

# 卒業論文

即時性の伴うイベントを  
可視化・共有する Web サービス群

Web Services Enabling Real-time Visualization and Sharing of  
Information from Real-World Events

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# 卒業論文要旨 2015年度（平成27年度）

## 即時性の伴うイベントを 可視化・共有するWebサービス群

### 概要

Twitterに代表されるマイクロブログの広まりやスマートフォンの普及により、ソーシャルメディアに人々の自発的で自然な反応が多く含まれていることが可能になった。本研究においても、リアルタイムの個別ユーザからの実世界のイベントに関する反応入手し、トレンド分析やイベントの整理、共有などを行う様々なサービスを最新のサーバ技術を用いて構築した。リアルタイムな情報共有に注目し、複数のアプリケーションの作成を通じ共通基盤を構築したことについて述べる。

キーワード:

ブラウザネットワーキング, マイクロブログ, 人流

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## Web Services Enabling Real-time Visualization and Sharing of Information from Real-World Events

### Abstract

It is possible that contain many spontaneous and natural reaction of people in social media with spread of microblogging represented by Twitter and smart-phones. In the present study, to obtain a reaction related to real-world events from the real-time of the individual user, organizing of trend analysis and events, was constructed using the latest server technology a variety of services to perform the share such. In this paper, focuses on real-time information sharing, we describe that was constructed a common infrastructure through the creation of multiple applications.

Keyword:

Browser Networking,Microblogging,People Flow

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# Chapter 1

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## Introduction

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In this chapter, the background of this study and the purpose and describes the contents of the configuration of the present paper.

## 1.1 Background

Against the background of the spread and smartphones spread of micro-blog, which is represented by Twitter, it is as spontaneous and natural reaction of people is contained in a large amount in social media, has become easily able to acquire it.

## 1.2 Purpose

In the present study, to obtain a reaction related to real-world events from the real-time of the individual user, organization of trend analysis and events, to construct a variety of services to carry out, such as shared by using the latest server technology. Focusing on real-time information sharing, we describe that it has built a common infrastructure through the creation of more than one application.

The following configuration of the present paper is organized as follows. Chapter 2 describes the detection and visualization of routes and events using a micro blog. Chapter 3 describes the proposed system of improvised browser communication. Chapter 4, describes the extraction of local trend on Twitter. In Chapter 5, describes the construction of a mobile terminal sensing server API. In Chapter 6, we describe the GPS route noise removal technique. Finally, we describe the conclusion of this paper in Chapter 8.

# **Chapter 2**

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**Route event detection and  
visualization  
by the location information with  
Tweets analysis**

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This chapter focuses on tweets marked with location information, describes the visualization technique based on Web applications of human movement path that is expected to event participants.

## 2.1 System summary

In this study, creation of visualization and application of human movement path of user expected to event participants, with location information. In addition, we describe a Web application that was created for the purpose of detection and visualization of clustering to events from the location information and tweet content.

### 2.1.1 Moving path visualization

Was visualization of the collected moving path a tweet from the sample as 2014 October 18, Fujisawa Enoshima fireworks [4] that have been made in days of study(fig 1). Data was collected, and defined as follows event participants Fireworks on the day.

- Tweeted in within a radius of 10km.
- Made the tweets including the "花火" or "ふじさわ" or main station name.

### 2.1.2 Event detection

Sample of a study collected tweets, was posted May 9 to May 12, 2015, in the circumference of the time when a system has been developed. Visualization to tweets keyword and latitude, on the map and color-coded for each cluster performs a clustering longitude parameters. Also created a Web application that allows to manage and map view of clustering results(fig 2).

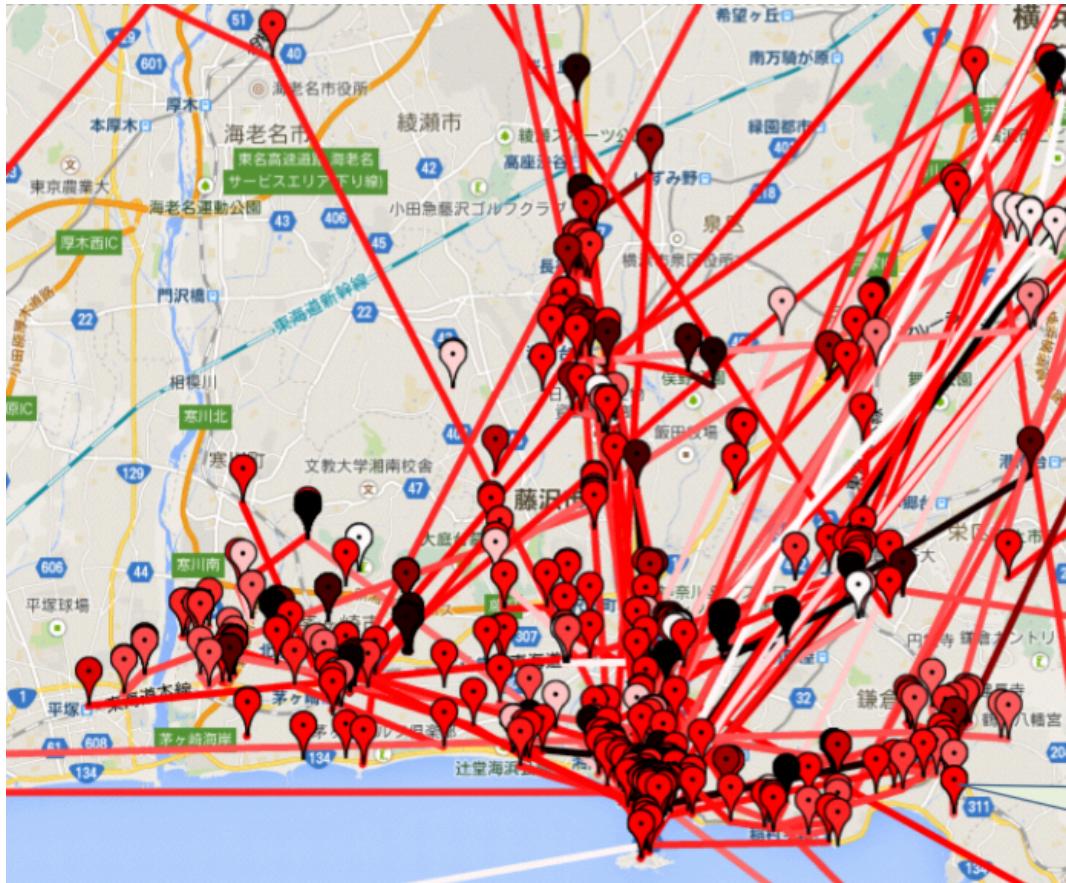


Fig. 1: Visualize Application Screen in Fujisawa fireworks

## 2.2 System structure

### 2.2.1 About Twitter API

The tweet collection of the present study was using the Twitter API. Mainly use the <https://api.twitter.com/1.1/search/tweets.json> and <https://stream.twitter.com/1.1/statuses/filter.json> was collected tweets. search/tweets API is a possible acquisition of the past tweets range specified in the past tweets search and latitude and longitude and a radius of a keyword specified as the filtering of the tweet. In addition, the past tweets by "search/tweets" there is a limit of up to a week ago.



