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# BringUBus: Matching Buses to Passengers with Lower Mobility

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**Abstract**

Nowadays, some citizens of Taiwan are still suffering the inconvenience when taking public transportation. The research has shown that the average distance between passengers and bus is 10 to 15 meters in approximation caused by imprecision of bus stopping, therefore the scenery which passengers with lower mobility unable to get on bus smoothly is not uncommon.

As one of the potential solutions to the above issue, our research team has designed a new system named "BringUBus", which generates a designated parking spot for drivers to respect, thus being notified to stop right in front of the passengers with lower mobility. Eventually improves the bus-taking experience of those in need and promotes the completeness of accessible environment.

**Author Keywords**

Lower Mobility; Physically Challenged; Passengers; Bus Stop; Public Transportation; Electronic Ticket; Reservation System; Priority Zone; App; Matchmaking

**ACM Classification Keywords**

H.5.m. Miscellaneous.

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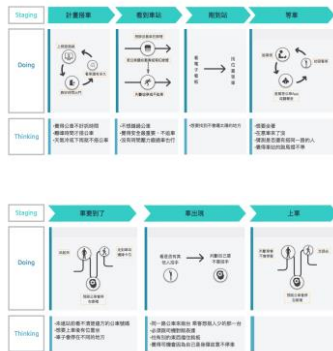


Figure 1 and Figure 2: The journey map – process of taking bus.

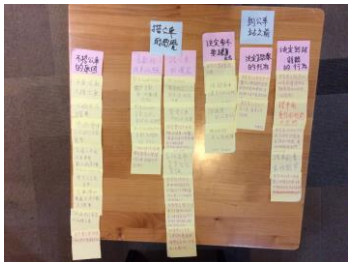


Figure 3: The affinity diagram to identify key properties.

## Introduction

The statistics provided by Ministry of Transportation and Communications reveals the fact where almost three million passengers have taken bus in average per day, in the metropolitan area of Taiwan [1]. From here we can conclude that bus ranked as one of the prior preferences in choosing of transportation for short-distance traveling, giving credit to both low-fare and accessibility.

However there are still many rooms remain for being improved, typically when the passenger has lower mobility, or those who moves slower. The primary issue is that due to the population, the bus stops sometime are overcrowded and being difficult for passengers to make a gesture telling the bus driver to stop, since the gesture will sometimes not be enough obvious to the bus driver. What makes the situation worse is the occasion when many buses arrive all at once, make it even harder for bus driver to recognize the gesture.

The heavy traffic worse the problem as well. The design of the bus stop in some mega-terminals are often extended into a long shape, therefore the bus coming in front is very likely to block the sight for the bus drivers in the back, causing undesired ignorance of the gestures.

As the result, passengers are having problems delivering stopping message to the bus driver, and even if the bus stops, the distance between bus door and the passenger will become an obstacle for those with lower mobility.

## Preliminary Research and Survey

For identifying the passengers in need, the ethnographic inspired research methods including contextual inquiry and field observations are conducted, with the target research field set as metropolitan area of Taipei, the biggest in the country, followed by the considered factors namely bus stopping position, traffic flow, street patterns, route plan, and the behavior of pending awaiting passengers. The result of analyzation of passengers in need fall into the categories of physically challenged person, injured patient, elderly person, mother with her child etc., with their need double confirmed by personal interviews by asking their actual bus-taking experience and following difficulties, response strategy and the emotion caused.

### Strategies in Mind

The affinity diagram for analyzing results from field studies have been done after the research (Figure 3). Our research team discovers a variety of actions from different individuals during bus-taking, which has been resorting into chronological order divided as 7 parts (Figure 1 and Figure 2). Thus the conclusion of which the most troublesome moments happened in between parts of "a bus showing up" and "getting on a bus" has been made, according to anxiety from concerning failure of sending stopping signal to driver caused by hardly noticeable gesture, or the uncertainty of the final bus stopping position, where the passengers are reluctantly forced to guess where they shall stand for boarding.

### Who's in Need?

The main body of interview is composed by an experiment with 8 subjects and materials of 12 cards contain the written sentence denoting 12 different key attributes, or the actions in response to the approaching of bus, respectively. By picking the cards based on the experience of subjects, the shown result can therefore reveal the fact which the decision of those with lower mobility (e.g., elderlies, mother with child, student with injured leg) have picked the cards in a common pattern. The result further indicates the general problem which more effort is required for the above mentioned group of people. In some extreme cases, the action of giving up the taking of bus also appears to be possible.

### Insight from the Interview

After the interview, our research team has identified two significant issues from bus-taking experience of general public. Firstly is the difficulty of making gesture to inform the bus to stop, since it is common to have multiple buses approaching simultaneously to the bus stop, therefore blocking the sight for the bus driver in the back. Secondly, the passengers are forced to make assumption of the possible stopping position of the bus, which may appear on any random place beside the long parking area, otherwise the bus may leave soon after picking up passengers successfully standing right next to the bus door.

As one of the potential solutions, the concept of matching the stopping position of bus with those in need (i.e., the ones with lower mobility) has emerged.

