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WIFI SCANNER FOR OBTAINING PEDESTRIAN DATA

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ABSTRACT

Recently, many technologies to estimate pedestrian data to know about pedestrian travel behavior. Wifi is one of the most useful technologies that can be used in counting pedestrian data. This paper described using of WiFi scanner which carried out seven times circulated the bus. The method used WiFi and GPS are to counting MAC address as raw data from pedestrian smartphone or WiFi devices nearfrom the bus as long as the bus going around the route, generate and processing to be pedestrian data. There are five processes to make pedestrian data from raw data. The purpose of this study is to calculate, obtain and estimate the number of pedestrian data divide circulation number and road segmentation.

Keywords: *WiFi scanner, pedestrian, processing*

A. INTRODUCTION

Pedestrian movement research is always developed for the pedestrian behavior. Technological advances require faster data analysis and faster data retrieval. BIG DATA are requires processing both of these things require technology input in it. In this case, counting of data pedestrian using technology such as Bluetooth, smartphones or WiFi developed. Some researchs have applied Bluetooth sensors and WiFi to know the position of the vehicle and human. However, most of them used considerable cost and a fairly limited time with high maintenance levels. Some methods of count provided high cost and difficult to apply for some further research.

WiFi is one of the most widely used method today for smartphone, laptop, tablet and some other devices that are currently in high demand around the world and very close to human who do a movement. WiFi becomes one of the most useful options for getting movement data. WiFi tracking provides a good approximation to crowd densities and pedestrian flow (Schauer, Werner, & Marcus, 2014) because WiFi has a longer detection range, and so a greater area is covered by each sensor (Dunlap, Li, Henrickson, & Wang, 2016) and WiFi is being detected increasingly every year from portable devices (Nishide & Takada, 2013).

This research will describe and explain WiFi scanner data in Obuse Town, one of tourism place in Japan. This paper method used WiFi scanner as a counter or detector for obtaining pedestrian data. This WiFi Scanner placed on the bus as moving detector. The Novelty this research are moving detector (WiFi Scanner) data, using simply equipment and lack of used energy source, and describe the process of filtering raw WiFi scanner data into pedestrian data based on bus circulation and road classification.

B. LITERATURE REVIEW

Recently, several researchs about pedestrian and how to get pedestrian data using technologies. Research using WiFi and Bluetooth as tools for counting non-motorized travel users was confirmed (Böhm, Ryeng, Haugen, & (AET), 2016; Malinovskiy, Saunier, & Wang, 2012; Nishide & Takada, 2013; Poucin, Farooq, & Patterson, 2016). Significant benefits and challenges of WiFi and Bluetooth data for analysis of spatiotemporal dynamic of people movement and crowd data collection and monitoring (Abedi, Bhaskar, & Chung, 2013) and Combining data from both sensor types (WiFi and Bluetooth) results in useful insights into the pedestrian dynamics (Heuvel, 2016).

In principle method, multiple sensors are used to record the unique Bluetooth or wireless fidelity (WiFi) media access control (MAC) address for each wireless communication device (Dunlap et al., 2016; Petre, 2016). WiFi MAC address can be used to identify a mobile device and it can be used to determine the location of a mobile device when it is combined with received signal strength at multiple locations (Xu et al., 2013). The use of android is also widely used to detect pedestrian movements. Most smartphones, which have WiFi functions, usually sends probe request frame to associate with a WiFi access point (depends on device). A probe request frame includes MAC address to analyze the pedestrian flow (Fukuzaki, Mochizuki, Murao, & Nishio, 2014). MAC address data was traced for make decision about position of pedestrian with probabilistic method consists in a set of candidate lists of destinations, with the probability of each list of destinations being the true one (Hamacher, Heller, & Ruzika, 2011). Another method, a penetration ratio is calculated by combining tracking and counting data from WiFi. This ratio describes the ratio between the number of counts and the number of tracks (Heuvel, 2016). Pedestrian data can be estimated with system to detect anonymous MAC addresses of devices at short distances at fixed locations (Jackson, 2014) and evaluated the performance of a BT-WiFi system to detect anonymous MAC addresses of devices at short distances at fixed locations (Lesani, 2016).

However, some lack or weakness from the last research such as using WiFi devices paired permanently in strategic locations (Lesani, 2016) or Or pairing Bluetooth on poles to detect pedestrian (Malinovskiy et al., 2012; Nishide & Takada, 2013), And the use of software that must be installed on a smartphone where most pedestrians do not install the software (Shlayan, Kurkcu, & Ozbay, 2016).

