IPIN 2019
TENTH INTERNATIONAL CONFERENCE ON
INDOOR POSITIONING
AND INDOOR NAVIGATION
30 September - 3 October 2019, Pisa, Italy

Consiglio Nazionale delle Ricerche
Area della Ricerca di Pisa

Track 2: "Video-based"

This document is intended to give a complete overview on the criteria used to organize the Track 2: "Video-based" positioning competition and evaluate the competing systems.

Addenda (such as maps, usable areas, etc…) to this document should be requested to the track chairs (see bottom), while the contest@evaal.aaloa.org mailing list should be used for general enquiries. Changes to this document will be communicated on the same list and subsequently added to the last section: Clarifications and Additions.

Overview of the competition

The purpose of this on-site competition track is to assess and measure the ability of competing systems to accurately identify their position and/or orientation inside a large, public indoor area using localization process with visual data. This track will take place at the CNR Area in Pisa.

Since the research in visual localization has been intensified with the advancement of computing power, there can be various kinds of technical approaches and system configurations. In Track 2, competing system should be engineered or implemented in a form of localization system that exploits vision sensors (i.e. Monocular or Stereo cameras without Depth sensor). Please note that laser based technologies (i.e. Lidar) are excluded.

Competitors will be provided with a detailed map of the area, while the predefined reference path used to test the competing systems will not be disclosed to competitors before the competition.

An actor will walk along the reference path while holding the processing system in his hand (or body) and a competitor can accompany along the path. The competing system should submit the resulting log file to the organizers automatically[1] or manually.

Any additional or specific requirement of the proposed localization system should be communicated at an early stage to the track chairs in order be approved and to make the necessary arrangements. For any technical inquiries please e-mail the Track 2.

Hardware Requirements

- Competitors are not allowed to install any instrumentation in the competition area.

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[1] See the section of software requirement

- Mobile laptop or tablet PC, smartphone etc. can be used to process the vision data stream.

- A competing system (processing system) is carried by the actor, and the competitors can accompany him; the system should be located on the upper part of the human body.

Software Requirements

According to the type of hardware system, the competing system should follow:

i. Competing system as a form of smart-phone App

- If the competing system is implemented in smart-phone as a form of app, then the app should continuously communicate real-time estimates of its position to a **measurement app** provided by IPIN organizers. Final scores will be based on the accuracy of the estimates as measured by the measurement app.

- Competitors are requested to integrate their app with the measurement app provided by the 'track 1 organizers'.

- Details about integration of the competing app with the measurement app, documentation and code can be found at (http://evaal.aaloa.org/2019/software-for-on-site-tracks)

- Any additional or specific requirement of the proposed localization system should be communicated at an early stage to the track chairs in order be approved and to make the necessary arrangements. For any technical inquiries please e-mail the Track 2 (sylee@etri.re.kr) and software chair (michele.girolami@isti.cnr.it).

ii. Competing system as a form of PC, tablet, etc.

- If the competing system is implemented in PC, tablet, etc. then it is considered to use wireless data logging PC to mobile app. Detailed guide will be updated soon.

Measurement procedures (same as Track 1)

The score of each competing system will be evaluated during the time slot assigned to each competitor. At the beginning of the time slot, the competing team will configure their system and the actor will keep it in his hand (or body in case of); during this phase the competitors will have the opportunity to perform only short reconfigurations of their systems, in the order of few seconds. Subsequently, the actor will start moving and the measurement will take

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place.

The actor walks at a natural pace along a loosely-defined reference path, equal for all competitors. The path connects some tens of keypoints identified by markers placed on the floor and may span multiple floors and multiple buildings. The list of time marks, together with the ID and positions of the keypoints, will be the ground truth used by the measurement app to compute the localization errors. When the actor steps above the keypoints, the actor will set a time mark using the measurement app in smart-phone processing, or using a competing software developed by the competitor.

The competing system (or app) should provide coordinates with a suggested frequency of 2 Hz to the measurement app, but only the last estimate prior to each time mark will be taken into account to evaluate the competing system accuracy. The competing system (or app) must provide (x, y, z) coordinates in the WGS84 coordinate system (longitude x and latitude y) and the floor number (an integer starting from 0 to z, 0 being the ground floor). The timestamp should be in milliseconds from the Unix Epoch (e.g. retrieved from the Java `System.currentTimeMillis` ()).

The path followed by the actor will be approximately the same for each competitor. It will take approximately the same time and will pass through all the keypoints in the same order. It may include pauses, loops and any kind of natural movement.

Evaluation criterion (same as Track 1)

The accuracy score will be the third quartile of the localisation errors at the keypoints. The localisation error is the distance between the competitor's estimate and the real position of a keypoint.

The error will be measured based on x, y coordinates (longitude and latitude). To this, a penalty P = 15 m will be added for each floor error (z). For example, if the x, y error is 4 m and the estimated floor z is 2 while it should be 0, the computed error for that estimate will be 4 + 2P = 34 m.

Competitors for which the third quartile of error is greater than 20 m are not eligible for the winner prize.

Final scores will be disclosed at the end of the competition, and the competing systems ranked according to this final score.

Organization (same as Track 1)

The coordinates of the starting point for the reference path walked by the actor will be provided the competition day, about half an hour before the competition starts. Competitors will use the setup day, the day before the competition, to survey the area themselves, take measurements where needed (e.g. make measurements of the Wi-Fi network signals) and ensure that their system or app interacts correctly with the measurement app. Additional survey of the area is only possible and allowed during the setup day. Specifically, competitors are not allowed any additional survey during the competition day under penalty of exclusion.

A number of markers will be put on the floor. The actor will walk a path going through all markers while keeping in her hand the phone running the measurement and the competing app; the actor will often look at the screen, because she must tap a button on the screen when passing over the markers on the floor. The position of the phone with respect to the actor's body can vary during the measurement. We estimate that a trained actor will provide marker timestamps with an error less than 250 ms in time and less than 0.5 m in space. While walking the path, if the actor makes an error, like forgetting to press a button, the test will be stopped and repeated from the start. Competitors are advised to follow the actor during the path, so they can check that everything is working as expected. Competitors cannot tune their app/system after the official start of the competition. However, if they notice that things are clearly going wrong during the measurement (system, app crashing, for example), they may ask for a second chance, which will be normally given if time permits. In any case, the path will be run twice for all competitors, and the best result will be considered.

Competitors are required to integrate their system (or app) with the measurement app before coming to the competition: please do so as soon as possible so that we can solve possible problems before the competition. We have two versions of the measurement app: in one, your app runs as a service, while the measurement app runs in the foreground; in the other, your app runs in the foreground, while the measurement app creates an overlay with the button.

Clarifications and additions
To be added.

Contact Information

Last updated 5 March 2019

For general questions about Tracks, please write to the contest@evaal.aaloa.org mailing list.

If you need a question about Track 2 and private contact, you can write to the track chair:

Soyeon Lee sylee@etri.re.kr , ETRI (KR)