Fig. 2: Event detection application screen

### 2.2.2 Moving path visualization

To analyze the procedure in the following (fig 3).

#### Acquisition of sample

Were acquired focused around 10km distance from the fireworks launch point of Fujisawa Enoshima fireworks. Fireworks launch point is W $35^{\circ}18'25''$  E $139^{\circ}28'43''$ . Furthermore collect the tweet, posted by acquired tweet's owner, of the day from 17 to 19 days(table 1)

#### Visualization Web application

The visualization was using the Google Maps API [5]. To display the marker in each tweet point, the same user displays signed before and after the tweet and the

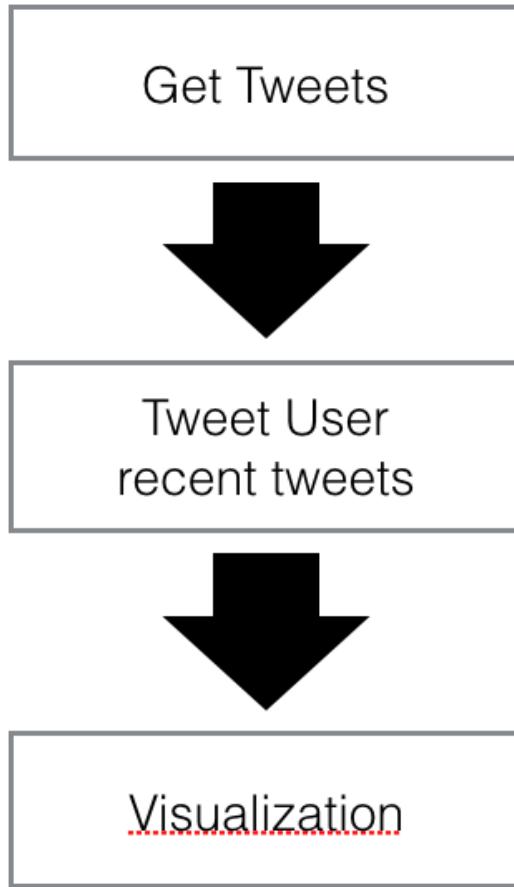


Fig. 3: Flow of fireworks Tweets analysis

line use a polyline, is a straight line was attempted visualization of the route. The color of the marker to change the brightness with time, and the display in a dark red from bright red through the night from morning(fig 4).

### 2.2.3 Event detection

To analyze the procedure in the following (fig 5).

#### Tweets collection

Discover were obtained similarly to the visualization of the movement path. This time, as a sample of the Tokyo metropolitan area of the tweet. Tokyo downtown,

Date	Number of sample
Oct. 17	5052
Oct. 18	26723
Oct. 19	20227

Table. 1: Fireworks - Sample tweet number

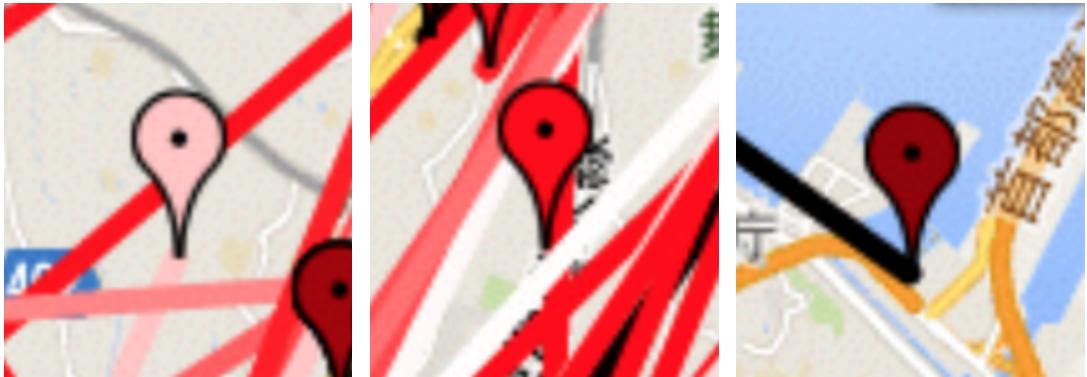


Fig. 4: From left to right, marker of the morning, noon, night, time zone

100km within the from E35°40'24" W139°42'37", collection date and time was 4 days of May 9 to May 12th.

## Clustering

Were clustered using K-means the keyword latitude and longitude to the shaft. A result, was able to classify the number of cluster (table 2) for each date. Further, it is necessary to examine techniques since the result desired result of attempting K-means could not be obtained, including the time zone.

Date	Number of Culster
May. 09	10
May. 10	12
May. 11	7
May. 12	7

Table. 2: Event detection - the number of clusters

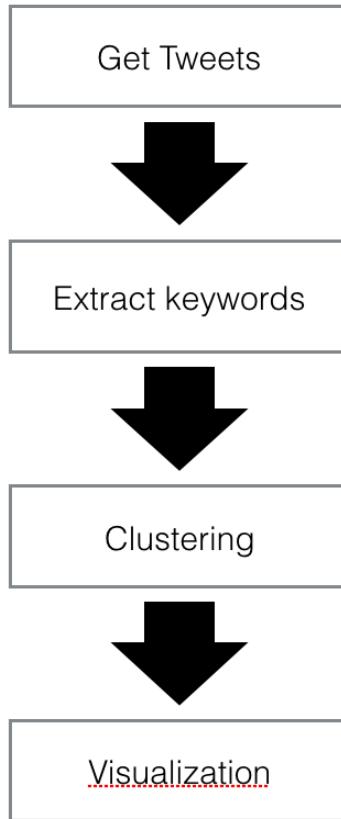


Fig. 5: Flow of event detection and visualization

### Visualization Web application

Using GoogleMap like the path visualization. It has changed the color of the marker in each cluster. Pick up because the good results in the result of the visualization results 10 days were obtained. 10 days clusters became list, such as follows (fig 6).

### Events that could be discovered by visualization

It is on 10 May shrine of Kanda Festival of events that had been understood from the previous experiment Miyairi has been carried out throughout the day. It was actually able to detect the tweets around events [6]. In addition, has also been events that did not run in advance on the same day ”野外音楽フェスティバル 人間交差点 2015 [7]”, it can be said that here also could be detected as tweets around



Fig. 6: Plot the results May 10

events.

#### 2.2.4 Geo Tweet collection client

We have created a Web application that collects in bulk tweets with location information as a tool to collect the Tweet in this study by using the API (fig 9). In applications to get a recent tweet, it is expected to take advantage in future research.

### 2.3 Conclusion of this chapter

As a result, although it is such speculation stations that are key to use from the visualization, the moving source and the human flow of only the information obtained in the collection to join each user it could not be predicted only roughly.

Keyword	Number of Tweets
imacoconow	264
kawaguchi	76
神田祭	65
photo	43
横浜	41
週末限定	38
神田明神	35
東京	30
天氣	28

Table. 3: Event detection - May 10

As a related study, information adding approach to Discover no location information have been proposed[3], the analysis can be expected with respect to the increase and the user information by utilizing.

Because the current is not able to attribute pickled user, I want to try or not find any significance in the visualization in the future and the additional information. Clustering, including the time axis is also considered to be involved in the detection accuracy of the event. Visualize using the animation is also believed to have spread the possibility of representation.

