Journal of Industrial Information Technology and Application Vol.4 No.2
ISSN(Online): 2586-0852

Development of Shape Measurement Tablet Application to Create Transit Data for Regional Public Transportation

Chinasa Sueyoshi [1,*)], Hideya Takagi [2)], Kentaro Inenaga [1)]
[1)] Faculty of Science and Engineering. Kyushu Sangyo University, Fukuoka, Japan
[2)] Graduate of Information Science. Kyushu Sangyo University, Fukuoka, Japan

Abstract. Domestic regional public transportation is positioned as one of the foundations of regional revitalization in Japan. However, contrary to its importance, it has not been promoted. According to the Japan Bus Association, the number of bus passengers in Japan has declined, peaking at about 10.1 billion in 1968 and 4.3 billion in 2015. Although municipalities which manages regional public transportation have made various efforts to address the lack of regional public transportation services that have arisen due to the abolition of private fixed-route transportation, most municipalities manage "community bus" services to improve the welfare of their residents. In regional public transportation, operating income decreases as the number of users decreases, leading to decline in services such as the reduction or abolition of routes. On the other hands the number of transportation company lines is decreasing throughout the country, the introduction of community buses is increasing. One of the problems in regional public transportation is that there is no fundamental transportation data available for making route searches on the Internet. Our laboratory team developed a practical solution for regional public transportation services provided by the service management support systems of municipalities in Japan. We converted fundamental data on regional public transportation to the feed of the General Transit Feed Specification-Japan (GTFS-JP), which is based on Google's GTFS and was formulated by the ministry of land in Japan. The GTFS/GTFS-JP defines a common format for public transportation schedules and associated geographic information. In this study, we created a GTFS/GTFS-JP feed required for publish on google maps route search services, and have developed a route shape measurement application SUE to make it easier to create stops and shape files of GTFS/GTFS-JP feed, and evaluate the SUE application.

Keywords; Regional Public Transportation; Transit Data; Route Shape Measurement

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[*] Corresponding author: sueyoshi@is.kyusan-u.ac.jp
Received: Nov 8, 2019; Accepted: Dec 18, 2019; Published: Sep 30, 2020

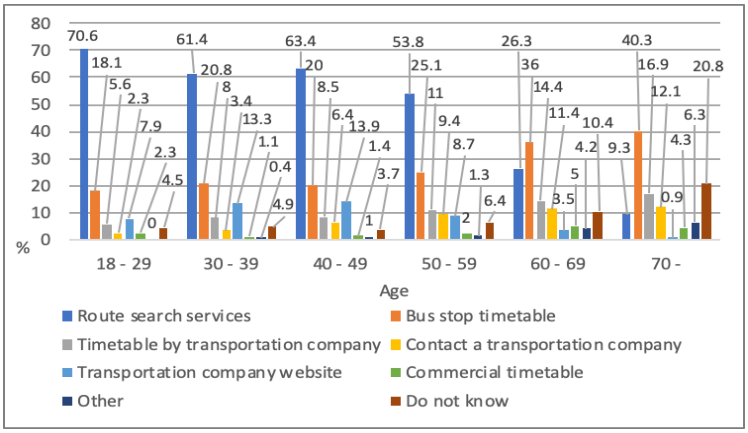


Fig 1. How to check usage method / route in the case of route bus (priority graph created in source data [4]).

1. Introduction

In recent years, the number of users in domestic regional public transportation has decreased in Japan due to population decline, declining birthrate and aging, and motorization (car society). Operating revenue decreases as the number of users decreases, leading to a decline in services such as route reduction or abolition. According to the Japan Bus Association, the number of passenger buses in Japan has declined, peaking at about 10.1 billion in 1968 and 4.3 billion in 2015[1]. While the number of domestic regional public transportation lines is decreasing throughout the country, the introduction of "community bus" is progressing. A community bus is a bus that is planned and operated mainly by local governments in order to eliminate traffic vacant areas and inconvenient areas due to the abolition of routes. However, contrary to its importance, public transport has not been promoted. Although municipalities have made various efforts to address the lack of regional public transportation services that have arisen due to the abolition of private fixed-route transportation, most municipalities manage community bus services to improve the welfare of their residents [2,3].

