

# VISUALIZATION OF BUSINESS HOURS FOR SHOPS AND OFFICES CLASSIFIED BY BUSINESS CATEGORIES IN SHOPPING AREA

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**ABSTRACT:** Detailed information such as shops, offices and customer's spatio-temporal distribution may play a important role as one of the basic data in many fields, e.g. marketing research, disaster prevention plan and security plan. In addition, some business activity data, address, business categories, business hour etc. in each shop and office also can be corrected in detail by developing of Web services. If actual business hours of each shop and office could be obtained, it may be possible to monitor the business activities by hourly basis during the whole day. Therefore, in this study, we got business hours of shops and offices from Web information in some shopping areas of Japan. As a result, it was realized that almost 85% of shops and offices have been obtained their business hours. In addition, it has succeeded to create a method of visualization for open and close of shops and offices. This method visualizes open and closed of shops and offices in daily and hourly changes by using animation.

## 1. INTRODUCTION

Recently, the development of Internet services allows us to obtain detailed information of shops and offices. If information of location and business hour in each shop and office could be obtained, it may be possible to monitor the business activity by hourly changes in a whole day. In addition, to integrate information of people's spatial distribution obtained from fluid population data etc. with information of business hours, it is expected that we can monitor more detailed behaviors of people and shops. These information are considered to be very effective and useful as one of key data/information for researches of marketing activities such as determination of shop location, and for planning of disaster prevention and regional security.

### 1.1 Previous studies

For the survey of actual condition in shopping areas, there are some studies to monitor hollowing and declination in central city (e.g. Tominaga, 2002). In addition, there is the study to monitor changes of shopping areas in front of station in the suburbs of Tokyo and to point problems (Ato et al., 2006). Moreover, Akiyama and Shibasaki (2010) developed the system which can monitor distributions and shapes of shopping areas throughout Japan. However, these studies tracked business activities of shops and offices in long term (e.g. at every year). Therefore, these studies could not track activities of shops and offices at short term (e.g. at every day or every hour etc.).

## 1.2 Objective

Information of business hours is necessary to monitor business activities of shops and offices in short term. Therefore, the objective of this study is to develop the system which can obtain business hours of shops and offices from the Web in some shopping areas of Japan. In addition, we visualized business activities in shops and offices.

## 2. DATA DEVELOPMENT

### 2.1 Source data

In this system, we used the digital telephone directory which contains location information as the source data. Digital telephone directory is provided by ZENRIN CO., LTD.. If our system is provided at least names and addresses of each shop and office, it is possible to obtain their business hours. In addition, if you provided the information about business category in each shop and office for the system, more detail analysis such as comparing business hours in each business category is possible.

### 2.2 Processing flow

This system collects business hours of the shops and offices automatically. At first, the system searches by the retrieval term which consists of name and a part of address of shops and offices by using search engine (Yahoo!). In this study, the retrieval term was constructed by following order words, name of shops and offices, place-name, business hour for each shop and office. The term place-name consists of city/district name and larger section name in each shop's address. Second, we obtained a summary from results of the search up to 10 results. Third, the system extracted the first summary which contains the information of business hour of all results. Finally, business hours are extracted from each summary. Figure1 shows the processing system to obtain business hours of shops and offices from the Web.

### 2.3 Determination of search term

This study's outcome depends on the result of the Web searching. Especially place-name of shops and offices in retrieval term is considered as important factor for determination of retrieval term. Therefore, we compared with the case that retrieval term consists of name of shops and offices, city/district name, Business Hour (Case1), for example, Okamoto Electric Co., Sendai City, Business Hour, with the case that retrieval terms consists of name, city/district name + larger section name, Business Hour (Case2). In addition, both of terms were compared with its accuracy of obtaining business hour from the Web searching in Sendai city (western area of Sendai station) and Fukuoka city (Tenjin district) (Table1). A method of accuracy verification is showed in Section 3.2.

According to Table1, it is realized that the case2 is higher accuracy in obtaining business hour from the Web searching compared with the Case1. Therefore, we adopted the Case2 as place-name in retrieval term because accuracy of business hour data would be required in order to conduct well visualization.