### Final Design: "BringUBus" system

The proposal from our research team is composed of three key features hereby listed:

#### Priority Zone

A rectangular area derived from the bus parking area enclosed by yellow colored lines (Figure 5), located in the foremost part of the parking area.

The average length of bus parking area is estimated to fall into the range from 15 to 20 meters, which may possibly become the required distance for passengers moving to the bus door. Showing from the diagram, the implementation of setting the priority zone is able to decrease the moving distance into less than 5 meters. The bus driver is required to stop right in the priority zone upon receiving request, thus by waiting right beside the priority zone, the passengers with lower mobility is possible not to be left by bus ever again.

#### Booking App

The app on mobile device, named "BringUBus", functions as the medium, or communication tool, for passenger with lower mobility and bus driver. Once the passenger registered a one-time electronic ticket with his personal account, the bus driver will be informed to stop at the priority zone of the designated bus stop. For passenger's reference, the estimated remaining waiting time will also appear on screen (Figure 6).

The personal account of each individual requires linking with at least one smart card, in this case Easycard of Taiwan, during registration. Therefore after the successful boarding, the system is able to automatically cancel the request for the afterwards upcoming buses,



Figure4: The behavioral and demographic variables for our targets.

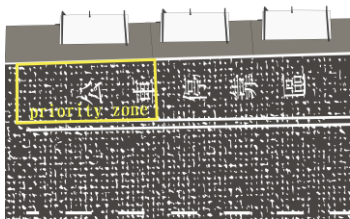


Figure 5: In this image, there are three bus stops and a parking area marked in white lines. The priority zone we designed are marked in yellow lines.

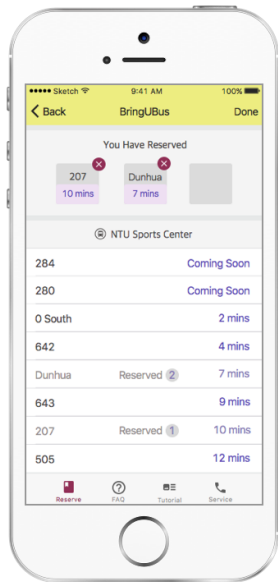


Figure 6: The Booking App. Showing the arriving time of each bus at NTU Sports Center. Users can click them to reserve buses.



Figure 7: The bus driver's view. There are boarding bells in the red circle.

by tracking the data through smart card usage database from Easycard Company. Giving award to advance informative technology, the immediate cancellation can prevent the bus driver of second bus from meaningless waiting when there are two buses coming in at once.

Also, passengers are required to abort their electronic ticket reservation if the decision of not taking the recent bus has been made, to avoid unnecessary confusion for bus driver. Those who violate this rule shall have their account be suspended.

### Boarding Light

There are two places where new indicators need to be installed, both on the bus and the bus stop. On top of dashboard in front of bus driver, the traffic signal-like device emits red light upon receiving request for the bus to stop at the priority zone of next bus stop (Figure 7). Several buses might receive the request signals altogether, since there might be many other passengers need to board, but the driver from the first bus cannot ensure that all the passengers in need can be picked up at once. Only when all the present requests are completed will the following buses stop receiving request-to-stop-at-priority-zone-signals when they left the previous bus stop.

Meanwhile, the new icon of heart appears on the upcoming bus information board at the bus stop, beside of the corresponded bus line, to visually notify passengers that which of the upcoming bus has been put on request to stop at priority zone by one of the passengers. Both light dim and go disappeared after

the passenger have successfully board the bus, sensed by the using of their smart card for boarding.

### Other Concerns

Beyond the above features, there will be a potential problem in which several upcoming buses for different route have received the request, which may result in traffic congestion during rush hour. The problem is unfortunately inevitable, therefore it is necessary for bus drivers to line up and make those reserved buses stop in the priority zone, while the others stop at the other end of parking area. By doing this the bus on the back can gain buffering space for acceleration when the reserved bus is still picking up passengers, thus maintain the maximum of smoothness for traffic.

### Service Scenario

This section will demonstrate what will happen in real life situation (Figure 9).

A mother carrying her baby walks on the pedestrian path, heading towards the nearby bus stop, in a slow pace. Since here locates in the downtown of the city, it is not uncommon to have numbers of passengers waiting at the bus stop and make it over-crowded. Therefore once they are at the bus stop, the mother decides to make a request to make the bus stops in the priority zone, due to the unwillingness to miss the bus if it stops in the different place to where she stands, and cannot make it to have herself and her baby moved to where the bus stops in such a minimal of time, plus the crowdedness also worsen the situation. The mother open the app "BringUBus" on her phone, and successfully confirm the request by receiving the



Figure 8: The electronic board at the bus stop will light up a heart sign next to the bus that is reserved.

electronic ticket, with the clear information of estimated time, bus line number and destination shown on the screen altogether.

In less than few seconds, the BringUBus system has received the request, and will make the indicating light starts emitting red color on top of the dashboard, as far as the bus has left the previous bus stop where the request was made. The bus driver then aware that he need to stop the bus in the priority zone for the next bus stop. Also a heart icon will appear on the information board at the bus stop right beyond the bus information to inform the other passengers that this bus has been requested and will stop in the priority zone.

