

Main contents

- Waypoint placement
 - Make points on floor plan match reality
- Map collection technical details
 - Efficient and reliable data collection
 - Avoid most common pitfalls
- Map coverage and testing
 - Fill the space densely enough
 - Generate map and test it with MC2



Waypoint placement

Waypoint placement

- Purpose
- Floor plan quality and obvious good places
- Not-so-obvious good places
- Adjusting waypoints later on-site with MC2

Waypoint placement: purpose

- Way to tell MC2 exactly where the user is with respect to the floor plan
 - Usually a waypoint is related to some easily recognizable feature or landmark in the floor plan
- Accurate waypoint placement (and check-in) leads to better
 - Paths
 - Speed estimate
 - Better map data => better localization

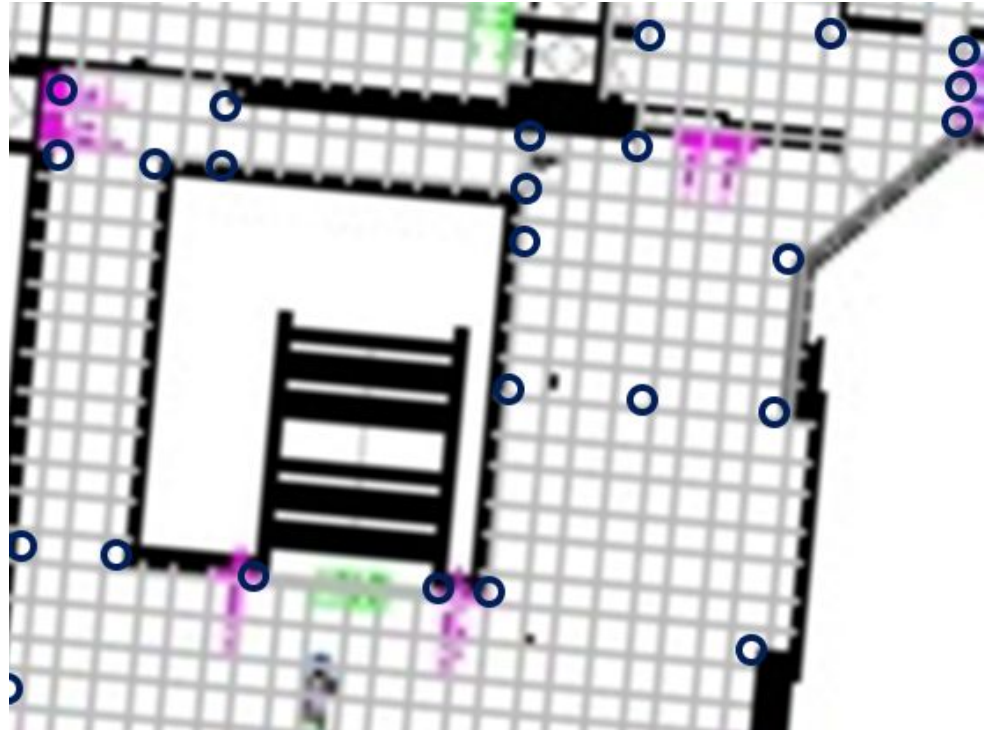
Floor plan quality and obvious good places

- Floor plan should contain enough spatially correct and easily identifiable details (landmarks)
 - You should be able to easily tell that you are standing on or very near a certain spot
 - Good distance from example a pillar or wall is about 0.5-1.0 meter (clear space to walk)
- Some of these make natural and excellent places for waypoints
 - Corners
 - Pillars
 - Entrances, doors
 - Stairs
 - Identifiable floor tilings
 - Walls separating shops (e.g. in malls)



Not-so-obvious good places

- Often easily-identifiable places can be derived from the existing easier waypoint locations
 - Opposite wall of a corner or pillar
 - When walking by, it is easy to verify that you are passing the landmark, only e.g. other side of the corridor
 - Use floor tilings if available: allows using even far-away landmarks
 - Especially in corridors, also the middle point of two waypoints can be used



Adjusting waypoints later with MC2

- The easiest way to add the initial waypoints is with the web tool
- However, often you can not tell from home if certain landmarks really
 - Exist
 - Are usable
 - Match reality
- Use MC2 on-site to
 - Add new waypoints to easily identifiable locations
 - Move the existing waypoints to match reality
 - Delete unusable waypoints (e.g. obstructed by some structure not seen in the floor plan)
 - Use measurement tool to verify distances in unclear cases
 - Grid tool to align waypoints e.g. along long corridors (see MappingGuide)



Map collection: technical details

Map collection: technical details

- Limits of pedestrian dead recognition (PDR)
- Phone orientation
- Walking style
- Beginning the mapping
- Checking into waypoints
- Choosing the mapping paths
- Checking the path validity

Limits of PDR

- Pedestrian dead-recognition (PDR) tries to estimate your path by
 - Estimating your direction by using the phone's orientation (gyroscope)
 - Estimating your speed and movement by detecting steps
- Limitations
 - Even calibrated gyroscope will have some drift
 - Effect depends on path length
 - This is negated by using waypoint check-ins
 - Tells PDR that we are exactly here
 - Corrects drift
 - Steps are sometimes not detected or detected falsely
 - With constant walking speed and normal walking, rarely an issue
 - Irregular walking, e.g. short burst of steps, causes problems
 - Short paths might cause radical error in speed estimation

Phone orientation

- Keep the phone aligned with your walking direction
 - When you turn, the phone should turn as well
 - Easiest way to accomplish this is to keep the phone or your arm against your stomach
- Phone approximately at 1 m height
 - Little above the waistline is fine
- Avoid rapid movements