## Chapter 3 Route event detection and visualization by the location information with Tweets analysis

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Fig. 7: Plot of Kandasai Tweets



Fig. 8: Plot of nkfes Tweets

### GEO Tweet Collector

ツイート収集フォーム

ラベル

収集対象日

緯度(lat)

経度(long)

半径

ラベル	Geocode	日付
emo	<a href="#">35.673343,139.710388,100km</a>	2015年11月12日
all_move3	<a href="#">35.673343,139.710388,100km</a>	2015年09月22日
all_move2	<a href="#">35.673343,139.710388,100km</a>	2015年09月14日
all_move	<a href="#">35.673343,139.710388,100km</a>	2015年09月06日
hanabi_adachi	<a href="#">35.673343,139.710388,100km</a>	2015年07月20日
rain_back	<a href="#">35.673343,139.710388,100km</a>	2015年05月10日
rain	<a href="#">35.673343,139.710388,100km</a>	2015年05月22日
cl	<a href="#">35.673343,139.710388,100km</a>	2015年05月14日
reitai	<a href="#">35.673343,139.710388,100km</a>	2015年05月14日
first	<a href="#">35.689634,139.692101,100km</a>	2015年04月22日

Fig. 9: Tweet collection application UI

# Chapter 3

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## A instant browser networking game platform supporting multiple players

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In this chapter, we describe a browser capable of networking game is improvised multiplayer play that was created.

### 3.1 Background and summary

Recently, real-time communication technology has been attracting attention by WebSocket [13]. Communication tools is in demand at technical positions to work effectively. Thus, the study of real-time synchronization WebGL technique suggestions [8] and Web desktop sharing of using WebSocket [?] is being carried out in joint research. Moreover, against the background of the widespread use of smart phones [11], take advantage of the QR code [12] has also penetrated, recognition rate of QR code reader is a more than 90%, finding that use experience rate is about 70% are out [10].

We focused on immediate establishment of a connection where the smartphone with the controller. And by the creation of immediate participation capable browser application, describes the proposed information sharing method based on smart phone using the QR code and WebSocket[25].

### 3.2 System summary

As an example with the creation of the game platform, creation of a multiplayer-enabled browser shooter. QR code (fig 1) as the is displayed when you start the server to access from the monitor terminal to the game page in a browser. Players who play in the same screen can participate in the play can be accessed by the QR code read by smartphone terminal to the URL for the controller.

Controller is a horizontal possession smartphones, shake (shake the smartphone) was placed in the game as the input also like behavior (fig 2). Immediate participation in the smartphone by using a socket communication [17] can be a real-time operation of the player can be.

#### 3.2.1 Game system

The content of the game will be explained.

The game was to create a plane of the shooting game. Section, consisting of the wall can be moved on the stage is the player (fig 3) object can not pass through



Fig. 1: Authentication QR code

(fig 4). Players have an HP<sup>1</sup>, MP<sup>2</sup>, consume MP to shot attack, consumed MP is scattered in the map, MP is restored and to get scattered MP.

Action of the player can be done, but three of the move and shot attack and dash. Shot in the controller right, shot in the controller left attack, dash can be in the shake.

Discussion about the number of players to affect the processing speed, game was performed regression analysis taking the connection number and FPS about creating the game (fig 5). Some display was the state are heavy in seven of 28.28fps at the time of connection

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<sup>1</sup>Hit Point

<sup>2</sup>Magic Point

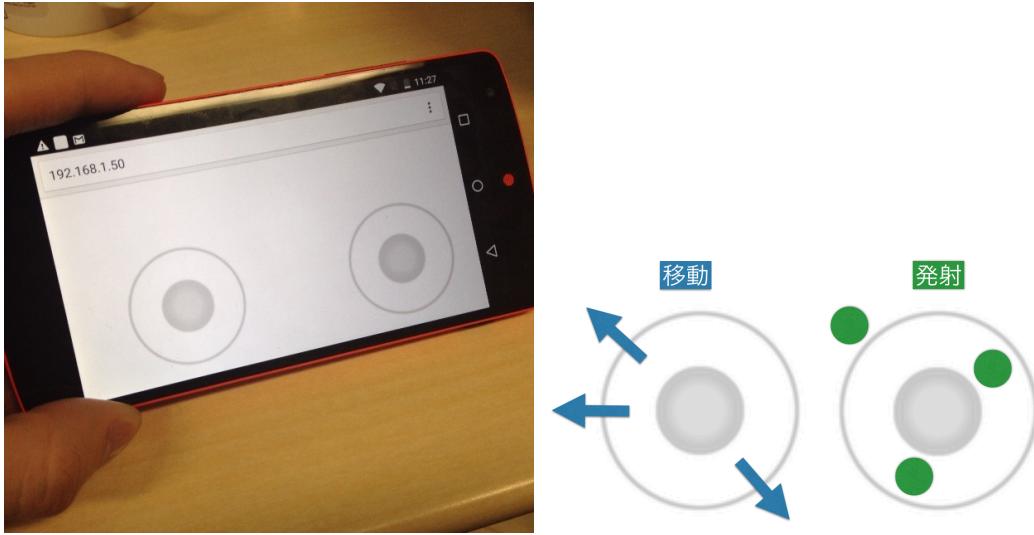


Fig. 2: Controller, controller of the description

### 3.3 System structure

#### 3.3.1 Diagram

The configuration of the system will assume the two, and the configuration shown in (fig 6) move and operate the online server, the configuration shown in (fig 7) like can play only in the local network by to make a server on the PC.

#### 3.3.2 Flow of network communication

To establish a connection in the flow (fig 8), such as:

- To access the main page from the terminal as the display. (1, 2)
- To establish a socket connection at the time of the response. (3, 4)

Performs the following communication before playing preparation of the game (fig 9).

- Clients access to the team selection page (/con). (1, 2)
- To access the team to the selected completion page (con/team=), to establish a connection of the socket. (3, 4, 5, 6. )

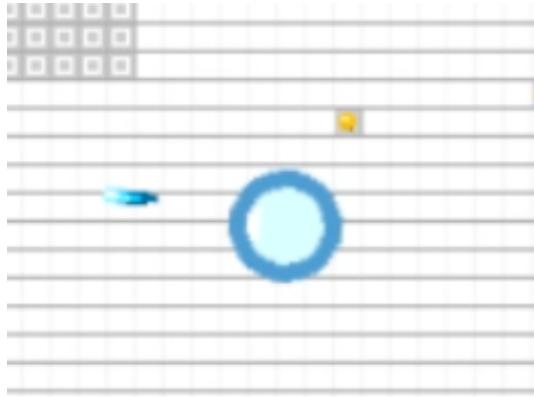


Fig. 3: Player (blue circle on center) and  
Players shot (light blue)

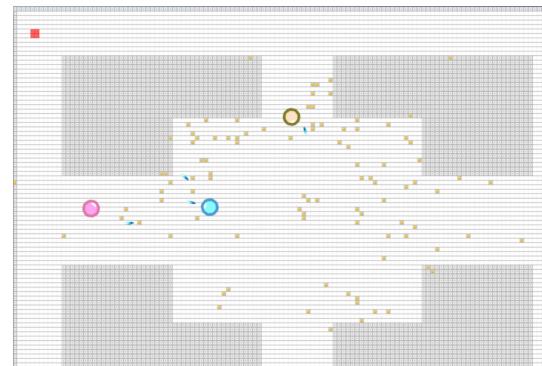


Fig. 4: Game screen

- To send additional information to the display terminal or other users. (7).