C. METHOD AND EXPERIMENT

Location of the study in Obuse Town, Kamatakai District Nagano, Prefecture in October 2016. Obuse is one of the top tourist destinations in Japan. The uniqueness of Obuse is chestnut processing, one of historic city, as well as a variety of tourist attractions. In 2016, the town had an estimated population of 10,698 and a population density of 560 persons per km². Its total area was 19.12

square kilometres (7.38 sq mi). The area of present-day Obuse was part of ancient Shinano Province. The modern village of Obuse was created with the establishment of the municipalities system on April 1, 1889. It was elevated to town status on February 1, 1954. Obuse annexed the neighboring village of Tsusumi on November 1st,1954 (Wikipedia, 2008).

1. Field Experiment

Obuse Town has a shuttle bus called Circle Bus "Romango". Romango bus is a Hop On-Hop Off bus. Romango Bus have seven circulation journeys from bus stop number one to bus stop number nine. From morning 9.50 until 17.50. There are 9 bus stops that passed by Romango bus that is as follows; Bus Stop 1: Obuse Highway Oasis Park, Bus Stop 2: Obuse Station, Bus Stop 3: Hokusai Museum, Bus Stop 4: Obuse Museum, Bus Stop 5: Matsumura Town Parking, Bus Stop 6: Obuse Hot Springs, Bus Stop 7: Floral Garden, Bus Stop 8: Jyokoji Temple, Bus Stop 9: Ganshoin Temple. The Obuse town operates two circular buses which connect nine buses stops on every Saturday and Sunday. The circular route is approximately 15 km long and it takes 50 minutes for a round trip. Each bus starts in every 30 minutes from 9 am to 4 pm. There are two types Romango bus no.1 and no.2. There are two types of Bus Romango bus number 1 and 2. Please refe to Figure 1 on below;

Figure 1. "Romango Circle Bus" No.1 and No. 2
Source: field experiment, 2017

The overall route length is 8805 meters. The longest route is from bus stop no.1 to bus stop no. 2 that is 2675.92 meters long. For the shortest route length that is bus stop number 4 to bus stop no.5 with length 304.59 meters. As shown in the following Figure 2. Obuse Town have road classification such as class I (Primary/highway), class II (secondary/city) and class III (tertiaty/local).

Figure 2. Length of Route
Source: SAS Planet and QGIS software

2. WiFi Equipment

This study used WiFi Scanner to acquire data. This Scanner using minicomputer Raspberry Pi 2 B V1.1 (Raspberry, 2015a) as a WiFi scanner, GPS tracking, and micro USB power source to save the data (Raspberry, 2015b). Mobile battery keep WiFi scanner stay on for 12 hours. The result of collecting and analyzing data, it is possible to grasp data, such as spatial flow and distribution of information device users. In this survey, we placed WiFi scanner as Figure 3 in the bus.

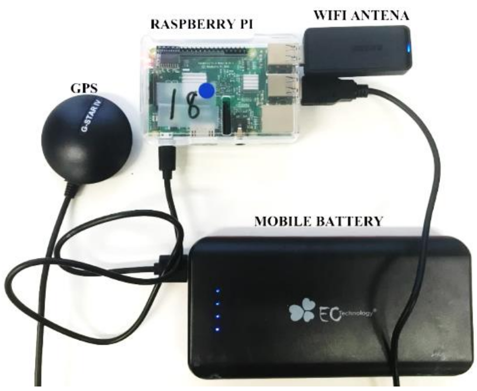

Figure 3. WiFi Scanner, GPS and Mobile Battery
Source: Transport Laboratory TUS Asset

3. Experiment

WiFi scanner put on the board of a bus and manually counted number of boarding and descending passengers at each bus stop (Figure 4). We estimated the number of non-passengers each section between bus stops. A scanner device mounted on the shuttle bus from 09.50 - 17.50. The installation of the tool is not complicated, put in a place that does not interfere with bus drivers and bus passengers. The WiFi tool is installed on buses no.1 installed near the left window and no.2 placed above the driver.

Figure 4. Installing WiFi Scanner on Bus No.1 and Bus No.2
Source: field experiment, 2017

It can detect people who have those MAC Address devices such as smartphones and tablets within 300 meters radius approximately (Figure 5). This scanner records unique identification code of detected mobile devices. We analyzed the log files to obtain the duration of detection for each id code non-passengers like pedestrians and drivers outside of the bus. Several rules of discrimination were applied to cleaning the log data.