One of the problems in regional public transportation is that there is no fundamental transportation data available for making route searches on the Internet. For people who are unfamiliar with a region, such as inbound tourists, the lack of route search capability for regional transportation means that no transportation service is available. Figure 1 shows part of the results of a public-opinion survey on public transport [4] by the Cabinet Office (Government of Japan). The data show that route search services are most often

used for public transport checks, route type, high-speed bus, short-to-long-distance railway, etc. For such reports, immediate response by the route-search service regarding regional public transport is desired. We think it is necessary people who do not know the region, it means that transportation does not exist if no regional transportation is found by such a service on the Internet. Solving this problem could revitalize not only regional public transportation services but the region itself.

Our laboratory team developed a practical solution for regional public transportation services provided by the service management support systems of municipalities in Japan [5,6]. We converted fundamental data on regional public transportation to the feed of the (General Transit Feed Specification-Japan (GTFS-JP), which is based on Google's GTFS and was formulated by the ministry of land in Japan [7]. The GTFS defines a common format for public transportation schedules and associated geographic information [8]. In this study, we created a GTFS feed required for publish on google maps route search services, and a route shape measurement application SUE has been developed to make it easier to create GTFS feed stops and shape files. Figure 2 shows the GTFS/GTFS-JP flow from public facilities to google and other domestic-content providers. There are municipalities that are managed by paper style such as time schedules so that digitizing the basic data enables easy route search and is expected to be used for the analysis of various operation statuses. This digitalization is a symbol of the promotion in ICT that has tackled regional public transportation in Japan, and it is closely related to the future of transportation such as Mobility as a Service (MaaS), which is one of the latest trending important keywords related to transportation. Chapter 2 introduces building and publishing fundamental data. Chapter 3 introduces the developed a route shape measurement application SUE. Chapter 4 conducts SUE application's demonstration experiments and evaluations, and Chapter 5 is conclusion.

2. Building and Publishing Fundamental Data

Table 1 shows a GTFS configuration file lists. The difficulty and large amount of work required to explain these expertise is an obstacle to the creation of GTFS that requires different ICT support addresses.

TABLE I. GTFS CONFIGRATION FILES

File name	Definition (Description)
agency.txt	One or more transportation agencies that provide data
stops.txt	Boarding point

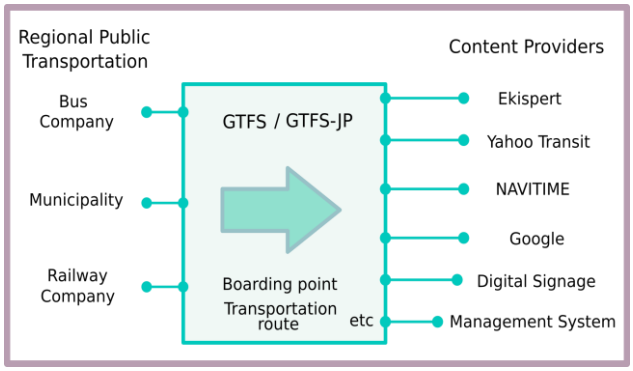


Fig 2. GTFS/GTFS-JP flow from public facilities to Google and other domestic-content providers.

File name	Definition (Description)
routes.txt	Transportation route
trips.txt	Itinerary for each route
stop_times.txt	Arrival and departure times at each stop for each itinerary
fare_attributes.txt	Route fee information
shapes.txt	Rules for drawing a route line

The Ministry of Land, Infrastructure, Transport and Tourism, the Kyushu District Transport Bureau Traffic Planning Division, and the Fukuoka Prefecture Transportation Division, Information Policy Division have promoted the building and publishing of GTFS-JP feeds containing transit-site data on the Internet. We have promoted our building and publishing GTFS-JP transit data feeds as a catalog site on the Internet and have provided Google and domestic content providers (such as Ekispert [9], Yahoo Transit [10] and NAVITIME [11]) with the feeds.

One example of the use of GTFS for domestic regional public transportation is OpenTrans.it [12] built by Masaki Ito and others at the University of Tokyo for public transportation data feed in Shimada City and Yaizu City, Shizuoka Prefecture. We think that information regional public transportation to content providers will be more promoted than ever if it has been building about on fundamental GTFS/GTFS-JP as shown in Figure 2. As a result, regional public transportation and content providers can be easy to share data for route searches, so that it contributes to improving convenience for regional public transportation users.