Game-time communication is sent to the client that opened the main page through socket for input of a controller as shown (fig ??)nodegame), moreover, synchronized with the player's actions.

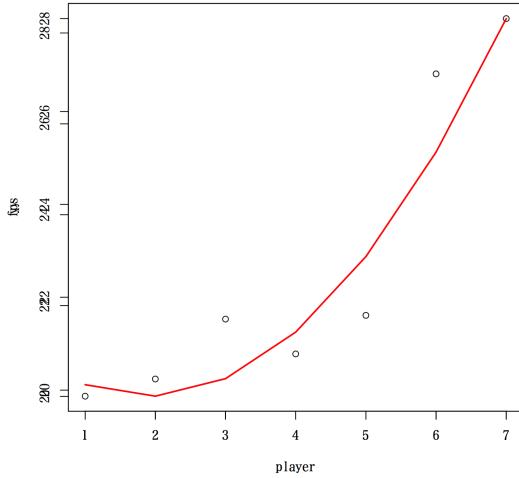


Fig. 5: FPS Graph

### 3.4 Conclusion of this chapter

It shows how you are playing the game in the following (fig 11). Game freeze occurs this time made the game is about once in 20 seconds in connection with four people, was seen constantly Kaku with that's connected in eight. If the data to be handled in the socket is simple is believed that can improve the performance of.

The system made a demo and poster sessions presented at the University of the open campus and academic. Although many of the participants were able to participate in its own smart phone, the case of QR code reader app is not in the terminal occurs in one percent or less. Considered and evaluation of packaging and network load as the starting point and the game framework for future development.

The application of this system, a general purpose of the server-side, a library can be expected. It seems to spread the possibility of communication to the mobile terminal in such there is no network environment affected areas by blowing the router if it is possible to perform also porting to RaspberryPI.

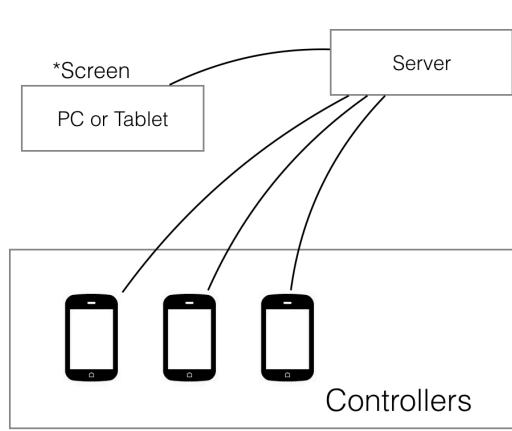


Fig. 6: System structure online

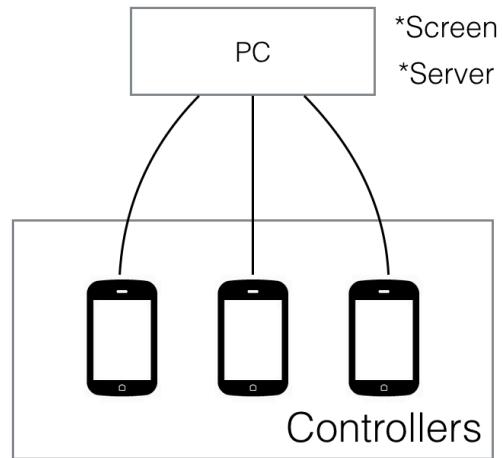


Fig. 7: System structure offline

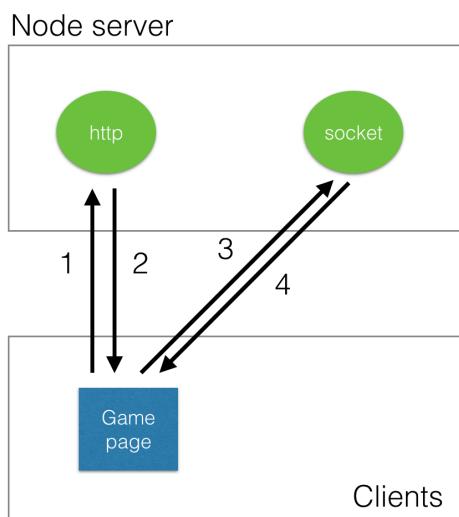


Fig. 8: Communication at the time of the main page connection

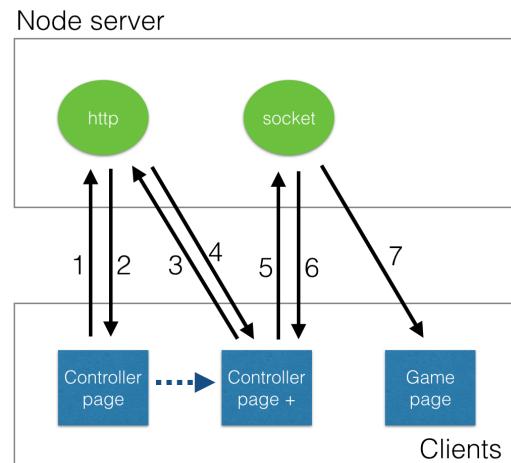


Fig. 9: Communication at the time of the controller connection

Chapter 4 A instant browser networking game platform  
supporting multiple players

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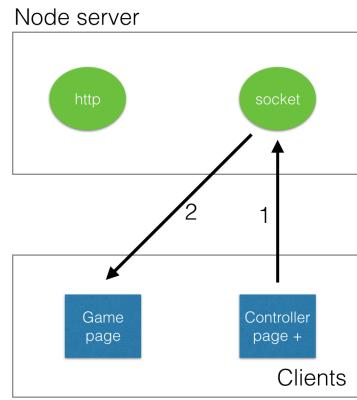


Fig. 10: Synchronization control query at the time of the game

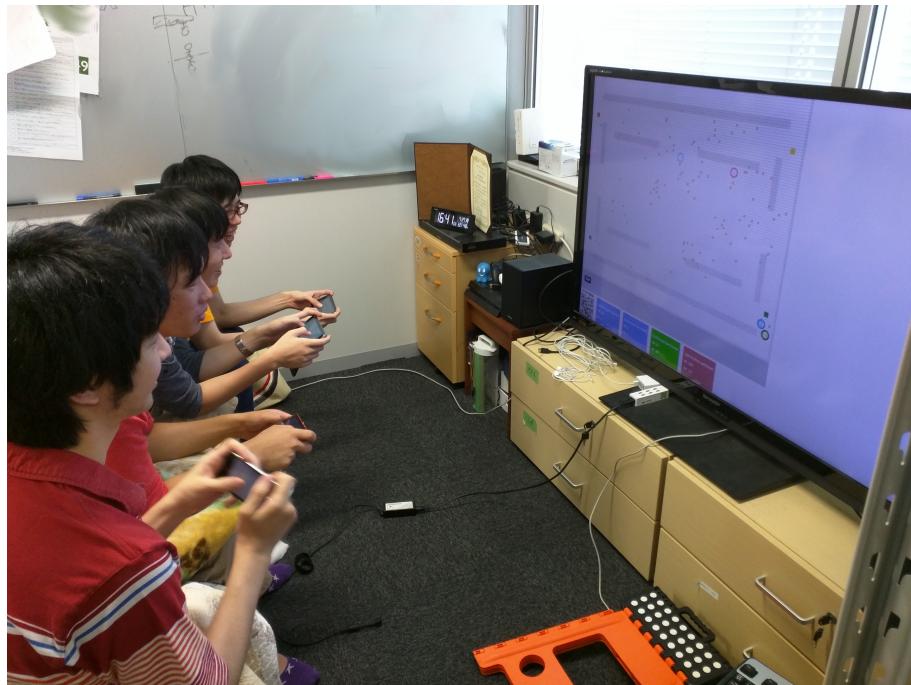


Fig. 11: State of play

# Chapter 4

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## Extraction of the local trend of Twitter

