure 1.

This study aims to construct a system that can be played by anybody anywhere regardless of physical limitations. (We call it a “universal game.”) Therefore, we emphasized a simpler game design and researched a number of methods of playing. We propose a game without visual information in order to make it simple. It is based on traditional children's outdoor games because they have rules that are easy for children to understand and can be played by a lot of children. Therefore, we believe that they have many elements that can be utilized in the universal game. We chose to base the content on Red Light, Green Light because this game requires physical activity and is played the in similar ways all over the world. Moreover, we verified that this system could overcome physical limitations and was enjoyable for healthy people.

## 2 Related research

Wii Sports (Nintendo Co.,Ltd.) is a video games system that requires players to move a lot. Wii Sports games need players to move as if they were playing real sports, such as tennis or bowling, while holding the Wii Remote. Therefore, it is simple to understand and easy to play. However, if a player's arm or hand cannot move due to some sort of limitation, it is difficult for him or her to play it enjoyably.

Japan Software Company for the Handicapped released “Space Invaders for the Blind [3].” This was made for the visually impaired to play, but it was not easy for them to enjoy playing because they had difficulty recognizing the situations of the game by only sounds.

Team Kanai proposed games that can be played by using only the sense of touch. In their study, they supposed an interface and contents that both visually impaired and sighted people could play together [4].

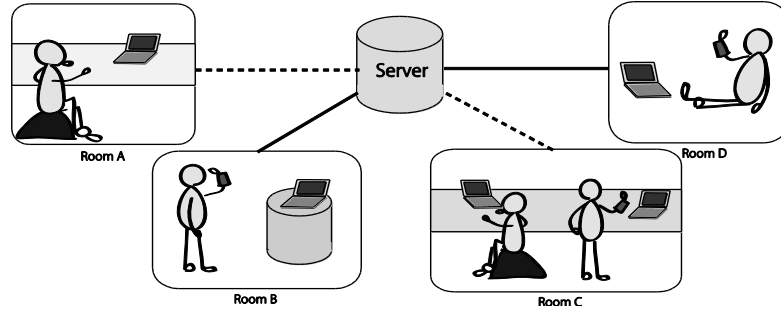


Fig. 2. Playing on-line versus mode

### 3 System Configuration

#### 3.1 How to play

In this study, we developed a game named *Daruma* (based on the Japanese variation of Red Light, Green Light are called *Darumasan ga koronda*) in which a system plays the role of *Oni* (the tagger) and the players wear sensors. A lot of voices that were recorded in advance and have different playing speeds (*Darumasan ga*: ten patterns, *koronda*: ten patterns, total: 100 patterns) are played at random. A player can move when he or she hears voices. If a player moves when he/she should not, a voice (“You moved!”) is played and the player losses. At first, the player and *Oni* are 100 meters apart. The player can approach *Oni* by running when he or she hears the voices. The change in value gotten by sensors and the times over the set threshold were given as the variable number for the judgment of approaching. The goal of this game is for a player to arrive at *Oni* and release a captive. Therefore, if a player arrives at *Oni*, he or she wins. The closer the player gets towards *Oni*, the louder the voices becomes in order to let the player know the distance between he/she and *Oni*. Moreover, we had the players wear eye-masks so they could not to obtain any visual information and wear head-phones or ear-phones so to block any outside noise. These could give the players the voice exactly, making it easier for them to imagine where they were.

We provided two game modes. In the single mode, one player plays against the system. Single mode can be played offline. In the online versus mode, two players play together. The first person to arrive at *Oni* was the winner. In the on-line versus mode, we can play *Daruma* by using network. Figure 2 shows people playing the on-line versus mode of *Daruma*. Each room is connected to a server computer. The server sorts opponents. The players in Rooms 1 and 3 are playing against each other, as are players in Rooms 2 and 4. Moreover, each player chose either way of playing.

#### 3.2 Devises

We devised two methods of playing the game: one swinging an arm, which are detected by an acceleration sensor; the other is tapping a forefinger and a middle



Fig. 3. Arm-swing and finger-tap *Daruma*

finger on a desk, which are detected by a microphone. We define the former as “arm-swing *Daruma*” and the latter as “finger-tap *Daruma*.” Players can select either, enabling people with physical limitations to enjoy the game.

In arm-swing *Daruma*, the system converts analog data obtained by the tri-accelerator (AE-KXP84) into digital data by using a microprocessor (PIC12F675), which is connected to a PC through a USB conversion module (AE-UM232R) and USB mini cable. Each player wore a wristband with the sensor. The number of arm swings was measured, and the distance between the player and *Oni* was calculated on the basis of the measured value and the number of arm swings in the same space of time.