Our laboratory team developed a practical solution for regional public transportation services provided by the service management support systems of municipalities in Japan [13,14]. Figure 3 shows a schematic outline of the system. All data is managed by ACE

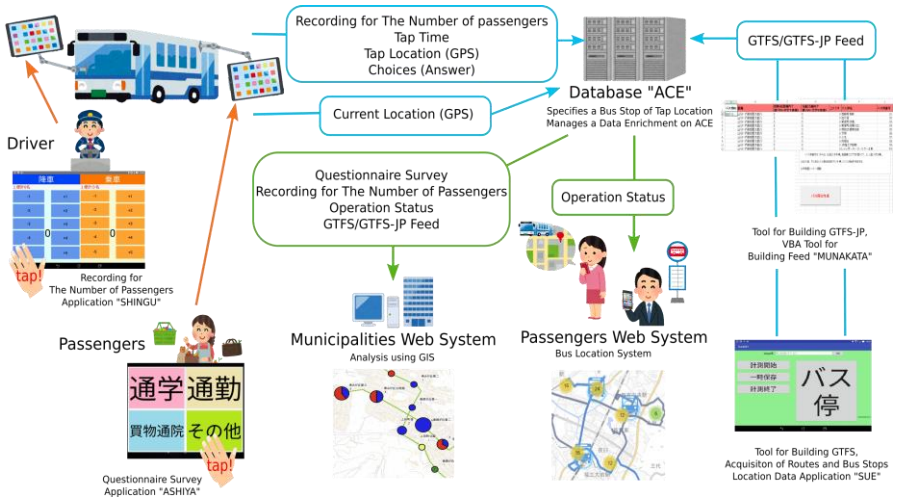


Fig 3. Support system for public transportation management including the shape measure applications SUE.

that has GTFS, GTFS-JP. We assign two tablets to each bus, one of which uses the application SHINGU to record the number of bus passengers and the second provides a questionnaire survey for passengers using the application ASHIYA. We developed a tool for building the GTFS, the application SUE used to acquire routes and bus-stop location data, and a VBA tool for building the GTFS-JP and feeding the data to Munakata City. The data generated by these tools are stored in the ACE database, which maintains raw tap data and performs data enrichment. The results enable us to visualize a bus stop with many passengers. Moreover, the bus location system uses the operation status available in ACE. This bus location system is a convenient tool for bus passengers because it contains information such as how many buses have passed through a bus stop.

3. Development a Shape Measure Application

Figure 4 shows the screen of the developed a route shape measurement application SUE. In [Shape Name], enter the name of the route for measuring the shape and the destination name. The inputted name is saved as the CSV file after the measurement is completed. Specifically, two CSV files are generated; Shp.csv and <shape_name>.csv. By tapping [Submit Button], the shape name is determined. By tapping [Start Measurement Button], acquisition of position information starts every 12 seconds at 4km/s. The location information is displayed in blue characters on the left of the screen. Tap Start to start the measurement, and press Cancel to do nothing. By tapping [Save

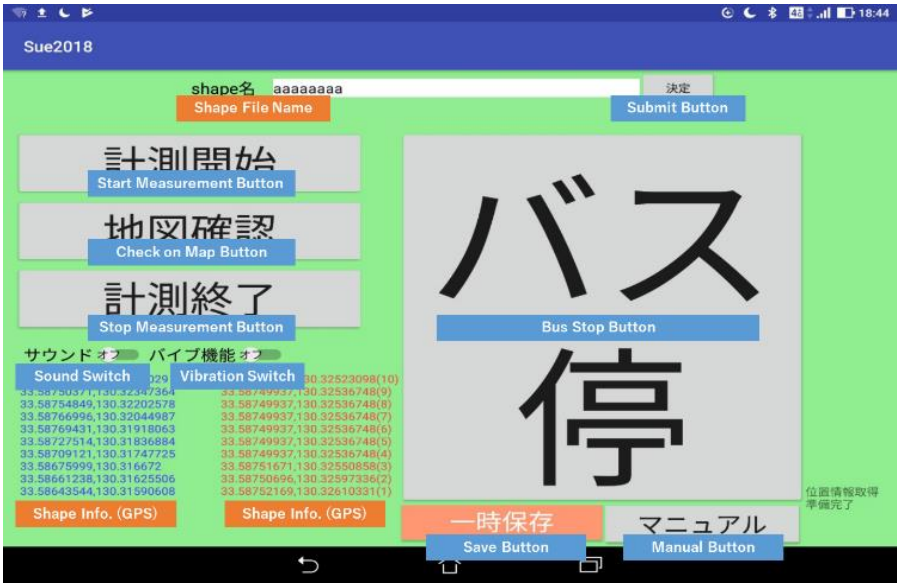
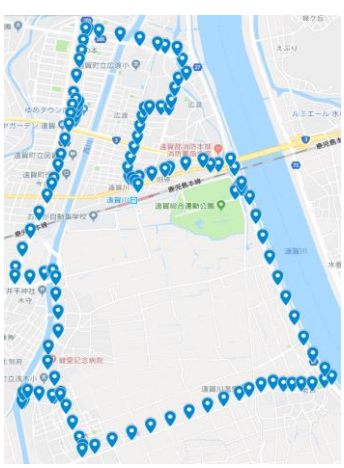


