

# 1908692

*by* Sai Harsha Jangili

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# **Usability engineering**

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## Introduction

In the recent past, the idea of smart transport public systems has been evolving. This has transformed how public transport is managed. According to Zapata (2013), the evolution of these systems has seen many public transport public information systems created. This system such as aid traffic police and traveller to make wise decisions on parking routes to use to manage traffic snarl-ups in cities (Diamantaki et al., 2015). According to Zapata (2013), public transport public information system helps to ease access to transport to city travellers by offering reliable real-time insight on best options to navigate the city. This helps the local authority and residents to effectively manage traffic and movement on roads (Zapata, 2013). Many of the systems use various Usability Engineering (UE) to increase their predictability accuracy. Therefore, improved UE or lack of it in a public transport information system determines the effectiveness of service provision. It is against this background that the paper assesses the UE of the Trent-Barton LCD map style display system (Cottrill, 2018). The paper uses the theory of human factor and usability guidelines to evaluate the UE of the Trent-Barton LCD map style display system in Nottingham County Council. Relevant sketches, maps, diagrams are used for illustrations and explanation.

## **Explanation of chosen public transport Public Information system and outline of design idea**

The Trent-Barton LCD map style display system falls under the UK Public Transport Information System which uses Split Cycle Offset Optimization Technique (SCOOT) software. The system operates both in dynamic mode and a fixed time to optimise traffic flows. The software facilitates re-scheduling for buses to eliminate the long gap in transport service. Besides, the software in collaboration with the UK Public Transport Information System provides real-time passenger travel information. The system was installed in Trent–Barton Buses in Nottingham County Council as shown in Photography in Figure 1.



Figure 1: SCOOT Software installed at Trent–Barton Buses in Nottingham

At the Trent-Barton Buses, the digital public transport system is designed using LCD map style display into an info-pole layout which is user friendly for passengers to read the map and obtain public address announcement as shown in Figure 2. According to Dekker (2004) and DeCamp and Herskovitz (2015), the user-friendly screen interface of SCOOT software allows more accurate reading from its users; such as significantly help to reduce human errors. The human theory factor of accident causation observes that consistent human accuracy or lack of it can lead to an accident. The consistent and friendly screen interface might allow appropriate responses and activities and improves safety regulations (DeCamp & Herskovitz, 2015).



Figure 2: SCOOT LCD map style display fits into an info-pole layout

Split Cycle Offset Optimization Technique is Siemens mobility software that uses an adaptive traffic control system and signal control to improve human usability (Muresan et al., 2019). The software re-adjusts itself based on signal and environment to reduce errors, and increase accuracy for traffic prediction. The technique applies the signal timing at each intersection to reduce delays.

The ability for software to automatically adjust its functions based on the existing environment is one of the constructs between human and device integration. In the case of SCOOT, the signal timing allows effective interaction between people in the LCD screen interface (Muresan et al., 2019). For instance, during the night, the SCOOT software is engineered with sensors that automatically flash for the users to read the information presented on the screen as shown in Figure 3 obtained from the Trent–Barton Bus stop in Nottingham. The nighttime exposure of illuminated bus stop shelters also helps to reduce the human error associated with poor visibility.



Figure 3. Nighttime exposure of illuminated Trent–Barton bus stop

## Usability Guidelines and Accessibility Applied to Public Transport Information System

The Trent-Barton LCD map style display system was assessed on its usability using Shneiderman's (2016) golden rule for user interface design. It was established that the SCOOT LCD map style display at the bus station was several components that conform to the Shneiderman (2016) guidelines as shown in Figure 4. However, in general, SCOOT's interfaces have been faulted with their inability to manage and use common traffic symbols and terminologies (Dubey & Gupta, 2020). It could be perceived that the use of uncommon symbols and terminologies in the map interface as shown in Figure 2 above could confuse passengers of different cultures since Nottingham is an international city. The limitation violates Shneiderman's (2016) interface design guideline on strive for consistency.



Figure 4: Trent–Barton Public Transport Information Display System Sketch Diagram.

