



IPIN 2017

Eighth International Conference on
INDOOR POSITIONING AND INDOOR NAVIGATION
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IPIN 2017 PDR Challenge in Warehouse Picking

Track 4: "PDR for warehouse picking (off-site)"

Challenge Goal

The goal of this challenge is the precision improvement of positioning technique, sharing a common recognition of problems and establishment of a method to compare the warehouse technique for the logistics by competing the precision of the pedestrian dead reckoning(PDR) techniques using the picking data measured in a real warehouse for the logistics. Comparing to the usual walking, PDR positioning using the measuring data in a warehouse includes a variety of tasks like picking, gathering, walking in a warehouse, carrying goods with carts and so on. Therefore, the advanced PDR positioning techniques and its correction techniques to treat a variety of situations as mentioned above are needed.

Main feature of the challenge

Off-site challenge approach

This challenge is done off-site, so all data processing will be done using sensor data measured by 8 people in a warehouse for about 3 hours for each. For evaluation standard, competitors need to use the WMS picking logs recorded during measuring the sensor data.

Multiple sources of information

As the sensor data for PDR, the gyro data, the acceleration data, the magnetic data, the pressure data and BLE beacon data were measured using the android smartphones (LG Nexus5). The smartphone was mounted by the warehouse worker and the wearing position was kept as same as possible.

Continuous motion and recording process

The test subjects of this challenge were the workers picking goods in a warehouse. The expected actions of the picking workers are as follows.

- Walking in a warehouse
- Vouching
- Picking at shelves (including the operating the terminals)
- Carrying goods using carts

Information about correct actions of each time are not given.

Realistic walking style

As mentioned above, during data measurement, the test subjects do not always walk. They do several types of behaviors while changing their position. The selection of the moving route for the picking instruction was left up to the workers in a warehouse, so while walking a variety of moving ways are possible like stop on the route, change

Sponsors



the direction, side stepping and rear w

Phone holding

The smartphone was mounted to the test subject's low back with a rubber belt. 1.

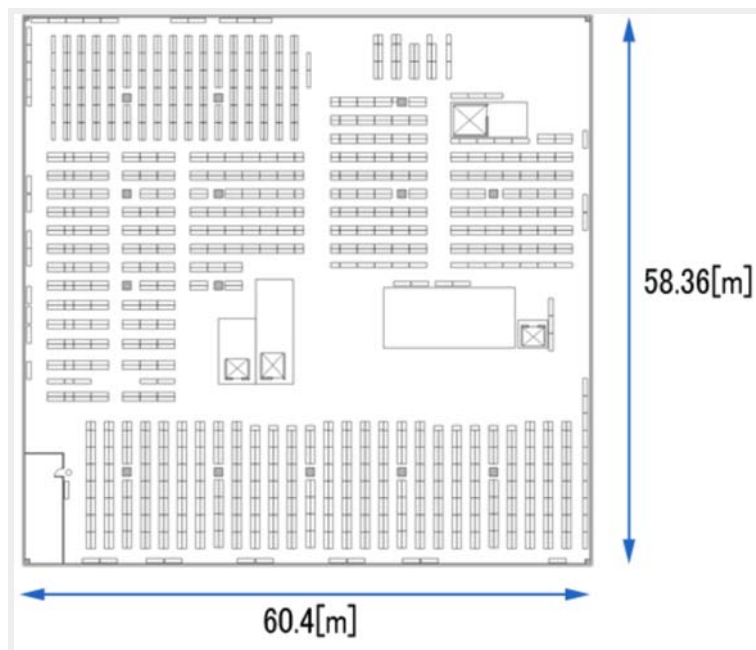
Desired localization approaches

By the nature of the data measured in this challenge, the positioning methods used by the contest participants are desired to have following abilities.

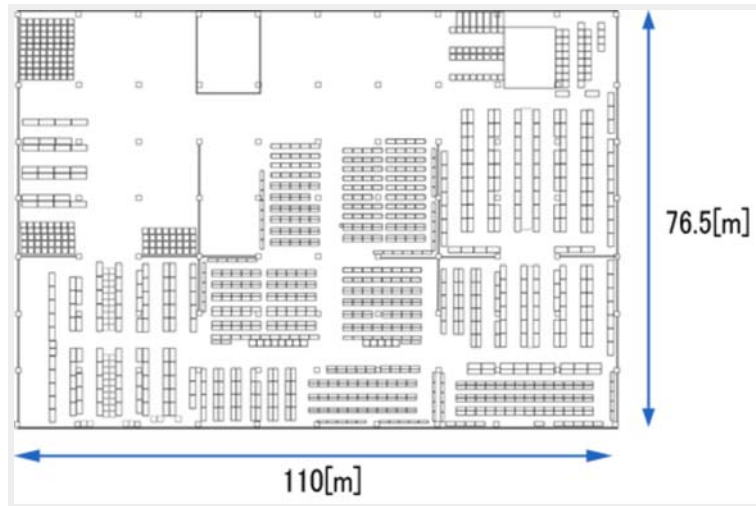
- PDR method which has robust positioning functions for moving in a warehouse
- Functions to cancel out accumulated errors by given discrete positional reference and RSSI of BLE beacons
- Time series optimization using the given data
- Keeping naturality of attitude during the picking action (picking position, amount of moving)
- Keeping naturality of walking speed
- Function to avoid incursion into the area of objections