Table1: Difference of result by retrieval term

Verified area	Verified number	The number of obtained business hours/Obtained percentage	The number of shops and offices for accuracy verification	The number of shops and offices obtained business hours collectly /Corect percentage
Sendai(contain larger section name)	2581	2138/82.3%	350	279/79.7%
Sendai(contain city name only)		2203/85.3%		257/73.4%
Fukuoka(contain larger section name)	3264	2605/79.8%	350	315/90.0%
Fukuoka(contain city name only)		2793/85.6%		295/84.3%

## Source Data

Number	Name of shops and offices	Category of business	Address	Longitude	Latitude
0	岡本電気	設備工事	東京都世田谷区大原1丁目3-	139.668	35.6627
1	秋山楽器	楽器	東京都世田谷区代沢2丁目3-	139.668	35.6625
2	仙石サイクリング	自転車店	東京都世田谷区北沢1丁目1-	139.668	35.6623
3	バー上山	酒場	東京都世田谷区代田4丁目3-	139.669	35.662
4	柴崎理髪店	美容店	東京都世田谷区大原3丁目2-	139.669	35.6621



- Make search terms  
(name city name + larger section name Business hour)

Name	place-name	Business hour
Search term: 岡本電気	世田谷区大原	営業時間



- Search the Web
- Extraction of summaries which contains business hour information

Number	Name of shops and offices	Summary
0	岡本電気	営業時間:10:00~23:00です。品ぞろえ多数ご
1	秋山楽器	秋山楽器...09:00~13:00,16:00~21:00定休日
2	仙石サイクリング	営業時間午前11時~午後9時住所:東京都世田
3	バー上山	バー上山..17:00~2:00まで営業しております。お
4	柴崎理髪店	営業時間火~金/10:00~21:00土日/10:00~



- Extraction of business hours from summaries

Number	Name of shops and offices	Opning hour1	Closing hour1	Opning hour2	Closing hour2
0	岡本電気	10:00	23:00		
1	秋山楽器	9:00	13:00	16:00	21:00
2	仙石サイクリング	11:00	21:00		
3	バー上山	17:00	27:00:00		
4	柴崎理髪店	10:00	21:00		

Figure1: Processing flow to obtain business hours

### 3. EXPERIMENT

#### 3.1 Experimental area

For the experiment, we selected some shopping areas and extracted 1,000~3,000 shops and offices in each area from the digital telephone directory. We obtained business hours of all shops and offices by using this system from the Web and we conducted comparative verification and accuracy verification. Experimental areas are Sapporo city (southern area of Sapporo station), Sendai city (western area of Sendai station), Shinjuku-ku (kabuki-cyo), Shibuya-ku (northern area Shibuya station), Setagaya-ku (around the Shimo-kitazawa station), Nagoya city (Sakae district), Osaka city (around the Namba station), Fukuoka city (Tenjin district). In order to conduct comparing verification, each experiment area was downtown near the station.

#### 3.2 Accuracy verification and result of experiment

This section shows the result of experiment in each area referred in 3.1. In each area, Table2 is showed experimental number of shops and offices and number of obtained business hours by using this system. In addition, we conducted accuracy verification about shops and offices which can be obtained business hours because of confirming whether obtained business hour is true or not. Whether obtained business hour is true or not is judging from the content of summary (name, address, telephone number etc.) by manual processing. In this study, it is difficult to conduct accuracy verification about all number of cases in each area because the number of shops and offices is very large. Therefore, we extracted samples of shops and offices from each area at random. If the universe was selected at random, the number of sample is calculated by equation1. This number is statistically reliable over 95%.

$$n \geq \frac{N}{\left\{ \left( \frac{e}{Z} \right)^2 \times \frac{N-1}{0.25} \right\} + 1} \quad (1)$$

$n$  : The number of sample

$N$  : The number of the universe

$e$  : Maximum error (In this study, 0.05 is adopted)

$Z$  : Normal distribution point (In this study, 1.96 is adopted)

In this study, number of shops and offices for accuracy verification is determined by equation1 in each area. Table2 shows the result of experiment including result of accuracy verification.

Table2:Result of experiment

Experimental area	The number of experiment	The number of obtained business hours/Obtained percentage	The number of shops and offices for accuracy verification	The number of shops and offices obtained business hours collectly /Correct percentage
Sapporo	2902	2450/84.4%	350	313/89.1%
Sendai	2581	2138/82.3%	350	279/79.7%
Shimo-kitazawa	1140	1000/87.7%	300	274/91.3%
Shinjuku	2202	2034/92.4%	350	293/83.7%
Shibuya	3479	2998/86.2%	350	332/94.9%
Nagoya	1838	1468/79.8%	350	303/86.0%
Osaka(Namba)	2334	2182/93.5%	350	316/90.3%
Fukuoka(Tenjin)	3264	2605/79.8%	350	315/90.0%

### 3.3 Analysis of the experimental result

Table2 shows that Osaka has the highest percentage of all areas in the ratio of shops and offices which could be obtained business hours (90.3%). On the other hand, Nagoya city (Sakae district) and Fukuoka city (Tenjin district) have the lowest percentage of all areas in that ratio (79.8%). In addition, Shibuya have the highest percentage of all areas in the ratio of accuracy (94.9%), on the other hand, Sendai city (western area of Sendai station) has the lowest of all areas.

