Automatic Occupancy Analysis of Sports Arenas

Gade, Rikke; Jørgensen, Anders; Moeslund, Thomas B.; Jensen, Rasmus Krogh

Publication date:
2012

Document Version
Early version, also known as pre-print

AUTOMATIC OCCUPANCY ANALYSIS OF SPORTS ARENAS

Author:
Rikke Gade*
rg@create.aau.dk

Co-authors:
Anders Jørgensen*
Thomas B. Moeslund*
Rasmus Krogh Jensen**

*Aalborg University
**Aalborg Kommune

ABSTRACT

INTRODUCTION

Over the last decades the demand for physical activities has been growing, which puts a high pressure on the sports arenas. From 1964 to 2007 the number of athletes has quadrupled with a steady increase (Pilgaard, 2009). Surveys also show that people are dropping the classic club sports in favour of more flexible sports (Brixen et al., 2010). This calls for a better and more optimal use of the existing sports arenas to keep up with this growing trend. In order to improve the utilisation of a sports arena, its existing use must be examined. This includes examining the number of users using the arena at the same time and the occupancy of the court. Administrators are especially interested in whether the arena is empty, used by a few people or full and the time for when the occupancy changes. The position of the users is also important as they might only use half a court, which means the other half could be rented out to another group. Manual registration of this is cumbersome and expensive and an automatic approach is therefore needed. For such a system to work in general it should be independent of the size of the court, lighting conditions and without any interaction with the users. This can be obtained with a camera. Detecting people with a camera raises some privacy issues though. Not all people like surveillance and the fear of being observed could keep some people out of the arenas. This work therefore proposes an automatic method to analyse the occupancy of a sports arena using thermal imaging. One of the advantages of thermal cameras is that the persons recorded cannot be identified, which is an important factor if the system is to be accepted by the users of the sports arena. On top of that, thermal cameras are invariant to lighting, changing backgrounds and colours, which make them more desirable for an automated application.

METHOD

The activity at the court is measured by a thermal camera mounted on one of the walls around the arena. The camera detects the long waved infrared radiation emitted by all hot objects which generates a greyscale image that represents the temperature in the scene. Hot object will be bright and cold objects will be dark. This makes it relatively easy to make software algorithms that automatically separate people from the colder background.

For each image the persons are counted and their positions on the court are found using a prior calibration. By summing over several images this gives the number of persons and their position for every 5 minute period, which can be used to analyse the use of the arena. The detailed technical description of the system can be found in (Gade et al., 2012).

RESULTS

Preliminary tests of the system have been conducted in ten different sports arena, one week each. Capturing video with 10 frames per second generates 60,480,000 frames during the ten weeks. As this amount of data will be nearly impossible to manually annotate, the precision of the system have been compared to ground truth for two days covering different types of sport. The result is an average error of 11.76 % in the number of people during time with activity. During the full test period the system shows that it very precisely categorises activity level in zero, low and high activity.

Comparing the observations during an arbitrary week to the booking schedule shows that 21.2 % of the booked hours were not used and 23.4 % were used by an average of two or fewer persons.

The registration of the positions has been visually evaluated by comparing with manually annotated positions and shows great resemblance.

DISCUSSION

The results show that for nearly half the booked hours the arena was used by two or fewer persons. The observed sports arenas were booked by the local schools from 8 am to 3 pm during weekdays and booked by sports clubs in afternoons, evenings and weekends. This shows great potential for optimising the use of the sports arenas.

Work is currently being done to optimise the precision of the detection software. Furthermore we work on including detection of activity type, activity level and user types.

REFERENCES

Brixen, S., Larsen, K. H., Lindholm, J. V., Nielsen, K. F.,

and Riiskjær, S. (2010). *Strategi 2015: En Situationsanalyse (Strategy 2015: A Situation Analysis)*. DGI.

Gade, R., Jørgensen, A. and Moeslund, T. B.(2012). *Occupancy Analysis Of Sports Arenas Using Thermal Imaging.* Proceedings of the International Conference on Computer Vision Theory and Applications. p. 277-283.

Pilgaard, M. (2009). *Sport og Motion i Danskernes Hverdag (Sport and Exercise in the Everyday Life of Danish People)*. Idrættens Analyseinstitut.