The Trent-Barton LCD map style display system in Figure 5 meets Shneiderman's (2016) usability guideline for the provision of informative feedback. This is also evident from Figure 4, where is observed that the LCD supports digital signage for advertisement. According to Shneiderman (2016), every operator's action must provide some system feedback for its users to be an update of major and minor actions.



Figure 5: SCOOT LCD installed at Trent–Barton Buses in Nottingham

The W3C accessibility guidelines in WCAG 2.1 oblige mobile computer applications to incorporate assistive functions, tools, and features such as sound and human sensors that support disabled people to use the software for improved universal benefit (Alajarmeh, 2021). The Trent-Barton LCD map style display system has a multi-layer route map that allows users not to be confused after they press the route button as shown in Figure 4 sketch. The driver will be alerted on the passenger waiting to be picked using LTE antennas that connect the LCD to the internet for push notifications. Besides, disabled people are supported with a route button that has an audio alert and touchscreen accessibility function on the LCD monitor. These features allow the Trent-Barton LCD map style display system to comply with W3C Web accessibility guidelines for people with disabilities (Alajarmeh, 2021).

### **A Usability Evaluation Strategy for project implementation of Public Transport Information System**

The usability evaluation process entails the incorporation of testing, inspection, inquiry methods to obtain a relevant system interface that supports users to perform their tasks without having usability challenges. The most prevalent three usability evaluation techniques to incorporate into the interface design development process of the public transport system are baseline usability testing and data collection on an existing site, Card Sorting testing to help the Information architecture (IA) development, and wireframe evaluation on interface navigation (Wilson, 2014). Each of these three techniques is appropriately used based on the project stage such as planning, analysis, design, and installation, and testing (Kent and Williams, 1996).

During planning and analysis baseline usability testing techniques are used to collect relevant data and user opinions. As such, a user personas survey can be used during this stage to identify exact design choices that potential system users prefer. For instance, the preferred type of maps, interface layouts, navigation features, and accessibility functions that users need to be included in the system (Wilson, 2014). Card sorting test is another usability evaluation technique that can be used during this development phase. According to Wilson (2014), the card sorting test helps the designer to analyse the AI and prototype data of the public transport LCD map style display system. Further, this technique models the design choices and the way the contents would appear in the system interface.

During software prototype design, wireframe testing would be used to generate low, medium, and high fidelity prototypes of the system UI. The map and navigation layout of the LCD map style display system can be tested for usability through wireframe sketching. During the design, the developed wireframes provide a skeleton view of the interface features, functions, content, and navigation bar, as well as the appropriate position of content on the system interface. The final high-fidelity wireframe is later used to design the actual system interface (Wilson, 2014). Figure 6 and Figure 7 show sample wireframes for the proposed LCD map style display system.

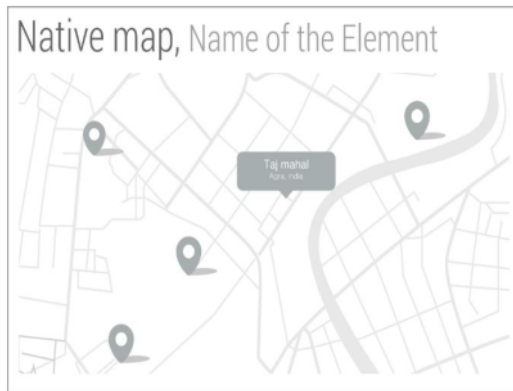


Figure 6: Medium-fidelity Wireframe Usability  
Evaluation Technique

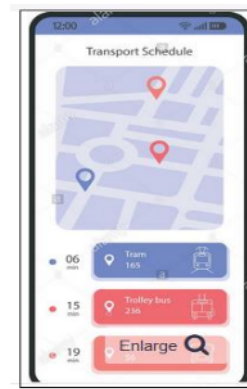


Figure 7: High-fidelity Wireframe Usability  
Evaluation Technique

During the installation and testing phase, usability simulation can be used to establish if the developed design meets the usability goals. User behaviour simulation (UBS) can then be applied at the final stage of the development to establish if all intended functions are working on the existing (Hillmann & Baumann, 2018). The UBS uses real users' experiments in this case, the passengers to determine the interaction between users and system functions such as voice recognition, touch recognition, device interface, and speech output of the system as illustrated in Figure 8 (Hillmann & Baumann, 2018).

