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 1: "Smartphone-based"

This document is intended to give a complete overview on the criteria used to organise the Track 1: "Smartphone-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 inside a large, public indoor area using a hand-held smartphone.

Competitors are requested to develop an application (competing app) designed for smartphones (no tablets are allowed). 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 smartphone in his hand. The competing app will continuously communicate real-time estimates of its position to a measurement app provided by IPIN organisers. Final scores will be based on the accuracy of the estimates as measured by the measurement app.

The competing app can use any sensor available on the used smartphone. Sensors external to the smartphone are not allowed. The competing app must run entirely on the smartphone: no access to remote services like external databases or remote servers is allowed. Only one commercially available smartphone per competitor can be used. Competitors are not allowed to install any instrumentation in the competition area. Competitors are requested to integrate their app with the measurement app provided by the organisers.

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 localisation 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 1 and software chairs.

Measurement procedures

The score of each competing app will be evaluated during the time slot assigned to each competitor. At the beginning of the time slot, the competing team will configure their smartphone and the actor will keep it in his hand; 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 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 localisation errors. When the actor steps above the keypoints, the actor will set a time mark using the measurement app. The actor is not required to keep the phone in any specific or fixed position or orientation.

The competing 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 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

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.

Organisation

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 compention, to survey the area themselves, take measurements where needed (e.g. make measurements of the Wi-Fi network signals) and ensure that their 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 after the official start of the competition. However, if they notice that things are clearly going wrong during the measurement (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 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

Detailed information about the competition environment (QGIS project with georeferenced maps and high resolution PDFs) should be directly asked to the track chairs via email.

Contact information

For general questions about Track 1, please write to the contest@evaal.aaloa.org mailing list.

If you need a private contact, you can write to the track chairs:
Filippo Palumbo filippo.palumbo@isti.cnr.it, CNR-ISTI (IT)
Antonino Crivello antonino.crivello@isti.cnr.it, CNR-ISTI (IT)

or to the software chair:
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