Fig 4. Screen of application SUE.

Button], the location information data up to when the button is tapped can be stored in the CSV file. The blue and red characters on left bottom side log are resets and writing starts from the first line. Tap [Bus Stop Button] to get the location information of the bus stop. The location information is displayed in red characters on the right bottom side log. Tap [Stop Measurement Button] to display a confirmation pop-up. Tap [End] to end location information acquisition and turn off the GPS function. If you press cancel to store the data acquired at the same time in the CSV file with the file name determined by the shape name, the acquisition of the location information is continued. By tapping [Check Maps Button], you can transition to Google Maps and visualize the location information being acquired. You can also use the bus stop button and the measurement end button on this Google Maps screen. The display as soon as the shape measure. Tap



(a) Travel route on Google Maps

(b) Bus stop on Google Maps

Fig 6. Example of route and bus stop data from SUE.

[Manual Button] to display the SUE operation manual. It can move to the next page by sliding the screen.

We investigated the community bus (Figure 5) route in Onga Town in Fukuoka prefecture use by application SUE. The bus stop information can be acquired by a tap. The acquired data is saved in the terminal as a CSV file after measurement. Figure. 6 (a) is an example of a route search in which the information acquired from a CSV file is displayed on google maps, and Figure. 6 (b) is an example of a bus stop.

Fig 5. Onga Town community bus.

A. Create GTFS feeds and post on Google Maps

The application SUE developed on a total of 27 routes for contact buses and community buses in Munakata City, Fukuoka Prefecture, Japan was created, and a GTFS feed was created. We convert information on routes, bus stops, timetables, and route

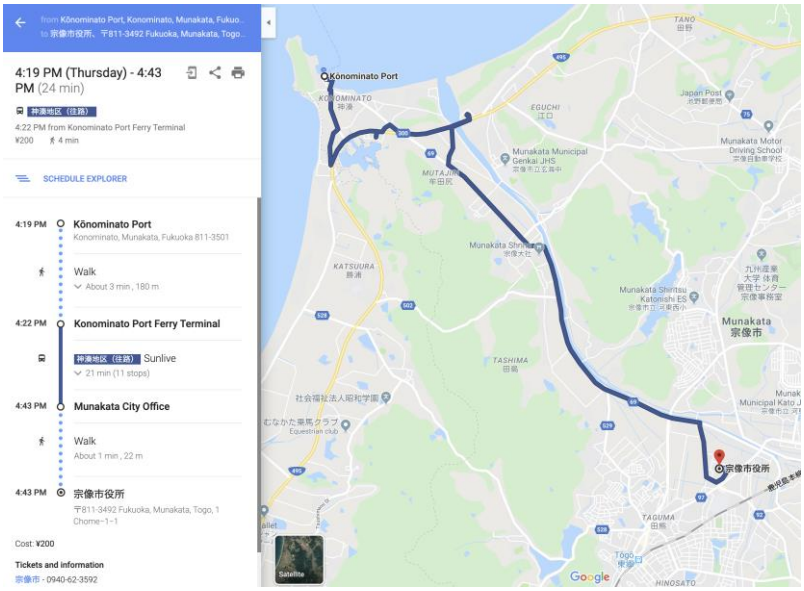


Fig 7. Munakata City community bus on Google Maps route guidance.

maps to GTFS format and provides them to Google as feeds for posting on Google Maps. In order to publish on Google Maps, the following process must be performed.