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In this chapter, we describe the study of the real-time trend analysis techniques within a particular cluster

## 4.1 Background and related research

The society has a variety of organizations and groups, there is a news and trends in the interior. In addition, Twitter has been actively used as a tool for the event acquisition of real-time information and progress. As related research, proposals and of the events of the congestion situation grasp by tweet analysis [19], have any other suggestions of the analysis method of forecasting and will trigger things trend [20]. We tried to extraction of the local trend keyword by the analysis of this time Tweets by university students.

## 4.2 System summary

As a sample, was registered at the user has been self-application and manual, the aggregate to target university students of Twitter user a total of about 600 users of the tweet, the extraction of keywords that are prevalent in the immediate vicinity of the time zone application the implemented. To do the statistics every hour, to the post from Twitter of bot<sup>1</sup> the top keywords as a trend(fig 1) [21].



Fig. 1: Twitter bot account that you created in the experiment

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<sup>1</sup>Twitter account that is running as an Internet bot

### 4.3 Algorithm

The evaluation of the trend using the proprietary algorithm as shown in (fig 2). Simply calculate the frequency of occurrence of the keyword First, the adjustment of the point by the number of users, carry out the removal of the noise the point of the words you accumulated and recorded trend of recent one day as a negative evaluation. A result the upper six stars of the tweet, the point is keep a record in the database is divided into the log and cumulative for the next evaluation.

And mounting a plurality of the following functions also discussed delivery of as a trend content of.

- The 1st and the delivery of one week of trend
- Additional features of the keyword dictionary by reply
- Display of trend-filled in a continuous

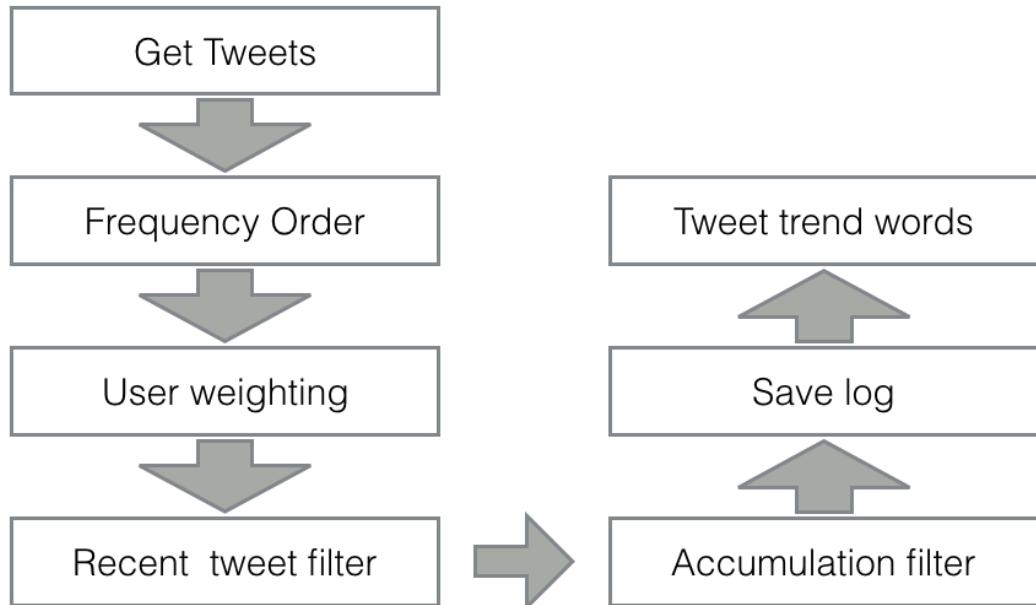


Fig. 2: Flow of analysis of trends

## 4.4 Conclusion of this chapter

As a result of experiments with extracts of trends in this technique, As a result of experiments with extracts of trends in this technique, was able to extract the information that happened to sudden on campus that became a hot topic on Twitter (fig 3). A result of the overlap in words that are posted as a trend in Twitter official was also seen many (fig 4). In addition, less likely to be such a special proper nouns from the sweetness of the space between words accuracy of sentences informal extraction, keyword of hash tags that are extracted reliably in opposite is the improvement tend to point is biased high.

For the delivery of at bot to be limited representation, it was further carried out the implementation of the web site, as shown in (fig 5) [22]. The introduction of the evaluation to put the emphasis on local characteristic keywords not only in the cluster, statistics by the evaluation of emotion, is considered the development of such a result display on the Web site.

メディセン■■■■■|||||  
ガラス■■■■■|||||  
階段■■■■■|||  
(△`△)■■■■■|||||  
メディ■■■■■|||  
うに■■■|

19:00 - 2014年4月29日

エイプリルフール■■■■■||||| 【7連続】  
嘘■■■■||| 【6連続】  
#エイプリルフール■■■| 【5連続】  
新入■  
勧誘■ 【4連続】  
社員■  
[trend.elzup.com/log/2015040113](http://trend.elzup.com/log/2015040113)

13:00 - 2015年4月1日

Fig. 3: Examples including sudden information that occurred on campus

Fig. 4: Example of the overlap with the Twitter official trend

## Chapter 5 Extraction of the local trend of Twitter



Fig. 5: Trend aggregation Web page

# **Chapter 5**

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## **Mobile terminal sensing server API**

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In this chapter, describes the creation of the server application for managing the log of data collected by a sensor attached to the mobile terminal

## 5.1 Background and related research

Against the background of the widespread use of smart phone that comes with a variety of sensors, the realization of sensing using a general user of the smartphone has been expected [24]. This time, the purpose of the sensor information management through the use and multiple users on multiple studies and projects, have created a need to achieve a user participatory sensing server application, a management application in the creation and Web screen of the Web API.

## 5.2 System summary

Defining the data structure to be stored on the server as shown in (fig 1). This is for the purpose of Project specific administration, Project and User was one-to-many. The mobile terminal of the client application, it is possible to create a simple sensing applications to use two to perform "Request to create a user of the project" and "Additional sensor information of the user". Management screen is a simple UI, was to allow the data export in the per-user or per-project basis from the management screen (fig 2) (fig 3). Implementation of the export function in CSV and KML format for analysis of the collected data. KML is effective for the analysis have been supported by the Google Earth and Google Maps (fig 4). And as an output using the Google Earth shows the displaying the altitude information (fig 5).