Table3 shows the number of shops and offices to fail failed to obtain business hours and causes of failure in Sapporo city (southern area of Sapporo station), Shinjuku (Kabuki-cyo), Nagoya city (Sakae district). There are three reasons why our system fails to obtain business hours. First is that our system cannot find the Web page of each shop and office (Cause 1). Second is that our system can find the Web page, however, there are no information about business hour in that page (Cause 2). Last is that our system can find the Web page with business hours, however, business hours in that page are not collect (Cause3).

Most shops and offices corresponded with Cause1 are private shops. According Table3, there are many private shops in Shinjuku (Kabuki-cho). Shops and offices corresponded with Cause2 are mostly private offices. In, addition, all of shops and offices corresponded with Cause3 are shops in the commercial complex, however, business hours of these shops are the same of the commercial complex's business hour. Therefore it is possible to compliment missed business hours of shops corresponded with Cause3.

Table3:Causes of failure to obtain business hours

Experimental area	The number of failed to obtain business hours	Cause of Fail		
		Not found the Web page	Not contained business hour in Web page	Obtain different/wrong business hour
Sapporo	37	15	18	4
Shinjuku	57	25	22	0
Nagoya	47	8	37	2

## 4. VISUALIZATION

### 4.1 Visualization of business hours

We developed the environment to monitor business activities at any time in each shop and office to integrate information of business hours with location information (longitude, latitude). Figure2 shows business activities in Shimo-kitazawa at 6a.m., 10a.m., noon, 11p.m.on weekday. In Figure2, green points are opening shops and offices, on the other hand, black points are closed shops and offices.

In addition, it is possible to show the business activities on Saturday, Sunday, and holidays. Moreover, it is possible to monitor business activities in each business category.

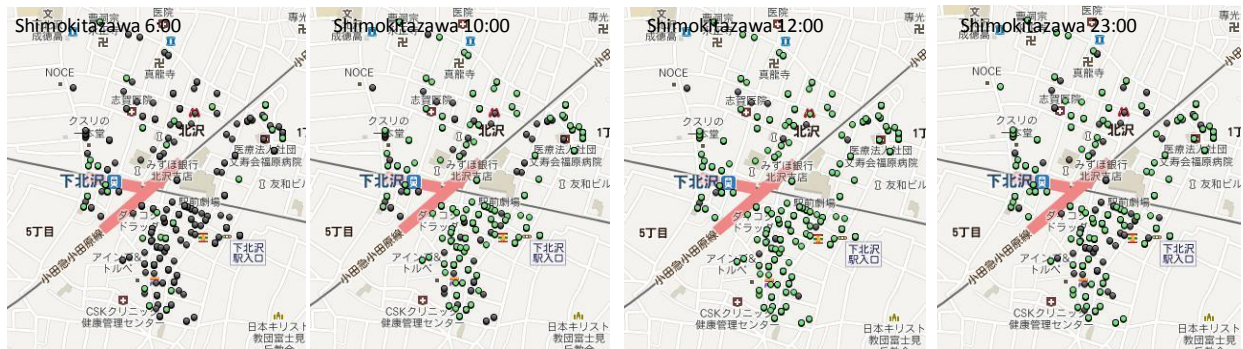


Figure2: Business activities in Shimokitaza area

Figure3 shows business activities in each area which is Sendai city (northern area of Sendai station), Shibuya (northern area of Shibuya station), Nagoya city (Sakae district), Osaka city (around the Namba station) at 0 a.m. and noon. According to Figure3, a lot of shops are opening even at 0 a.m. in Shibuya, however a lot of shops are closed at 0a.m. in Sendai city and Nagoya city comparing with Shibuya.

