Tethering a semi-autonomous vehicle by relative positioning

(Master Thesis)

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Topic

Autonomous vehicles following a person or an otherwise moving object are said to be *tethered*. Such vehicles have recently become available on the consumer market. An example are aerial drones which can track a person during some activity. The most important challenge of tethered vehicles is to determine the position of the object or person to be tracked as accurately as possible.

The goal of this thesis is to develop such a positioning system. It must be small enough to be embedded into a robot, work indoors as well as outdoors and provide sufficient accuracy to follow a pedestrian at a distance of one to two meters.

State of the Art

Many positioning systems exist and are widely deployed, both for outdoor and indoor localization. They use different transmission mediums such as radio, sound or light to determine their relative location in relation to some known position.

For indoor localization, technologies such as Wi-Fi-based positioning systems (WPS) and Bluetooth-based systems (“iBeacon”) exist. For outdoor localization, the Global Positioning System (GPS) is the most widely used system in the US and Europe.

Objective

For our application, a vehicle must be able to follow a pedestrian through unknown terrain. The following requirements have to be met by our localization system in order to implement the tethering functionality:

- **Compactness**, to be integrated into a vehicle with dimensions of approx. 10 x 50 x 50 cm
- **Accuracy** is sufficient to follow a pedestrian through unknown terrain
- **Indoor and outdoor** capability

Approach

The aforementioned existing positioning systems do not meet the given requirements. GPS may not provide sufficient accuracy and does not work indoors. The indoor positioning systems require rooms to be equipped with so-called beacons. This cannot be expected for the locations the vehicle has to operate in. Furthermore, they are hard to adapt to the dimensional constraints of the vehicle.

Therefore, a custom positioning system will be designed to meet the requirements. The first step is to determine the technology and transmission medium to use. Based on these, a system that is capable to determine the position of a person carrying a beacon will be designed. Finally, the system will be evaluated in accuracy and usability by installing it into the vehicle being subject to a user study.

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