Warehouse

Logistics warehouse A



Logistics warehouse B



Description of Datasets

Dataset list for logistics warehouse A

Sensor data of terminal

Sensor data when the terminal is placed on a stationary flat surface (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt
Sensor data when writing a figure 8 in the air with the terminal in hand (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt
Sensor data when picking with the terminal attached (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt

Map information

Map image (.png)	
Map size (.csv)	
Format	The coordinates of the four corners of the map and the coordinates at the start (xyz)
Shelf arrangement (.csv)	
Format	Shelf number, Arrangement coordinates (xyz), Width, Depth, Direction to pick

WMS data

Picking operation (.csv)	
Format	Worker number, Time picked, Shelf number, Number of picks

Dataset list for logistics warehouse B

Sensor data of terminal

Sensor data when the terminal is placed on a stationary flat surface (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt
Sensor data when writing a figure 8 in the air with the terminal in hand (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt
Sensor data when picking with the terminal attached (.txt)	
Format	Unixtime, Angular velocity (xyz), Acceleration (xyz), Magnetism (xyz), Gyro temperature(xyz), Temperature, Atmospheric pressure, Δt , BLE reception information

Map information

Map image (.png)	
Map size (.csv)	
Format	The coordinates of the four corners of the map and the coordinates at the start (xyz)
Shelf arrangement (.csv)	
Format	Shelf number, Arrangement coordinates (xyz), Width, Depth, Direction to pick

WMS data

Picking operation (.csv)	
Format	Worker number, Time picked, Shelf number, Number of picks

BLE beacon information

BLE beacon information	
Format	MAC address, Installation coordinates (xyz)

How to participate?

The contestants are requested to follow the steps as mentioned below for participating this challenge.

Step1 Request for admission

During the registration period, contestant of the competitions can register themselves as the contestants of the PDR challenge.

Step2 Downloading sample data

If the registration for the PDR challenge is completed, the contestants can obtain a password and a user ID for downloading the sample data of the PDR challenge so that

they start preparing the competition.

Step3 Registration of IPIN conference

Sample data introduced above are not the final data for the competition. Actual test data and participation rights for the competition are exclusively provided for contestants who also completed the conference registration of the IPIN2017.

Step4 Access to the test data for final evaluation

Actual data for the competition are provided after confirmation of the completion of the conference registration. The contestant can obtain another user ID and a password for downloading the actual data for the competition.

Step5 Result submission

Contestants should submit their result of estimation of the trajectory with predetermined format which includes x,y coordinate of the target positions and orientation of the targets with timestamps. Definition of exact format and sample data for submission will be included in the actual data package described above.

Dead-line for result submission: 8 September 2017

Step6 Oral presentation of results at IPIN Conference

Competitors can present their methods and algorithms, and state their advantages of the methods and algorithms in the light of the evaluation criteria in the special session of the competitions during the conference. At the end of the session, the competition organizers will show competitors' results and estimated trajectories. The results will be scored by a composite indicator according to the evaluation criteria.

Evaluation metrics

The final metric will be based on:

- The accuracy of the position estimation
- The naturalness of estimated trajectories considering human's attitude
- The unique criteria for tracking the picking workers

Details

The final score will be calculated by weighted sum of following individual scores.

The final comprehensive evaluation (C.E.) will be calculated as follows:

$$C.E=(E_d *0.2)+(E_s *0.2)+(E_v *0.15)+(E_f *0.1)+(E_p *0.05)+(E_o *0.3)$$

The accuracy of the position estimation

E_d :

E_d is a score based on the Euclidian distance between the ground truth positions and the estimated positions.

E_s :

In this challenge, the competitors can utilize given reference of picking data for cancelling the accumulated errors. Therefore accumulated error is also evaluated by separating the whole trajectory into sections subdivided by the picking data.

E_s is a score based on maximum Euclidian error in each section.

The naturalness of estimated trajectories considering human's attitude

E_v :

The naturalness of walking speed will be scored. If the temporal speed exceed

the threshold defined by average walking speed of human, The score E_v will be deducted by the exceeded speeds and the number of times of the excess. (point-deduction scoring)

E_f :

The frequency of position estimation will be scored. We determined minimal frequency of the estimation as 1 Hz. If the submitted trajectory include blanks (absences of the estimation during the period) of the estimation last for more than 1 sec, the score E_f will be deducted according to the length of the blanks and the number of the blanks.

The unique criteria for localizing the picking workers

E_p :

The correctness of attitude during the picking operation will be evaluated. In particular, workers are supposed to be stopped at the moment of picking operations. The walking speeds at the moments of the picking operation will be scored by the E_p .

E_o :

The collision between the estimated trajectories and the objections in the warehouse will be evaluated. In the warehouse, there are shelves as the objections. The score E_o will be deducted, if the estimated trajectories intrude into the area of the objections.

Important Dates

Open request for admission to competition	From Feb.6th,2017(Mon) to July 7th,2017(Fri)
Notification of admission	Shortly after requested by e-mail
submission of competitor's result	Before Sep.8th,2017(Fri)
Submission of paper (option)	TBD

Contact points and information

Please contact us freely via pdr-warehouse2017@aist.go.jp