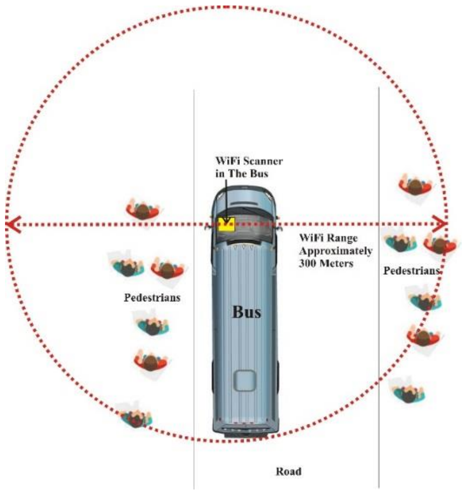

Figure 5. WiFi Scanner Approximately Range
Source: analysis, 2017

D. DATA PROCESSING AND RESULT

1. Data Processing

The result data are GPS log and WiFi log data as raw data. GPS log data contain time, latitude and longitude data. WiFi log data contain data of time and MAC ID (Address). MAC or Media Access Control is the unique ID or address assigned to each network device to be used as an identification code. The data still a raw data that needs to be re-analyzed or re-filtered to be good data for interpretation (Figure 6);

- The first step is combine raw data between WiFi log and GPS log to get WiFi data containing latitude and longitude. It needs to show the importance of MAC data and latitude and longitude location data with the existing MAC data in WIFI data so that the WIFI data become the primary data. Keywords to combine data is “Time” data. Combine the data form into a data frame.
- The second step is step is to unify the same data (MAC ID, Latitude, Longitude and Time) to get unique ID. The result data combination assigned new attribute as “1” for each line, to indicate that one line is one data. Once created the attribute, the data analyzed looping (pivot) to find out how much data are repeated.
- The third step is to identify the MAC Address for MAC IDs appearing between 1-3 times with different locations (moving) assigned as pedestrian.
- The fourth step is to combine the data from both buses (no.1 and no.2). For each bus, there are seven circulations, so after this step, there are 14 circulations in the data set. The data was coded with circulation numbers (CNs) 1-4. The Pedestrian data is then divided again by time into CN1–6 as the AM (before noon) pedestrian data and CN7–14 as the PM (after noon) pedestrian data to facilitate a time-based analysis.

- The fifth step is to divide 14 circulation number (CN) into 10 segment. This Segment based on road classification (class I, class II and class III) to give more detail pedestrian data every road (Figure 6).
- All of processing using Anaconda 1.5 Jupiter Notebook 5.0, Python 2.7, MS. Excel 2010 and QGIS software. Total lines of raw data were 71630 and the raw data were processed into 300-500 lines of data for each circulation. Filtering processing please refer to Figure 7 below.

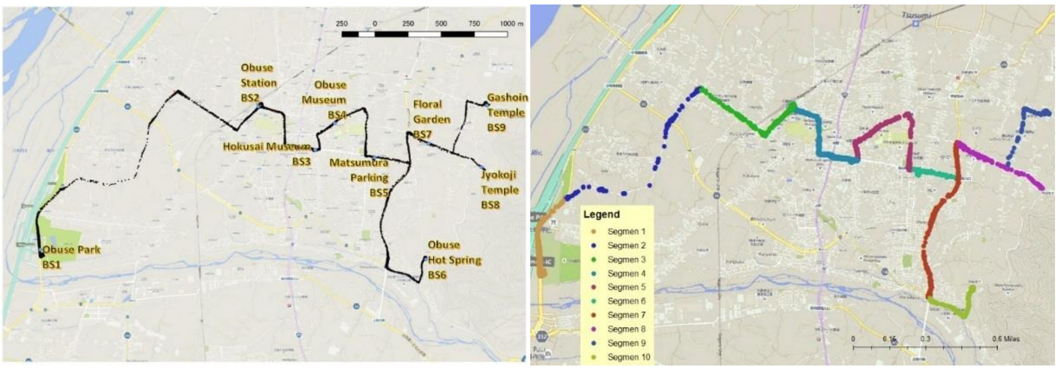

Figure 6. Mac ID WiFi Data and Segmentation based on Road Clasification
Source: Field Experiment analysis in QGIS