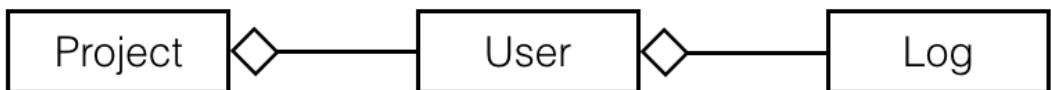


Fig. 1: Data structure to be handled by the server

CityWalkersMeter 管理画面						
Listing Projects						
Display Entries		Name	users	manage		
1	Project1	users	Show	Edit	Destroy	
2	大船渡_iOS	users	Show	Edit	Destroy	
3	北海道	users	Show	Edit	Destroy	
11	大船渡_android	users	Show	Edit	Destroy	
99		users	Show	Edit	Destroy	

Fig. 2: Management screen of the project list

CityWalkersMeter 管理画面						
Users [Project: ]						
Display Entries						
UserID	ProjectID	Created at	Log num	show logs	download	me
254	99	2015年12月19日(土) 15時18分29秒	799	logs	CSV	KML </> Sh
256	99	2016年01月03日(日) 06時58分12秒	1590	logs	CSV	KML </> Sh
257	99	2016年01月03日(日) 08時11分47秒	1823	logs	CSV	KML </> Sh
258	99	2016年01月03日(日) 18時38分00秒	3749	logs	CSV	KML </> Sh
259	99	2016年01月15日(金) 23時48分40秒	636	logs	CSV	KML </> Sh
260	99	2016年01月15日(金) 23時52分37秒	1013	logs	CSV	KML </> Sh
262	99	2016年01月17日(日) 07時16分54秒	~	logs	CSV	KML </> Sh

Fig. 3: User management screen that can perform such as downloading of data



Fig. 4: Visualization by Google Earth  
and analysis

# Chapter 6

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## GPS route noise removal

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This chapter describes the proposal of the noise filtering technique in the log of the GPS data

## 6.1 Background and related research

GGPS technology is a technology that enables highly precise positioning of real-time, are utilized in various fields. On the other hand it is widely known is also a problem for the positioning error by the GPS in[23].

## 6.2 Sample data

Long moving distance in the experiment, using the recording data on skiings for a special motion as the sample(fig 1). Of Skiing data for 3 days, day 2 data was seen particularly noisy. 5-second intervals using GPS data 1963 pieces of which were recorded in the log. From the sample data et GPS noise like (fig 2) was observed.

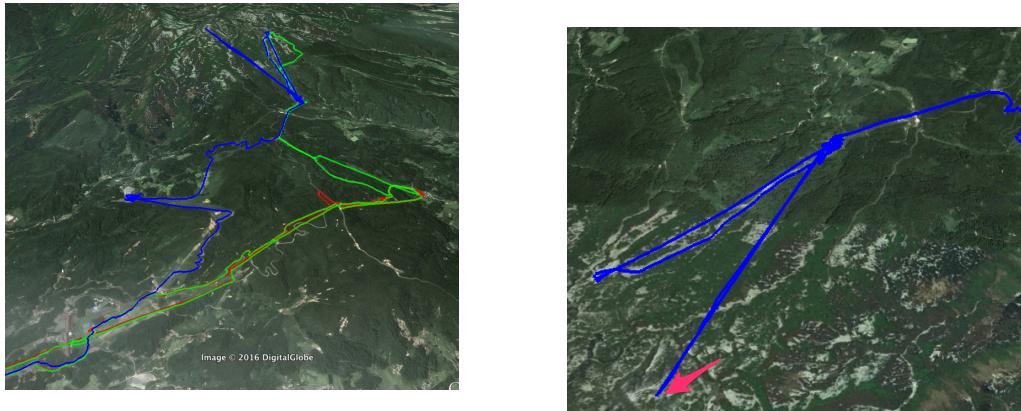


Fig. 1: Ski of acquired data Red: the first day, blue: the second day, green: the third day

Fig. 2: GPS noise, the arrow portion of the sample data

## 6.3 Algorithm

Since the data are recorded at regular intervals, the speed is determined from the size of the distance between two points of consecutive data. And delete data that are considered to have moved in the apparently unnatural speed. Procedure is carried out as shown in (fig 3) shown below. In addition, using the Hyubeny

formula the distance calculation. The ratio of upper and plotted on the map as a threshold in descending order of distance between two points, and evaluated

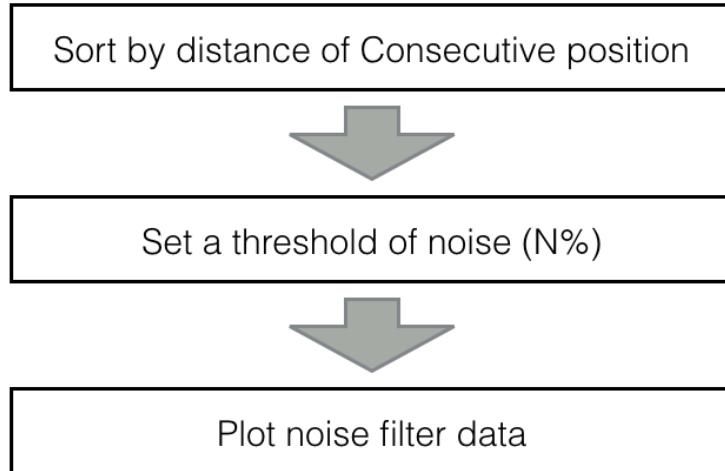


Fig. 3: Proposed filtering procedure

## 6.4 Result

The result of filtering as the ratio of error data 30% and 10% and 2% shown in (fig 4) and filteredfiltered2. In particular, removal of large erroneous detection data was able to do. However, the error of the GPS logs indoors as shown in (fig 6) could not be covered.

## 6.5 Conclusion of this chapter

It proposed a filtering method using it for determining the threshold as a percentage of the noise data. Altitude to the GPS information, and since the accuracy of the information is added and improved techniques in light of it conceivable. In addition, the number of data of the sample by the filtering process is thus reduced is improvement, it is necessary to devise also data cleansing process.