1) Check if the feed data conforms to the specification of this document

a) Use the feedvalidator tool [9]. Drag and drop the GTFS file into the appear window, and check it. If there are no error items as a result of the verification test, the operation is complete.se the feedvalidator tool [9]. Drag and drop the GTFS file you want to check into the window that appears. If there are no error items as a result of the verification test, the operation is complet.

2) Check if the feed data conforms to the specification of this document

a) Use the feedvalidator tool [9]. Drag and drop the GTFS file into the appear window, and check it. If there are no error items as a result of the verification test, the operation is complete.se the feedvalidator tool [9]. Drag and drop the GTFS file you want to check into the window that appears. If there are no error items as a result of the verification test, the operation is complet.

3) Check to the feed data is displayed on the map

a) Use the schedule_viewer application [10]. It is a basic tool for test, not a data preview tool that will how to show in other applications. Check the route and timetable, and confirm that the information specified in the data feed is displayed correctly. Start schedule_viewer.exe and drag and drop the GTFS file into the appear window. Then a

URL will appear, and enter the URL in a browser, a confirmation page will be displayed. This confirms the route and timetable, and if the information specified in the data feed is displayed correctly, it is complete.

4) Contact Google and request a quality review

a) Get a transit partner dashboard account to manage the google feeds. Upload and verify the GTFS feed created on the transit partner dashboard. Then, a quality inspection is performed on the google side, and when it passes the examination, it becomes publicly available (Figure 7).

We confirmed that the contact information on the google maps route guide and Munakata City community bus information was posted. As a result, people outside the area who do not know that the contact bus and Munakata City community bus are running, and foreigners can also recognize the contact bus and Munakata City community bus. We think that it leads to improvement of convenience of community bus user.

Fig 8. Location information extracted from CSV file.

Fig 9. Location information by check maps function.

B. Verification of measurement accuracy

Get on the Shingu Town community bus and check with subjects who have never used application SUE if the location information actually acquired and the shape (pin) displayed on google maps are synchronized. The confirmation method is to take a screen shot of the location information on google maps after the measurement. Then, the saved CSV file is transferred to a PC and extracted on google maps. Compare both of them, and evaluate two points: work to confirm that it is correctly synchronized, and whether it can be used by those who have never used the application SUE.

Figure 8 shows the result of the location information extracted from google maps by sending the shape CSV file acquired by application SUE. Figure 9 is a screen shot of information obtained by visualizing the location information acquired by application SUE using the map confirmation function. Comparing the two figures, it can be seen

that there is no difference between the location information of the CSV file and the location information obtained by checking the map, and that the location information can be obtained accurately and displayed on the application screen. Also, subjects who used application SUE for the first time were able to use without problems.

The application SUE adding a map confirmation function, it is now possible to detect mistakes in the measurement route in advance, since it is possible to confirm on the PC after measurement and to check the location information in real time. In addition, the problem that it became difficult for the user who used application SUE for the first time to add a function became easy to understand by adding an operation manual in the application. However, the map check function is convenient, however because using google maps, it cannot use the map check function if it exceeds the Google maps API usage limit, and it cannot use the bus stop button while checking the map. Future tasks include implementing a map confirmation function that has been changed from google maps to the geographical survey institute map, or a function that can be used with a pin of a different color that can use the bus stop button during map confirmation. This is considered to further improve convenience.

4. Conclusion

In this paper, we focused on regional public transport in Japan and aims to improve the efficiency of managing community buses operated by local governments. It is difficult for the local government to manage the community bus operation information alone because it requires a lot of work to register it on the google maps. Therefore, we have developed a route shape measurement application SUE that automatically measures the location information and automatically generates the files necessary for registration in google maps. The application was evaluated and no problems were found. Our future work is to create a web application version that can be used regardless of device and OS.

Acknowledgment

In this research, I would like to express my sincere gratitude to Sue Town, Munakata City, Onga Town and Shingu Town in Fukuoka Prefecture. We also express appreciation to Fukuoka Prefecture, Kyushu District Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism, and all the researchers of our laboratory for

supporting community bus service management. This research was supported by JSPS KAKENHI Grant Number JP 17K00472 and Kyushu Sangyo University KSU Research Funds Number K060142.

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