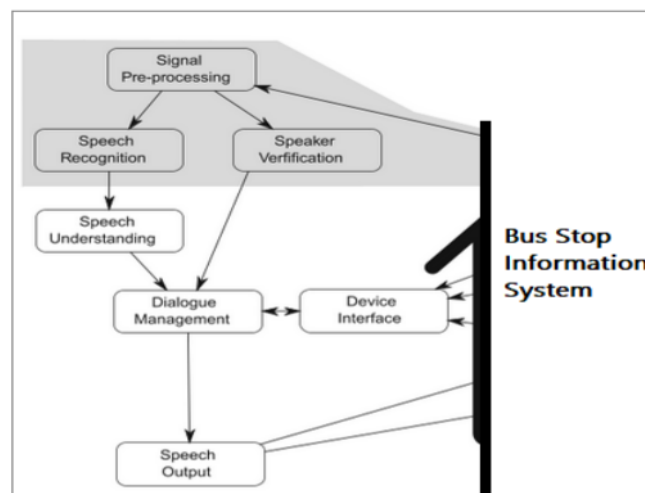


Figure 9: User behaviour simulation

### Analysis of map usability in Public Transport Information System

Map-based interfaces have several usability challenges, especially on the user interface, map navigation, direction, and public address of the map sites as well as search operations. For the user interface, when developing such an application, inserting aspects such as adverts, links, and image is tedious. The insertions crates create confusion and prevent users from searching relevant data easily. When developing the map interface in class as well as observations from the Trent-Barton LCD map style display system, it was apparent that the map interface layout would result in inconsistencies for MapQuest (MQ) and the use of symbols. Studies such as Kuparinen et al. (2013) and Nivala et al (2007) found that mobile map systems are susceptible to inconsistencies from MQ and map projection which provides poor usability for system users (Nivala et al., 2007). For map usability, users are usually unable to access the search box on the interface because of poor navigation from MapQuest (Nivala et al, 2007). Figure 8 shows a sketch of a suitable map-based interface of the Trent-Barton LCD map style display system.