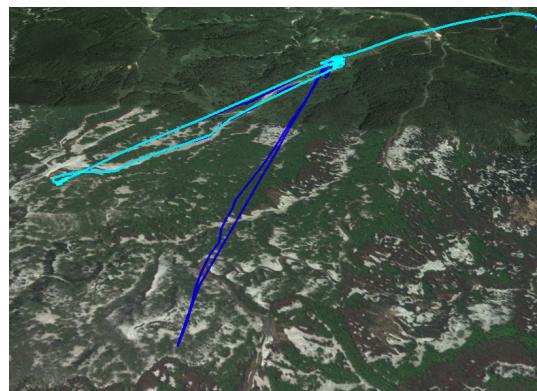


Fig. 4: Data after the filter, blue: pre-filter, light blue: After filter

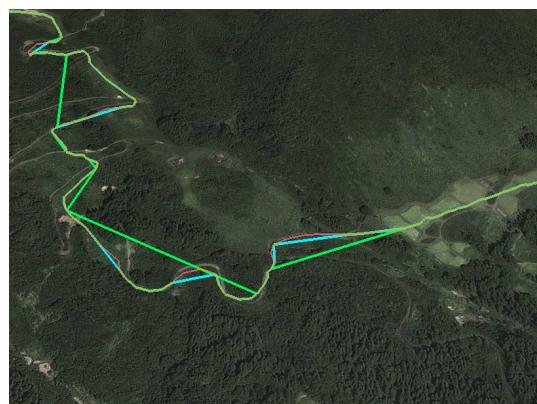


Fig. 5: Data 2 after the filter, yellow-green: 30%, light blue: 10%, red: 2%

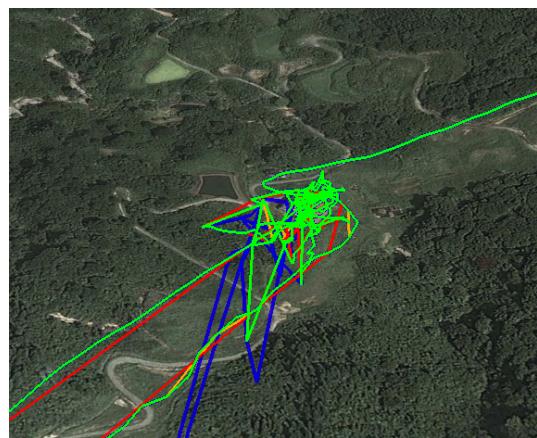


Fig. 6: Data filter results in the indoor, blue: pre-filter, red: 30%, yellow-green: 10%

# Chapter 7

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## Conclusion

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## 7.1 Conclusion Summary

With the spread of the spread and smartphones of micro-blog, which is represented by Twitter, it is to them continue to improve the Kaeyori convenience to people's lives as the infrastructure is essential server-side technology. In the present study, to obtain a reaction related to real-world events from the real-time of the individual user, organization of trend analysis and events, to construct a variety of services to carry out, such as shared by using the latest server technology.

## 7.2 In addition

We have introduced in this paper, will spread immediately smartphone participation application, trend delivery bot, such as through more open source the latest information visualization shared foundation of Web services group such as through extending the participatory sensing server API production and user evaluation.

# Acknowledgment

Upon proceed with this research, I deeply thank the Tokyo Denki University Future Science, Information and Media Department of Masayuki Iwai professor who have cooperation started in all aspects of the research guidance.

Finally, both the Tokyo Denki University Future Science Department of Information and Media Department of ubiquitous networking laboratory of friends the day-to-day research, I now gave over the encouragement words of when you blow a Windows little opportunity to touch other people , it represents the heartfelt gratitude to four years of families who have supported the college life.

March 31, 2016  
Hiroto Takahashi

# Off-campus Conference presentation

1. 高橋洸人, 岩井 将行, ”即興的な多人数チームプレイが可能なブラウザネットワーキングゲーム基盤”, 情報処理学会 エンタテインメントコンピューティング研究会 (SIG-EC). 2015 年 10 月.
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# **Appendix**

In the Appendix, attach a paper was presented at the Entertainment Computing 2015.

# 即興的な多人数チームプレイが可能な ブラウザネットワーキングゲーム基盤

高橋 洋人<sup>a)</sup> 岩井 将行<sup>b)</sup>

**概要：**近年ネットゲームによるネットワーク負荷が懸念されている。震災時の避難所生活ではネットワークが確立できないという問題が露呈した。我々はインターネット上のサーバーを必要としない即興的なクライアント間のリアルタイム通信を実現する、ブラウザネットワーキングを利用したゲーミング基盤の構築した。その場で自分のスマートフォン端末を用いて多人数で同時にプレイの出来るゲームを実現する。

## A Instant Browser Networking Game Platform Supporting Multiple Players

TAKAHASHI HIROTO<sup>a)</sup> IWAI MASAYUKI<sup>b)</sup>

**Abstract:** Network load due to net game is concerned. In the shelter life at the time of the earthquake was exposed is a problem that the network can not be established in recent years. We realize the real-time communication between the improvised clients that do not require a server on the Internet, and the construction of the gaming platform that utilizes the browser networking. To realize the play of the game can be at the same time by many people using their smartphone terminal on the spot.

### 1. はじめに

複数人でプレイするゲームはハードが複数必要である。最近ではスマートフォンをプラットフォームとしたゲームが多くあるが複数人でプレイする場合には参加者全員がアプリをインストールする必要があるなど、手間がかかる場合が多い。反対に、インストール不要でブラウザで行えるオンラインゲームはPC環境向けがほとんどである。つまり多人数でプレイ可能なゲームは環境を整えるのに時間がかかったり、ハードが人数分必要など制限がかかるなどプレイの実現に制限がかかってしまうのは問題である。

また現在のWeb分野ではクライアント間でも双方向通信技術の発展について、ブラウザを用いたP2Pの研究[1]も行われて有用性も示されている。スマートフォンを分割

表示に用いる研究[3]や、携帯端末を入力装置としたフレームワークの提案[2]なども行われている。

そこで我々の提案する手法では、近年使用者が多いスマートフォンをコントローラとするプラットフォームである。PCやタブレット端末をディスプレイとしてプレイヤーが囲ってプレイが出来て、QRコードによる即興的な環境準備の実現を目指す。

### 2. 全体概要

ゲームプラットフォームの作成とともに一例として、多人数対応のブラウザシューティングゲームを作成をした(図-1)。サーバーを起動してモニタとなる端末からブラウザでゲームページへアクセスすると(図-2)のようにQRコードが表示される。同じ画面で遊ぶプレイヤーはスマートフォン端末でQRコード読み取りをするとコントローラ用のURLへアクセスすることができプレイに参加が出来る。

コントローラはスマートフォンを横持ちで、シェイク(スマートフォンを振る)動作なども入力としてゲームに入れ

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<sup>b)</sup> iwai@ms.im.dendai.ac.jp

た(図-3). socket 通信を用いることでスマホで即時参加が可能でリアルタイムにプレイヤーの操作が出来る。

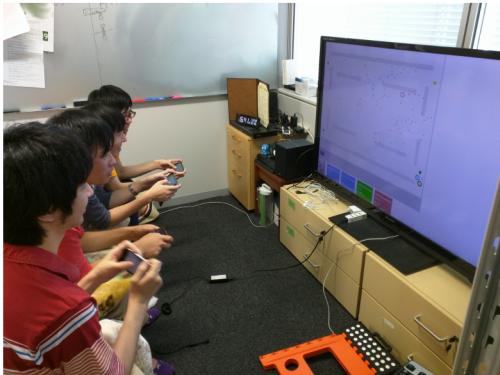


図-1 プレイの様子



図-2 認証 QR コード



図-3 コントローラ、コントローラ説明

### 3. ゲーム概要

ゲームの内容について説明する。

ゲームは平面のシューティングゲームを作成した。ステージ上をプレイヤー(図-4)が移動できて壁で構成される部分はオブジェクトが通過できない(図-5)。

プレイヤーは HP(Hit Point), MP(Hit Point)を持っていて、ショット攻撃に MP を消費し、消費した MP はマップに散らばり取得すると MP が回復するという特徴のルールを加えた。

プレイヤーのアクションは移動とショット攻撃とダッ

シュの3つが行える。コントローラ右でショット、コントローラ左でショット攻撃、シェイクでダッシュが出来る。

プレイヤー数に対する処理速度の考察を行った。作成したゲームについて接続人数と FPS を取って回帰分析を行った図-6. 7台の接続時の 28.28fps で若干表示がカクついている状態であった

