

Chapter 19

Monitoring Pedestrian Spatio-Temporal Behaviour using Semi-Automated Shadowing

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ABSTRACT

Mobility and orientation behaviour research often requires the monitoring of pedestrian spatio-temporal behaviour. A number of different empirical methods have been developed to investigate specific aspects of pedestrian behaviour. However, each method has certain drawbacks, which aggravate the collection and analysis of relevant data. This chapter describes a new method which combines the advantages of simple observation and technological data collection. Pedestrian trajectories are collected by observing and annotating spatio-temporal tracks using a semi-automated shadowing tool. In this chapter, the authors describe the background and related work in pedestrian spatio-temporal behaviour research as well as most commonly applied methods and their respective advantages and drawbacks. The authors then present a shadowing approach with specific characteristics and implementation. Additionally, three case studies are described to illustrate potential fields of application. Finally, ongoing efforts to enhance the method through the use of additional sensors and features, as well as potential future developments, are described.

INTRODUCTION

Pedestrian spatio-temporal behaviour is a particular phenomenon of interest to researchers of many different fields. Comprehensive knowledge about the way people use space, how they move around and what influences their motion behaviour is, for example, necessary for designing infrastructures, developing simulation models, and optimising the spatial distribution of services and facilities. In the field of mobility and orientation behaviour research the scientific interest is focussed on the routes pedestrians choose, the way they interact with the environment (other pedestrians, obstacles, etc.) as well as the places where people stop and why they do so. Various methods have been developed for collecting pedestrian spatio-temporal data in order to analyse their motion behaviour. First attempts mainly used direct observation applying paper maps and pencils for recording and analysing pedestrian movements. With advancing technological progress, several technology-based methods are now available for localising pedestrians and collecting trajectory data. Hence, nowadays researchers can choose from a variety of different methods each providing specific advantages. However, there are still several drawbacks which have to be accepted when adopting a particular method. Especially when pedestrian motion behaviour is to be analysed in larger environments and both indoor and outdoor, there is a lack of methods which are applicable, low priced, and providing sufficient accuracy.

Facing these difficulties, we developed a technology-enhanced variant of the classical observation method for annotating pedestrian trajectories and location-related activities in medium scale environments (public buildings, urban quarters). This “shadowing” method does not require any installations on site, nor do the participants need to be equipped with any devices. Here semi-automated shadowing denotes observations conducted by using a digital map on a tablet PC instead of paper maps, which facilitates data

collection in large and/or multi-storey environments and allows a more precise temporal and spatial annotation of events. It can be used in a non-disguised manner or unobtrusively and is applicable in indoor and outdoor areas.

In this chapter we introduce this semi-automated shadowing method and explain its advantages in comparison with other methods of tracing pedestrian spatio-temporal behaviour. The chapter is structured as follows: firstly, a general overview about the most commonly applied methods for monitoring pedestrians is given. Subsequently, we describe the characteristics of the semi-automated shadowing method, the data collection and analysis process and the method’s advantages and limitations in comparison with common methods. Next, we present three case studies of recent applications of the method, focusing on the specific benefits in empirical data collection the shadowing method provided. We further describe current ideas and efforts to enhance the method and combine it more effectively with supplementary sensors. The chapter ends with final conclusions and a summary of the main characteristics and advantages of semi-automated shadowing.

BACKGROUND: EXPERIENCES IN PEDESTRIAN SPATIO-TEMPORAL BEHAVIOUR RESEARCH

The investigation of walking behaviour has usually focused on the analysis of motion behaviour within a specific environment and/or a specific context. First attempts to record and analyse human spatial behaviour have been made for studying the movements of visitors of museums and exhibitions (Bechtel, 1967; Weiss & Boutourline Jr., 1962; Winkel & Sasanoff, 1966). Other research topics focusing on the investigation of pedestrian motion behaviour include for example tourism research, design principles for pedestrian facilities, evacuation behaviour, or the development of navigation and guiding systems (Helbing, Molnár, Farkas,

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