In finger-tap *Daruma*, the sounds made by fingers on a desk with a microphone on it were judged. The distance between the player and *Oni* was calculated on the basis of the number of taps by sound gain and frequency analysis. The sounds could be made on wooden, metallic, or glass desks. Although the player needed to wear a sensor on his or her arms in arm-swing *Daruma*, he or she does not in finger-tap. Moreover the player does not need a special sensor to input because many laptop PCs have a built-in microphone.

## 4 Experiment I

### 4.1 Verification experiment and result I-1

We experimentally evaluated each method of operation. At first, the participants had the game explained to them by an announcement recoded in advance. Then, we answered the questions about things that they did not understand. They experienced the single mode of *Daruma* by playing arm-swing and finger-tap three times each. The participants were five healthy people (21-22 years old). After they finished playing both forms of the game, we interviewed them. The results showed that participants found finger-tap *Daruma* was easier than armswing *Daruma*. However, there was no difference in the average of clear times.

## 4.2 Verification experiment and result I-2

We experimentally verified which physical limitations each method overcame. In arm-swing *Daruma*, we found no difference between playing while standing and sitting. In addition, we found that we could play even while lying down. In finger-tap *Daruma*, the players' posture did not affect their ability to make sounds.

## 5 Experiment II

**Objective and methods:** The purpose of the assessment experiment was to investigate whether *Daruma* is enjoyable for healthy people. Because the game contents do not depend on visual information and so tend to be extremely enjoyable for healthy people, we thought this game needed to be investigated to see if it was enjoyable enough for them to play.

First, the game was explained to participants by a recoded announcement. They played both arm-swing and finger-tap *Daruma*. The participants were ten healthy people (21-24 years old: six men and four women). We divided them into two groups (A and B) of three men and two women. People in Group A firstly played arm-swing *Daruma*, and then they played finger-tap *Daruma* while people in Group B did the opposite. We had the participants wear eye-masks so they could not to obtain visual information. After the participants finished both games, we gave them a questionnaire.

**Results:** The result for **Q1** are an average on a ten-point scale and those for **Q2** to **Q6** are the proportion of participants who answered "Yes". **Q1.** "How much did you enjoy this game? (10-point scale)" was Group A ( $M=7.20$ ,  $SD=1.94$ ), Group B ( $M=7.60$ ,  $SD=1.50$ ), **Q2.** "Did you easily understand the rules?" was Group A = .60, Group B = .80, **Q3.** "Did you feel difficult about the judgment for playing?" was Group A = 1.00, Group B = .80, **Q4.** "Were you aware of how close you were to Oni at any given point?" was Group A = .80, Group B = .60, **Q5.** "Did you enjoy this game even though your eyes were closed?" was Group A = 1.00, Group B = 1.00 and **Q6.** "Do you want to play this game again?" was Group A = 1.00, Group B = 1.00. As a result, Groups A and B did not significantly differ. When asked for reasons they answered "No" to **Q2**, one participant said "I wanted you to explain the rules by video because it was not easy for me to understand them by only an announcement." Eighty percent of the participants asked questions to clarify rules.

## 6 Discussion

First, *Daruma* can be played in different ways; players who have difficulty playing the original game can take part in the same game with running children by using the arm-swing or finger-tap techniques. Secondly, the results of the verification experiment showed that players could play the game with either method of operation even if their postures or environments were different. Therefore, these things suggest that *Daruma* is a universal game. What suggests this game could be enjoyed by

visually impaired players was all experiment participants answering “Yes” to “Could you enjoy this game even though your eyes were closed?” despite this game being simple and them having no visual information at all. In addition, Group A and Group B barely differed in their answers, suggesting that either method works just as well. Therefore, we found both methods were equally understandable and usable. In this experiment, we made healthy people pose in ways that assumed physical limitations. Therefore, as a future task, we need level adjustment by doing the same experiment with the people who actually have physical limitations.

In the future, we will consider how to produce the distance perspective and realistic sensations with stereophonic sound by using binaural recording technology. We must improve this because the sense of tension towards the climax is important in the original *Darumasan ga koronda*.

## 7 Conclusion

In this study, we aimed to develop a universal game that overcomes players’ physical limitations. Specifically, we suggested and developed a system by which players who have physical limitations can choose alternative ways of playing so that they can play with players who do not. Moreover, we suggested that players who have visual limitations could participate in this game because it has no visual information in order to keep the game design simple. However, the universal game that overcomes all limitations players may have has not been achieved because this system has no provisions for players who are hard of hearing. We believe we have succeeded in developing a narrow universal game.

As a future task, we will find ways in which players who have oral and aural limitations can participate. This will need a system that can explain rules without using either aural or visual information. Therefore, we aim to develop the perfect universal game that can overcome all physical limitations and that anybody can play.

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