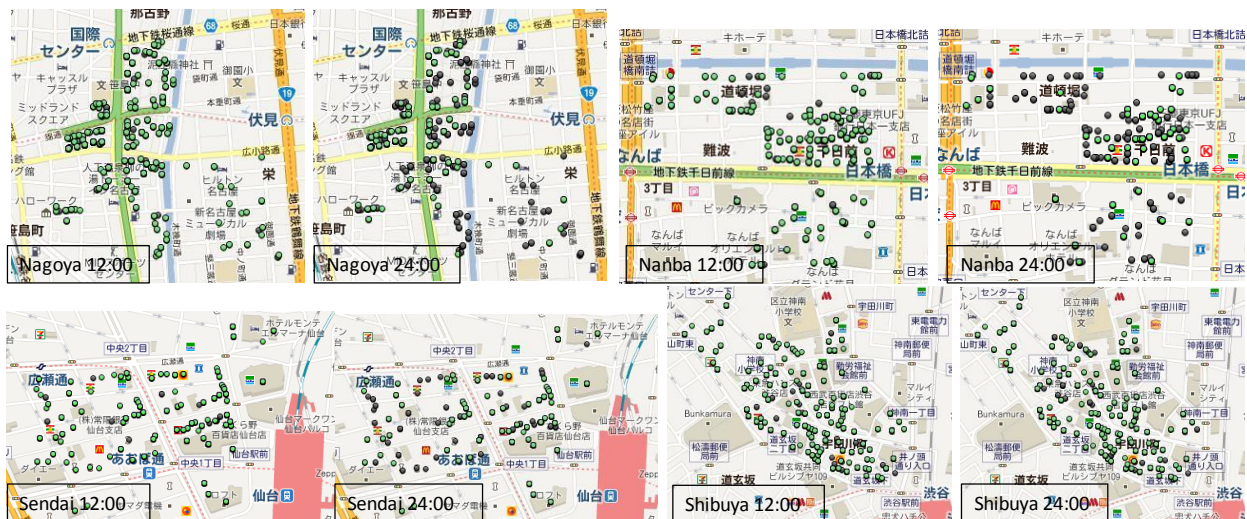


Figure3: Business activities in each area at noon and 0 a.m.

#### 4.2 Integration with fluid population data

Recently, the data which can monitor the place where the peoples are gathering or absent at every hour is getting utilized (it called the “fluid population data” in this study). If the fluid population data and shop and office data with business hours in each shop and office obtained from in this system could be integrated spatially, it may be possible to monitor business activities and areas where people gather every hour in a whole day. Figure4 shows an image to integrate these data. Each mesh shows degree of population in Shimo-kitazawa at 10a.m. by using fluid population data by Agoop Corporation and indicates that red mesh is large population, yellow is middle, and blue is low. It is expected that we can monitor more detailed behaviors of people and shops. In addition, each mesh size in figure4 is 500m square, however if mesh size become smaller, we can analysis more detail in shopping area. Moreover, it may be possible to integrate person’s trajectory information obtained from person trip data or GPS data of cellular phone with information of business hours in this system.

#### 5. CONCLUSION

In this study, we obtained business hours of shops and offices from Web page in some shopping areas of Japan. As a result, it was realized that almost 85% of shops and offices in each area were correctly obtained their business hours from the Web page. In addition, we succeeded to create a method of visualization for open and close of shops and offices. This method visualizes open and closed of shops and offices in daily and hourly changes by using animation. In the future, if more detail information about spatial distribution of people such as information of the fluid population and person trip data is getting utilized, it is expected that these information combined with data obtained

from this system is used as the method of understanding actual condition in shopping areas or researching marketing activities etc.

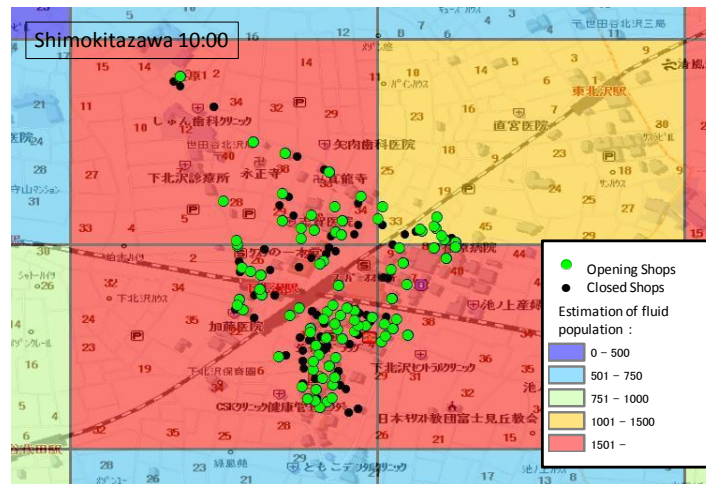


Figure4: Image of integration of shops and offices with fluid population data

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