If anything in urgent happened unexpectedly right now, for example the child is crying for wanting to have the diaper changed, the mother is asked to cancel her request immediately otherwise she will have her account suspended. Once the request has been canceled, both the indicating light on the bus and the heart icon on the information board at the bus stop will dim and disappear, return to their original state.

After solving the current issue, the mother comes back with her baby some time later, and makes the request again. The whole scenario repeats and another bus comes. The mother boards the bus, using her smart card to pay the bus fee. At this moment the purchase record will be sent to BringUBus system from smart card company, and automatically change the status of corresponding request to "complete", thus dim out all the lights and icons showing that there is no need to strictly stop in the priority zone for the following buses.

## Evaluation

The proposal has undergone several reviews including the expert examination and persona testing. Our research team proposed the entire project to 6 designers from iNSIGHT, a researching canter funded by National Taiwan University which has major focus on the field of user experience and service design, being committed to the industrial cooperation, as an expert review [2]. Our research team demonstrated the prototype together with visual aids to present the idea of our concept. Some positive feedbacks have been received, mainly for the elegant app interface design and the complete structure of the system.

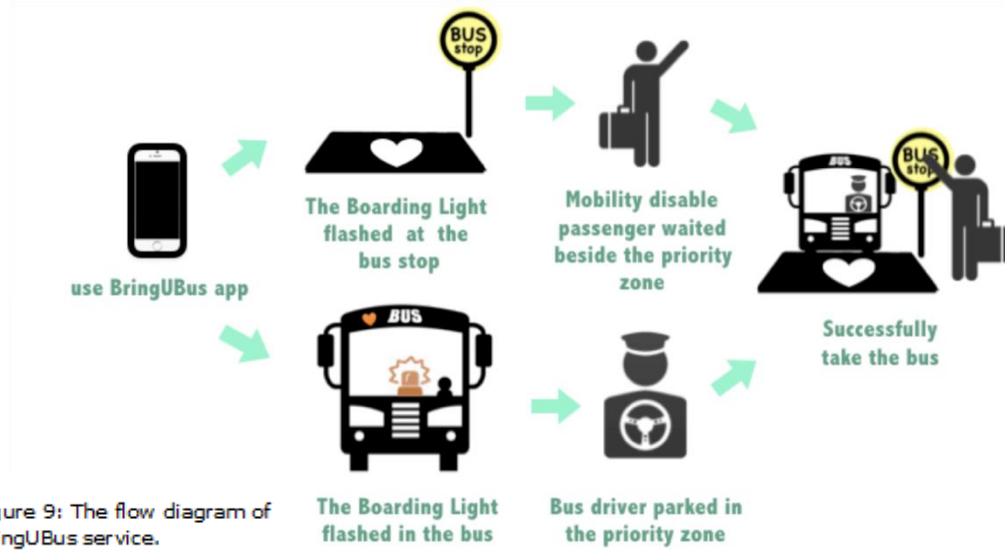


Figure 9: The flow diagram of BringUBus service.



Figure 10: Doing usability testing with our user, a 35-year-old mom who has a 2-year-old child.



Figure 11: The paper model we made to illustrate the scenarios at a bus stop.

The answer for them is actually simple. To avoid the abuse of the system, those passengers without necessity, i.e., which falls out of the category of “passengers with lower mobility” are excluded from the priority of using the system, and can only apply for a temporary account issued from the volunteers at certain main bus terminals, if the passengers are carrying large luggage or injured. Next, the definition of “passengers with lower mobility” is denied as those holding the personal smartcard, for authorizing purpose to the system, with the identity of child, elderly, physically challenged. The only exception is the woman with pregnancy proof, either by uploading photo or medical report to our website, can be issued the permanent account directly.

Apart from the questions above, there may also be people asking “for what reason why can we be bothered design the BringUBus system but enclosed the platform with fence and leave one single boarding gate as what Japanese did to solve the problem?” As mentioned above in the beginning of introductory session, the bus is one of prevailing options for people to both commute and travel, as the result the load of traffic is heavy and will worsen the congestion if we set only one boarding gate. This is not a perfect solution that fits the current situation of Taiwan.

Finally, an appointment with one of the subjects from previous interview, a woman who has a young child, had been made by our research team. The final design was demonstrated by the prototype of app and a paper model as in the figures (Figure 10 and Figure 11). The feedback was fabulous. The woman was completely satisfied with our design and was more than willing to

accept the change of bus-taking experience after the BringUBus system has commercialized.

## Conclusion

The central idea of BringUBus is easing the inconvenience for passengers with lower mobility, by eliminating the distance between where the passengers wait and bus stops. The BringUBus system is composed of both virtual app and actual elements of drawing of priority zone and indicating lights setting on the dashboard of every bus.

The introduction of new technology often appears to be a tough work, many adaption have to be made by citizens and bus drivers, and the process may be time consuming or even, to the extreme, somehow irritating. However this is the way how human civilization improves. Our research team is very proud to present the brand new system of BringUBus and hopefully the bus-taking experience can therefore be improved.

## References

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