Walking style

- Prefer
 - Constant speed
 - Natural walking
 - Clear, normal steps (no smooth ninja style here)
 - Straight lines (or smooth curves)
- Avoid
 - Varying step length
 - Sharp turns
 - Too much stopping or short continuous walking phases
 - Hard for PDR to detect single/few steps
 - Very short paths between two waypoint check-ins
 - Speed estimate might get confused

Beginning the mapping

- Make sure the radio scans are on (WiFi and BLE)
 - MC2 notifies about this (do not ignore!)
- Do-not-disturb mode recommended
- Currently we suggest using single phone model for mapping a venue
- Open MC and the correct floor plan
- Find yourself on the floor plan
- Choose the two initial waypoints where to start mapping
 - Good distance ~10-20 m to estimate the speed more reliably
- Walk to the exact location of the 1st waypoint
 - Select it
 - Start recording
 - Select the 2nd waypoint
 - Walk to the 2nd waypoint location
 - Check-in

Checking into waypoints

- When checking into waypoint make sure
 - You are actually in the location where the waypoint is (0.5 m accuracy recommended)
 - This may differ from path estimate
 - Do not try to trick it by altering your path or phone orientation
 - Check-in normally
- Automatic waypoint selection
 - Waypoint is selected automatically to be the closest candidate based on path estimate
 - Often speeds up mapping, as only single click is needed to check-in
- Manual waypoint selection
 - When path estimator has error (e.g. speed estimate is wrong)
 - When there is multiple close-by waypoints
 - The safest way

Choosing the mapping paths (1 of 2)

- Easily walkable, simple paths
 - Preferably straight path from waypoint to another
- Clear landmarks with waypoints
 - Not too far
 - Good maximum distance 10-20 m
 - Depending on the PDR drift
 - Not too close
 - Good minimum distance ~5 m
 - With continuous walking sometimes possible to use closer waypoints (~3 m)
- When beginning, prefer shorter paths
 - 1-2 minutes or less
 - 4-7 waypoints or less
 - Easier to do over if something goes wrong
 - With experience and confidence possible to collect longer paths (max duration 5 min)

Choosing the mapping paths (2 of 2)



- For efficiency and best coverage prefer paths that
 - Systematically fill the space
 - Do not completely overlap
- Do not walk over walls
 - This can be avoided by checking-in more often to correct waypoints
 - Very small overlap with walls is ok

Checking the path validity

- After stopping the recording, check the path validity
 - Not going over walls
 - Corresponding to your actual walking path
 - No wrong check-ins
- Especially if there are automatic warnings displayed
 - Double-check that everything is really ok with your path before saving
 - If not, collect the path again



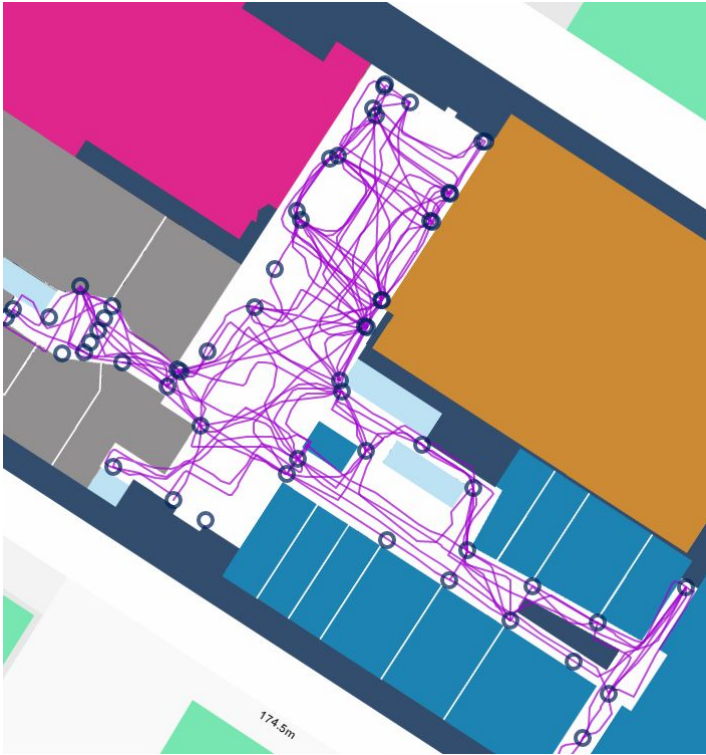
Map verification: coverage and testing

Map coverage (1 of 2)

- After mapping the most obvious paths, fill the rest of the map by
 - Collecting paths with different waypoint-configurations
 - Walking curved lines in non-mapped areas
- The more densely we can afford to map, the more accurate map we will receive
- Good rule of thumb for path distance is ~2m
 - For corridors > 3 meters, collect at least two paths
 - Different “lanes”
 - Preferably in both directions
 - In open spaces, where there is less magnetic variation and exact location is not necessarily so important, the mapping can be somewhat more sparse (~3-4 m)
- Actual performance must be verified by testing

Map coverage (2 of 2)

- Examples of mapping coverage in our local demo mall (Valkea)



Map generation and testing

- After finished mapping
 - Wait for all paths to upload
 - Generate map
- MC2 has the functionality to test the localization with either
 1. Fixed to the selected floor plan
 - Good to test single floor plan mapping quality/performance
 2. Using our full floor detection logic
 - Gives an accurate image how the localization is going to work with multiple floor plans like in actual situation
- If needed, map more and repeat
 - Concentrate on problematic areas