Claims

1. An apparatus for reducing error in indoor positioning, the apparatus comprising:
a memory;
a processor configured to execute instruction in the memory to operate the apparatus to:
receive an image of an indoor floor plan of a building;
extract from the image a first plurality of pixels marking out a first area inaccessible for indoor positioning and a second plurality of pixels marking out a second area accessible for indoor positioning;
assign position coordinates to the first plurality of pixels and the second plurality of pixels;
receive position coordinates of a target position in the indoor floor plan from a localization engine;
determine whether the position coordinates of the target position matches position coordinates of the first plurality of pixels so as to determine whether the position coordinates of the target position has to be replaced by position coordinates of the second plurality of pixels~~.~~

~~2. The apparatus as claimed in claim 1~~,
wherein the first plurality of pixels are provided with a tolerance to close any gap between pixels joining up as a solid line.

~~3~~2. The apparatus as claimed in claim 1~~ or 2~~, wherein the apparatus is ~~operated~~ operable to:
in order to assign the position coordinates to the first plurality of pixels and the second plurality of pixels,
determine a shape of the indoor floor plan of the building from pixels of the indoor floor plan,
obtain position coordinates from an outdoor mapping system outlining an outdoor structure perimeter shape of the building; and
determine whether the determined shape of the indoor floor plan matches the outdoor structure perimeter shape,
wherein if a match occurs, the position coordinates outlining the outdoor structure perimeter shape are mapped to the pixels of the indoor floor plan and the pixels of the indoor floor plan are provided with position coordinates taking reference from the outdoor structure perimeter shape that is mapped.

~~4~~3. The apparatus as claimed in any one of the preceding claims, wherein if position coordinates received from the localization engine is a single target position, the apparatus is ~~operated~~ operable to replace the position coordinates of the target position with the position coordinates of the second plurality of pixels after determining that the position coordinates of the target position matches position coordinates of the first plurality of pixels.

~~5~~4. The apparatus as claimed in any one of the preceding claims, wherein if position coordinates received from the localization engine forms a path or is to form a path, the apparatus is ~~operated~~ operable to replace the position coordinates of the target position with the position coordinates of the second plurality of pixels after determining that the position coordinates of the target position matches position coordinates of the first plurality of pixels.

~~6~~5. The apparatus as claimed in any one of the preceding claims, wherein the apparatus is ~~operated~~ operable to replace the position coordinates of the target position with the position coordinates of the second plurality of pixels after determining that the position coordinates of the target position matches position coordinates of the first plurality of pixels and after a check against calculations of a statistical model taking into consideration historical data of previous

position coordinates provided by the localization engine and position coordinates replaced by the apparatus.

~~7~~6. The apparatus as claimed in claim ~~6~~5, wherein if the apparatus is to fine tune movement tracking of a target object by the localization engine or fine tune a path provided by the localization engine for movement of the target object, the statistical model comprises a predictive function for predicting position coordinates of a next position of the target object that is to be provided by the localization engine based on historical data of movements of the device and traffic pattern of one or more neighboring devices that is also tracked by the localization engine.

~~8~~7. The apparatus as claimed in claim ~~6 5~~ or ~~7~~6, wherein if the apparatus is to fine tune movement tracking of a target object by the localization engine or fine tune a path provided by the localization engine for movement of the target object, the statistical model comprises a probabilistic function considering weightage of position coordinates provided by the localization engine, wherein the weightage is assigned based on distance coverable by a current speed of the target object and distance coverable by neighboring one or more target objects that is also tracked by the localization engine.

~~9~~8. The apparatus as claimed in claim ~~8~~7, wherein the weightage to be assigned is adjusted based on:

(a) a detection area surrounding the target object, wherein the detection area comprises an inner perimeter and an outer perimeter set relative to the target object, wherein the inner perimeter is within the outer perimeter, and probability of a predicted next location of the target object within boundaries of the inner perimeter is higher than probability of the predicted next location outside the inner perimeter but still within boundaries of the outer perimeter; and/or

(b) a predefined non-allowable area and/or proximity of a current coordinate of the target object to the predefined non-allowable area; and/or

(c) a detected direction that the target object is facing.