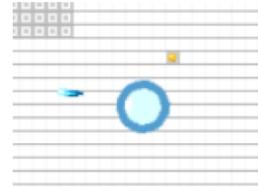


図-4 プレイヤー、ショット

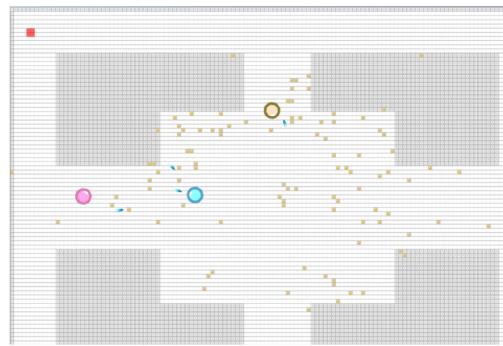


図-5 ゲームプレイ画面

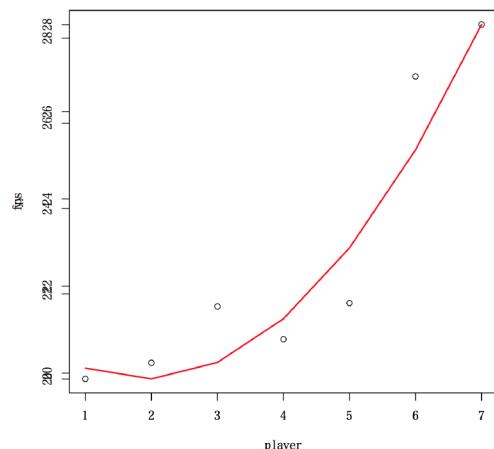


図-6 FPS グラフ

## 4. システム構成

### システムの想定環境

大きく分類して 2 のゲーム環境を想定している。

ひとつは外部にオープンなサーバーを設置してそこを介して、ディスプレイとなるクライアントとスマートフォンでプレイする環境である(図 8)。プレイヤー同士が離れていてもオンラインで対戦が出来る環境を作ることが出来る。

もう一つはローカルの PC でサーバーとディスプレイ両方の役割をするパターンである(図 7)。外部のネットワークが必要ないというメリットがある。

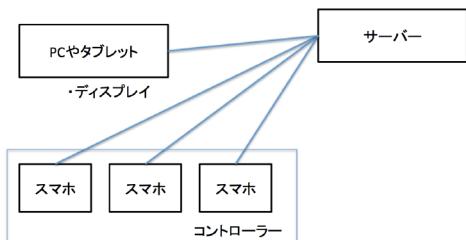


図 7 ローカル PC をサーバーとした場合

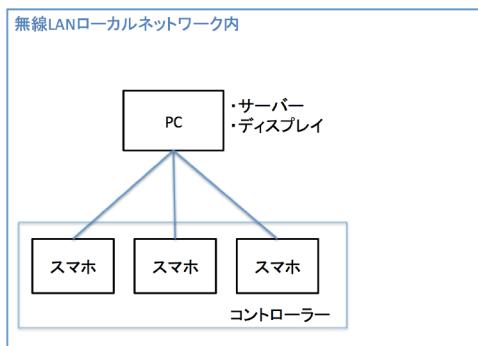


図 8 オンラインサーバーに設置した場合

### 通信の流れ

まずディスプレイとなる端末からメインページ(ドキュメントルート /)にアクセスする(図 9-1, 2)。レスポンス時に socket のコネクションを確立する(図 9-3, 4)。

その後、コントローラとして使う端末からチーム選択ページ(ドキュメントルート /con)にアクセスする(図 10-1, 2)。チームの選択によりコントローラページ(ドキュメントルート /con?team=[num])に飛び、socket コネクションの確立(図 10-3, 4, 5, 6)とともに、ディスプレイ端末へプレイヤー追加のイベントを送信も行う(図 10-7)。

ゲーム時の通信は(図 11)のようにコントローラの入

力を socket を通してメインページを開いているクライアントへ送信し、プレイヤーのアクションへと同期している。

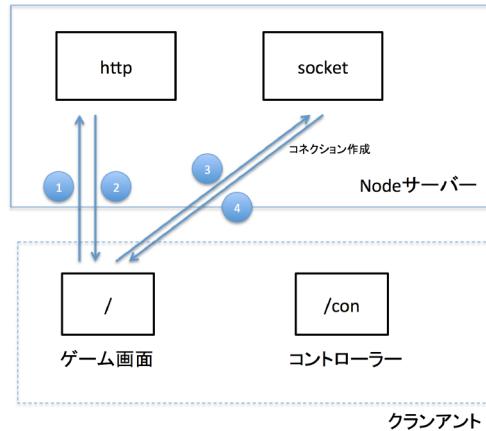


図 9 メインページ接続時の通信

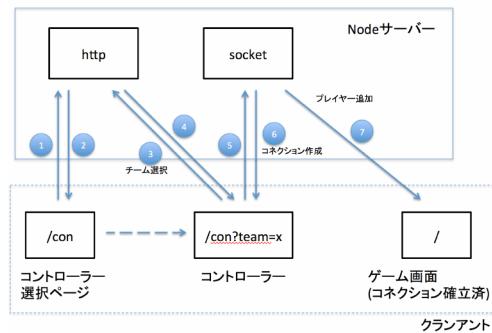


図 10 コントローラ接続時の通信

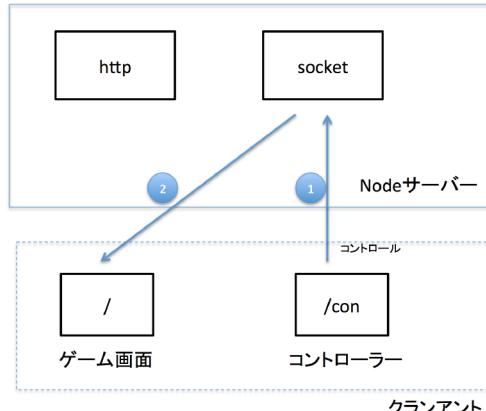


図 11 ゲーム時のコントロールクエリの同期

## 5. システム詳細

### socket.io

[4] 複数のプラットフォームでリアルタイムな Web 通信を実現する。Javascript で記入が可能、通信コストを削減できるというメリットがあり、ゲームのリアルタイム同期に使用している。

### Node.js

Socket 通信に向いているためバックエンドのフレームワークとして使用した。Web サーバの運用と、クライアントとのソケット通信を行う。

### enchant.js

[5] Javascript のゲームフレームワークであり、マルチプラットフォームで iPhone, Android, WindowsPhone などでも動作するアプリを開発することが出来る。メインのゲーム画面、コントローラの処理両方に用いた。

## 6. おわりに

今回作ったゲームは 4 人で接続で 20 秒に一度ほどゲームのフリーズが発生、8 人での接続だと常時カクつきが見られた。ソケットで扱うデータが単純であれば性能の向上ができると考えられる。

即興性の面での評価は、実際に使ってプレイまでの準備がスムーズに行えた。ローカルネットワーク内の場合はアクセスポイントの選択が必要になる場合もあるが大した手間では無いと考えられる。

このシステムの応用としては、サーバーサイドの汎用化、ライブラリ化が望める。RaspberryPI への移植も行えれば Wifi を吹くことでネットワーク環境のない被災地などでもモバイル端末への通信の可能性も広がると思われる。

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