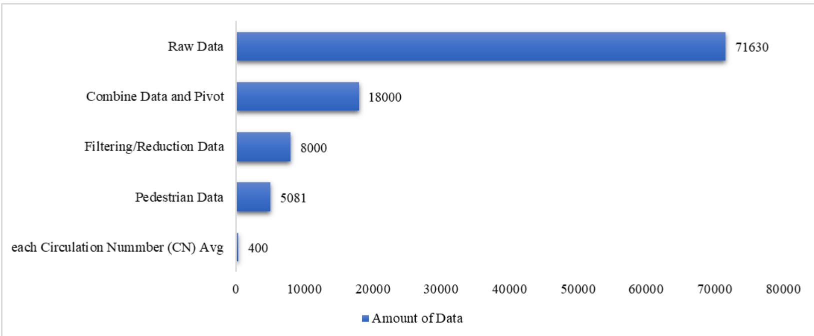

Figure 7. Filtering from WiFi Raw Data to Pedestrian Data
Source: field experiment, 2017

2. Result

Based on the results, the raw data had been processed into pedestrian data, as for Figure 8. Data in segment 1 is very high, because segment 1 is the tourism entrance area, and is an obuse park in the morning is very high with visitors. The trend of data is quite low in segments 6, 9 and 10. Low pedestrian around this location due to the low enough tourist attractions or tourism destination.

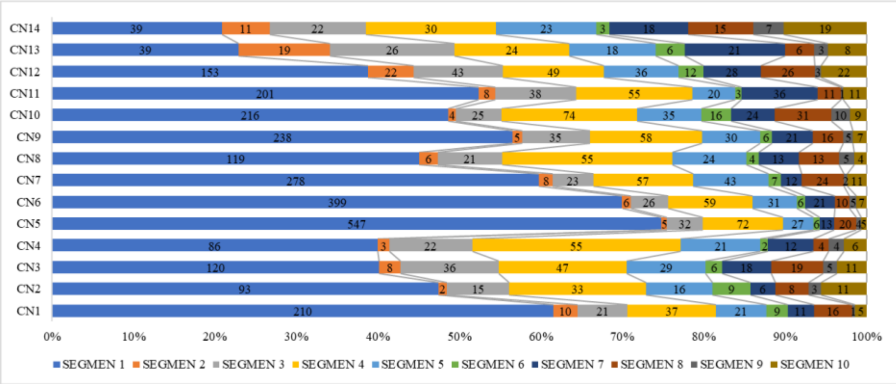

Figure 8. Estimate Pedestrian Data
Source: analysis, 2017

Further investigated by time, the pedestrian data was divided by circulation number (CN) 1-6 is before noon and CN 7-14 is after noon. The trend of data patterns between segments shows the same pattern. Differences in data between segments 3,4,5,7 and 8. The higher data afternoon tendency due to the number of pedestrians who travel to tourism sites or around the obuse area during after noon time. For more details please refer to Figure 9 below;

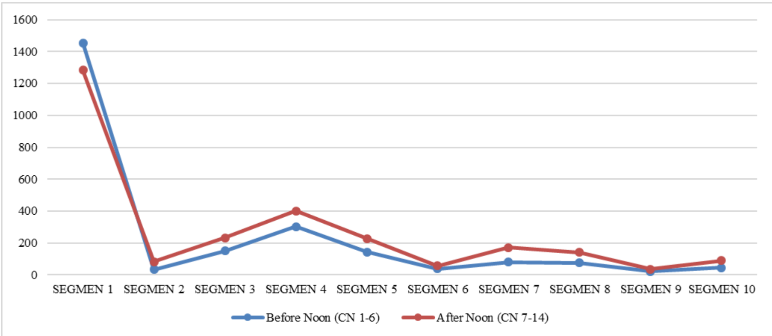

Figure 9. Estimate Pedestrian Data Based on Time
Source: analysis, 2017

E. CONCLUSION AND FUTURE WORK

The results of this paper obtained with the use of WiFi scanner on data collecting and process pedestrian data are:

- Pedestrian data can be processed by several methods to generate estimate data.
- Distance range of WiFi scanner as far as 300 meters is ideal distance for retrieving MAC address data.
- WiFi scanner data retrieval is powerfull for long time data retrieval.
- Composition analysis and data processing will be suitable for analyzing BIG DATA in the future.

Impact for spatial planning are prediction of the pedestrian distribution movements to the interesting locations or tourism spots in Obuse town as well as policy making locations for the development of pedestrian paths, the development of trade spots and the development of supporting the main object area.

The need for future work are to make processing travel data of bus passenger data, non-passenger data (vehicle and building) and make relation model between WiFi data, street and land use.

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