~~10~~9. The apparatus as claimed in any one of claims ~~6 5~~ to ~~9~~8, wherein if the apparatus is to fine tune movement tracking of a target object by the localization engine or fine tune a path provided by the localization engine for movement of the target object, the statistical model comprises a cluttering function that is a function of a factor derived from a comparison of position coordinates fine-tuned by the apparatus with the historical data during a specific time frame and location of the indoor floor plan.

~~11~~10. The apparatus as claimed in any one of claims ~~6 5~~ to ~~10~~9, wherein the statistical model is a logistic regression model, and an output of the logistic regression model is compared with a system threshold value to determine if the position coordinates of the target position is a non-likelihood pixel, wherein if the position coordinates of the target position is a non-likelihood pixel, the position coordinates of the target position is replaced with a nearest likelihood pixel using nearest k-algorithm, wherein the nearest likelihood pixel is one of the second plurality of pixels.

~~12~~11. The apparatus as claimed in any one of the preceding claims, wherein if position coordinates received from the localization engine forms a path or is to form a path, the apparatus is operated to:

determine for position coordinates of each position received from the localization engine whether there is a change of direction that results in turning of the path;

increase a count of a counter if determined for that position that there is a change of direction that results in turning of the path; and

replace the position coordinates of any position that matches position coordinates of the first plurality of pixels with position coordinates of the second plurality of pixels directing the turning of the path when the count is increased beyond a predetermined threshold value.

~~13~~12. The apparatus as claimed in claim ~~12~~11, wherein

the count of the counter is increased if determined for that position that there is a change of direction that results in turning of the path, and if a check against historical data indicates probability of turning of the path exceeds a predetermined probability threshold.

~~14~~13. The apparatus as claimed in claim ~~12~~ 11 or ~~13~~12, wherein the change of direction that results in turning of the path is determined based on input from a directional sensor.

~~15~~14. The apparatus as claimed in any one of claims ~~12~~ 11 to ~~14~~13, wherein the change of direction that results in turning of the path is determined based on whether position coordinates of positions received from the localization engine forms a line that intersects with position coordinates of the first plurality of pixels.

~~16~~15. The apparatus as claimed in any one of claims ~~12~~ 11 to ~~15~~14, wherein the change of direction that results in turning of the path is determined based on curve fitting of position coordinates of positions received from the localization engine.

~~17~~16. The apparatus as claimed in any one of claims ~~12~~ 11 to ~~16~~15, wherein the change of direction that results in turning of the path is determined based on whether position coordinates of one of two consecutive positions provided by the localization engine matches position coordinates of the second plurality of pixels in a predefined area surrounding an entrance, exit or junction in the indoor floor plan and the other one of the two consecutive positions matches position coordinates of the first plurality of pixels in the predefined area surrounding the entrance, exit or junction in the indoor floor plan.

~~18~~17. The apparatus as claimed in any one of claims ~~12~~ 11 to ~~17~~16, wherein the apparatus is ~~operated~~ operable to determine for position coordinates of each position received from the localization engine whether there is a change of direction that results in turning of the path when the received position coordinates of the position from the localization engine is in a predefined area surrounding an entrance, exit or junction in the indoor floor plan.

~~19~~18. The apparatus as claimed in any one of the preceding claims, wherein the apparatus is ~~operated~~ operable to receive another image of the indoor floor plan comprising specific non-allowable zone for extracting as the first plurality of pixels.

~~20~~19. A method for reducing error in indoor positioning, the method comprising:

receiving an image of an indoor floor plan;

extracting from the image a first plurality of pixels marking out a first area inaccessible for indoor positioning and a second plurality of pixels marking out a second area accessible for indoor positioning;

assigning position coordinates to the first plurality of pixels and the second plurality of pixels;

receiving position coordinates of a target position in the indoor floor plan from a localization engine; and

determining whether the position coordinates of the target position matches position coordinates of the first plurality of pixels so as to determine whether the position coordinates of the target position has to be replaced by position coordinates of the second plurality of pixels,

wherein the first plurality of pixels are provided with a tolerance to close any gap between pixels joining up as a solid line.