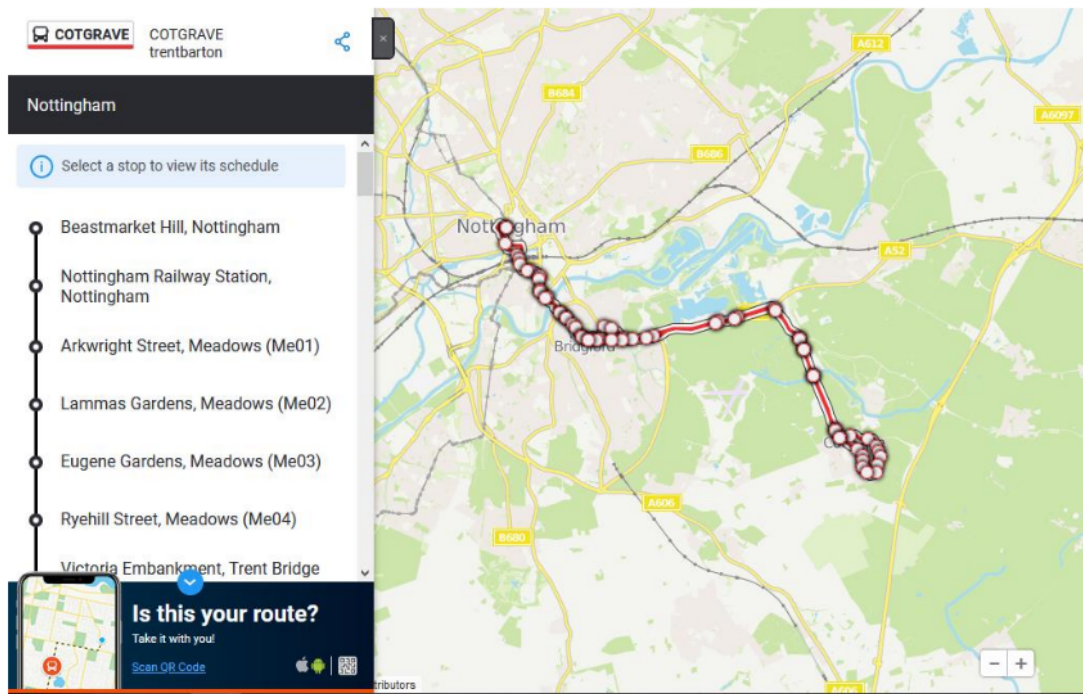


Figure 8: Sketch Map based on Trent-Barton SCOOT Application

The sketch map in Figure 8 provides essential design choices that ensure enhanced usability for the Trent-Barton LCD map style display system. As observed in the map, directional references are provided along with scale, spacious search box, scroll bar, and location references, as well as projection and legend. The symbols used in the map are common so that the user does not get confused based on their age and computer literacy level (Kuparinen et al., 2013). The directional reference in the map above easily allows users to identify the location of a specific place on the map (Wood & Krygier 2019). Conversely, a scale offers dimensional support for the user to estimate distances between locations in the map. The most essential design choice of the above map is the ability to incorporate a search box and scroll bar since users will have eased to type and request specific locations in the map. The map would then generate suggestions of requests and display the relevant places for the user to select, which also saves search time (Wood & Krygier, 2019). The zoom icon allows the users to change the resolution of the map to view places much clearer and much easier, especially for long and short-sighted users.

Kuparinen et al. (2013) proposed several usability guidelines for mobile map application design that could be used to improve the usability of the Trent-Barton LCD map style display system. For instance, the ability for the map to visualise the contextual map functions and essential location for users to interact and obtain information feedback within a reasonable time. Also, Kuparinen et al. (2013) proposed that mobile map interface design should give users control over map function, which can assist users of Trent-Barton LCD map style display system to be in charge of the map application regardless of any interruption. Consistency and standard in the use of map tools are important since the map user is provided with a clear, intuitive, and commonly used map symbol to eliminate confusion and complexity during map interpretation (Kuparinen et al., 2013).

### Conclusion

Usability engineering process streamlines regulatory compliance in interface design and development of software application that supports numerous accessibility functions and user needs. Usability engineering allows designers to develop systems that comply with W3C accessibility guidelines and other principles such as Shneiderman's (2016) interface design and Kupařinen et al. (2013) usability guidelines. These guidelines were applied to test the usability engineering of the Trent-Barton LCD map style display system. The evaluation found that the system complies with W3C accessibility guidelines, Kupařinen et al. (2013) usability for the mobile map, and Shneiderman's (2016) interface design guideline for system informative feedback support. However, it was established that the system uses uncommon traffic symbols and terminologies that could confuse passengers.

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## FINAL GRADE

# 49

/100

## GENERAL COMMENTS

**Instructor**

## 1. Analysis and Design

Choosing a system locally (Swansea or India!) would have been more effective than finding a system from your research. This didn't allow you to showcase your own design ideas. Some suitable topics were addressed and relevant research included.

11/25

## 2. Guidelines and Accessibility

A brief analysis is given, with good use of examples from your research. It can be OK to have a non interactive display in this context perhaps. Accessibility issues are briefly considered with references and examples. 13/25

## 3. Evaluation Strategy

A reasonable attempt is made to place usability evaluation activities in the project lifecycle. You have concentrated on a small number of methods.

12/25

## 4. Map Usability

Map usability challenges are outlined and an example map is included with some general features which as you correctly say may need reviewing for bus passengers. Kuperinen's guidelines are briefly discussed.

13/25

PAGE 2

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PAGE 3

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PAGE 4

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PAGE 5

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PAGE 6

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PAGE 7

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PAGE 8

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PAGE 9

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PAGE 10

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PAGE 11

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PAGE 12

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