A Portable and Low-Cost 3D Tracking System With Four-Point Planar Square Calibration

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ABSTRACT

Indoor tracking of humans or other objects often needs to be realized using affordable, accurate, portable and easy-to-use solutions. For example, in art performances, exhibitions, virtual reality applications and games these needs are evident. However, most of the current tracking technologies lack in at least one of these properties and are thus not optimal for these applications. Therefore, to fill this gap, we present an optical 3D tracking system that is both cheap and accurate, while at the same time being easily transportable, quick to set up and easy to use. Built around two to four wireless Nintendo Wii Remotes, the presented system can simultaneously track up to four infrared LEDs carried by the tracked persons or objects, as well in total darkness. The cost of the system is only some tens of Euros, if the price of the computer used for computation is discounted. The system can be calibrated in a few minutes with a semiautomatic four-point planar square calibration method, where the user only needs to place the tracked infrared-LED marker sequentially on the four corners of an imaginary square on the floor surface prior to use. The system was evaluated with both static and dynamic positioning tests and the accuracy was determined to be 3 cm within a cube with an edge length of 2.5 m. In addition to presenting the system setup and calibration algorithm, this paper discusses the requirements to cover large spaces and the optimal placement of the Wii Remotes in the environment. Likewise, computational methods for improving the positioning accuracy by altering the assumed optical centres of the cameras, which vary due to the intrinsic differences in them, are proposed. Altogether, the presented tracking system meets the needs of a simple and mobile indoor positioning system that can be used in multiple applications.

KEYWORDS: Wii Remote, indoor positioning, tracking, Four-point calibration, infrared.