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Real time monitoring of a mobile ticketing system

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The increasing use of smartphones to pay for services and the need to reduce the complexity of public transport systems has led to the development of a new 'mobile ticketing system'. Such a system has been implemented in the city of Porto in Portugal and has been evaluated using real-time monitoring. This study outlines the implementation of the monitoring system and evaluates the effectiveness of its deployment.

As technology has evolved and the use of smartphones is becoming more prevalent, mobile ticketing in public transport is replacing the traditional paper ticket. Despite this, in most cases, users are still required to have knowledge of the public transport system to enable them to buy the best ticket in terms of cost and time. That is, users still have to know the different areas of a city, and the exchange points and schedules to fully understand the ticketing system. This complexity of the fare system will continue to increase as transport systems develop and expand.

In Porto, a mobile ticketing system, in the form of a smartphone app named Anda, was implemented to address these issues while aiming to have seamless integration with the intermodal public transport system. The check-in/be-out system is based on existing technologies, specifically near-field communication and Bluetooth low energy beacons. The former validates a journey when communicating with a smartphone while the latter identifies the station where the user is. The application terminates the journey when beacons stop being detected or the user starts walking.

The principle advantage of the Anda system for the user is the billing system. The application calculates the fare and payment is only requested at the end the month, thus mitigating the need to understand fare systems or purchase individual tickets. Furthermore, tariff optimisation ensures that no user pays more than the minimum fare possible. While the advantages of the mobile ticketing system are clear, the system faced several technical challenges following its introduction. This included beacon signals being undetected or poorly interpreted, application failure and unsuccessful validations.

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A monitoring system was developed to detect and solve errors or inconsistencies in the new mobile payment system. The monitoring systems uses data that is sent via email in five fields:

- user information – name, email address and unique identifier;
- current state of internal database for journeys;
- information of users' phones;
- active beacons communications;
- logs of the users' phones including any Bluetooth signal that is received.

The data from Anda is received by the users of the monitoring system daily via email, which is gathered by the server through the Gmail™ application programming interface (API). After this, the server runs the email data through a parsing system and populates the database. The monitoring system rests on a web application which presents the data in three views: landing page, communication from beacons and occurrences.

The landing page holds an overview of the entire system, detailing indicators such as percentage of successful trips and some global statistics. The communication from beacons view presents the changes in beacon communication for a given period. The third view indicates occurrences where a traveller may have encountered problems. It presents all the errors identified and provides a crosscheck to determine the cause of such errors.
The system has been successful in presenting key indicators that identify specific beacons that are not operating as they should and the overall performance of the mobile ticketing system. Furthermore, it connects data to other relevant information such as the type of smartphone used. This enables a targeted approach to be taken when improving the ticketing system.

The key limitation of the system is that the sole update of the database is via email or external files. This introduces problems if the structure of the files/emails alters, meaning that the parsing module will have to be updated. However, there is no alternative method for populating the database.

This proof-of-concept work has shown that the real-time monitoring system is successful in not only identifying and correcting ticketing system errors, but also in presenting the strengths of the pubic transport system. By identifying monitoring indicators such as busiest hours and least travelled routes, it can facilitate the improvement and streamlining of transport services. There is scope to add further information to the database and this is likely to start with data from validators that could be used to identify errors at the validation stage.