

ISMAR 2011 Tracking Competition

In the realm of Mixed and Augmented Reality, a number of different tracking technologies have been proposed so far. These were met with varying degrees of success, sometimes even resulting in commercial products or prominent open-source projects. At the same time, promising new tracking approaches are still in the development phase.

The aim of the ISMAR Tracking-Competition is to provide a fair comparison of the state-of-the-art tracking modalities in the context of typical Mixed or Augmented Reality scenarios.

The tracking quality is evaluated based on a concrete and reasonably realistic task inspired by requirements as commonly encountered in industrial Mixed Reality settings. The task is based on the general logistics scenario in which a worker has to pick a list of items in a storage facility. The identity of these objects is only given by their respective 3D-coordinates in the storage area. Many times the worker has to determine the exact object to pick from a variety of similar or even visually undistinguishable objects. To correctly pick the right objects, the worker has to be guided by visually overlaying the correct location of the object onto the worker's view.

As the items vary in size and the picking areas are distributed over a large storage facility, both locally accurate and wide-area tracking are needed.

The Tracking Competition at ISMAR tries to capture the essence of this scenario in picking areas of varying difficulties. There are no restrictions on the type of tracking equipment used, and the competition is open to both academic and commercial participants. Participants are required to bring their own hardware and must supply their own software for the visualization. This visualization however does not need to be highly sophisticated, such that a talented undergraduate student could probably write an appropriate visualization in a short time, provided the hardware, the tracking system and registration tools are available.

By continually providing means for comparison, the competition hopes to help stimulate the further development of state-of-the-art tracking technologies

When

The tracking competition takes place during the main conference (October 26—29). More details about the schedule will be made available after the registration deadline.

Registration

In order to register for the tracking competition, participating teams have to submit a one-page summary of their approach. The summary should cover the following topics:

- What tracking technology will be used
- What installations or modifications are required to setup the tracking system
- A short description of the mobile setup
- Contact details

The deadline for proposals is August 15th, 2011.

The summaries are to be sent to: Manuel Huber <huberma@in.tum.de>.

Outcome

The results of the competition will furthermore be presented at the end of the main conference.

Further Information

Further Information can be found at the tracking competition website at <http://campar.in.tum.de/TrackingCompetition/WebHome>.

Also send additional inquiries to Manuel Huber <huberma@in.tum.de>.

Detailed Rules

Environment

1. The competition takes place in special designated contest ranges. In order to simulate a storage room environment, the room will be separated into different areas by moveable walls, shelves, or similar objects. In particular, there will be no single place from which the whole room can be observed.
2. The organizers will define a global coordinate frame in the room using geodesic equipment. For registration with the participant's tracking system, a number of reference points, spread throughout the whole room, will be provided. The coordinates of these reference points are provided as a text file to the participants before the setup phase. The shape of a reference point is given in the following picture:



3. The unit used for all coordinates is meters.
4. Participants are not allowed to make permanent modifications (e.g. drilling holes) to the room or its equipment.
5. The room will contain a number of designated "picking areas" from which the contest objects are to be picked. The extent of these areas will be clearly marked. Participants are not allowed to place markers or any other objects into these areas.
6. In order to provide different levels of difficulty, the objects to pick and the individual picking environments will vary in size and setup.
7. Participants can assume the availability of reference points in the vicinity of the picking areas in accordance with the individual difficulty. Precise local coordinate frame alignment should be attainable in any case.

Visualization System

1. The participants are required to implement a suitable visualization to support a picking-task. The organizers will not provide binaries or source code for visualization.
2. The location of the object to pick must be visualized on a tracked mobile display by highlighting it in a video image or by otherwise overlaying it onto the user's view.
3. The location of the object must be visualized by showing a 3D (e.g. sphere) or 2D (e.g. crosshair, circle) object registered at the given coordinates.
4. If the object to pick is outside the user's view, a suitable navigation hint (e.g. 2D arrow) should be displayed to indicate the direction to look to find the object.
5. Any other type of output (e.g. textual) is not allowed. In particular, the visualization must not make use of a map of the environment.
6. The system must provide a mechanism to select the next object, such as a button or speech input.
7. The participants are required to provide some means for the organizers to access the live augmented video during the contest run, for example by providing a VGA output. The participants further agree to have this video image publicly displayed. The technical

implementation should be coordinated with the organizers.

Hardware Requirements

1. The display hardware must be mobile such that it can be carried by a single user while performing the picking task. It is not permitted to install display devices (e.g. projectors) in the environment.
2. There are no other restrictions on the type of tracking or display equipment used. Thus all kinds of tracking methods (for example markerless inside-out, n-ocular outside-in, inertial, etc.) are welcome.

Contest Procedure

1. Participants will be given some time for the setup and testing.
2. Details about the schedule will be made available after the registration deadlines.
3. The setup phase is supervised by the organizers.
4. For a dry run of their systems, participants will be provided with coordinates of a few selected test objects.
5. The system will be tested by the organizers after setup, to make sure that it complies with the rules described in section "Visualization System".

Contest Run

1. At the beginning of the contest run, participants will receive the list of objects on a USB memory stick. The memory stick holds a Unix-format text file named "contest.dat" which contains the 3D coordinates of the objects. For each object, the file contains a line with three floating point numbers, separated by spaces. An example file is provided upon request. Participants are not allowed to display the contents of the file in any other way than described in section "Visualization System".
2. The contest run is performed by a single person ("the user") selected by the participant.
3. Only the mobile equipment carried by the user may be moved during the contest run. All other equipment must stay in place.
4. During the contest run, the user has to pick the objects in the given order.
5. If, after an appropriate effort, the participant is unsure about which object to pick, an item can be skipped. Skipped items can be revisited after the last regular item. The order for revisiting has to be kept the original order and any item may be revisited at most once.
6. All users start the contest run at the same location and have to return to it after having picked all objects.
7. The contest run is supervised by the organizers who will note the objects that were picked and measure the required time.
8. The timing starts when the location of the first object is displayed at the starting location and ends when the user has returned to the starting location.
9. While each contest run is publicly viewable, spectators are not allowed into the actual contest ranges either during or between contest runs.
10. The organizers will videotape the contest run to present the results to the ISMAR audience at the end of the conference.

Determining the winner

1. To determine the winner, a point system is used. The team with the highest number of points wins. Points will be allotted according to the following rules.
2. Correctly picked item score positive points. The number of points depends on the difficulty ratings of the individual picking areas.

3. Wrongly picked items score negative points. The number of negative points similarly depends on the difficulty rating of the picking area. The overall penalties for wrong items outweigh the positive points for correct items in order to discourage “picking by chance“.
4. Not picked items score zero points.
5. Additional bonus points are awarded for the overall top participants in the categories speed and accuracy.
6. Similarly the requirement of modifying the environment (installation of sensors or fiducials) results in a additional penalty points, based on the extent of the modification.
7. The exact weighting scheme will be announced before the contest. This includes the influence of the different difficulty ratings as well as the bonus and penalty system.
8. The concrete difficulty ratings of the individual picking areas are determined and fixed before the contest, but are kept secret until after the last contest run.
9. In case multiple contestants obtain the same number of points, the overall time required for contest run and for tracking setup are used as for tie breaking.