WHAT IS CLAIMED IS:

1. A system for an autonomous mobile robot to ride and co-share an elevator with humans, comprising:

a human detection and localization module configured to detect and locate at least one human relative to an autonomous mobile robot;

a human identification and state estimation module connected to the human detection and localization module and configured to identify and estimate a state of the at least one human;

a human-robot-interaction module connected to the human identification and state estimation module, wherein when an elevator riding task is started, the at least one human inside and outside the elevator is detected and counted through the human detection and localization module and the human identification and state estimation module, and the human-robot-interaction module is configured to interact with the at least one human; and

an elevator confined space positioning module connected to the human detection and localization module, the human identification and state estimation module and the human-robot-interaction module, wherein the elevator confined space positioning module carries out a space positioning inside the elevator according to a result of detecting and counting the at least one human through the human detection and localization module and the human identification and state estimation module, wherein the autonomous mobile robot is configured to perform an elevator occupancy state estimation to identify an available position with at least one traversable path, and is configured to choose to enter the elevator or restart another elevator riding task,

wherein the autonomous mobile robot is configured to determine an elevator floor panel to use and to determine an optimal position to wait in the

elevator with considerations of at least the elevator occupancy state and the elevator floor panel to use.

2. The system according to claim 1, further comprising a sensing and perception module for pre-process sensor data and information integration, information preprocessing and transmission of original sensors using communication.

3. The system according to claim 2, further comprising an elevator landmark detection and localization module connected to the sensing and perception module, wherein the elevator landmark detection and localization module allows to locate elevator door and elevator buttons inside and outside.

4. The system according to claim 3, further comprising an elevator actuator module, wherein the elevator actuator module allows to actuate/press the elevator buttons.

5. The system according to claim 2, wherein the sensing and perception module receives perception source for filtering and fusing.

6. The system according to claim 5, wherein the perception source is captured through a 2D/3D camera, a 2D/3D LiDAR, a sensor array or a combination thereof.

7. The system according to claim 5, wherein the human detection and localization module and the human identification and state estimation module are connected to the sensing and perception module to receive human features and cooperated to provide human poses and human count to the human-robot-interaction module based on the human features.

8. The system according to claim 1, wherein the human-robot-interaction module comprises a human-machine-interface (HMI) allowing a user to interact with the autonomous mobile robot and provide inputs and receive visual display or aids.

9. The system according to claim 1, wherein the human-robot-interaction module comprises an audio input/output array for audio interaction with the at least one human.

10. The system according to claim 1, wherein the human-robot-interaction module comprises an LED signal indicator for additional visual display or aids.

11. A method for an autonomous mobile robot to ride and co-share an elevator with humans, comprising steps of:

(a) navigating an autonomous mobile robot to an elevator lobby, wherein the autonomous mobile robot allows to detect and locate at least one human relative to the autonomous mobile robot, and allows to identify and estimate a state of the at least one human;

(b) pressing a button on a call panel through the autonomous mobile robot so as to start an elevator riding task;

(c) detecting that the elevator is in a door-open state or a door-close state through the autonomous mobile robot;

(d) detecting the at least one human inside and outside the elevator, and counting the at least one human through the autonomous mobile robot when the elevator is in the door-open state; and

(e) carrying out a space positioning inside the elevator according to a result of detecting and counting the at least one human through the autonomous mobile robot, wherein the autonomous mobile robot is configured to perform an elevator occupancy state estimation to identify an available position with at least one traversable path, and choosing to enter the elevator or restart another elevator riding task,

wherein the step (e) further comprises determining an elevator floor panel to use by the autonomous mobile robot and determining an optimal position

to wait in the elevator with considerations of at least the elevator occupancy state and the elevator floor panel to use.

12. The method according to claim 11, further comprising a step of determining the at least one human in and outside the elevator and determining positions and counts of the at least one human.

13. The method according to claim 11, further comprising a step of estimating an occupancy state of the elevator with reference to a 2D map related to a space inside the elevator and determining which elevator floor panel to use.

14. The method according to claim 11, further comprising a step of navigating the autonomous mobile robot into the elevator.

15. The method according to claim 11, further comprising a step of interacting with the at least one human for exception handlings in case of that the at least one human is blocking the call panel, the at least one human enters/exits the elevator, or the at least one human is blocking a floor panel.

16. The method according to claim 15, wherein visual displays on HMI/LED or voice commands are used for interacting with the at least one human.

17. The method according to claim 16, further comprising a step of stopping motion when the at least one human enters a safety stop zone of the autonomous mobile robot and alerting the at least one human by using the visual display on HMI/LED or the voice commands.

18. The method according to claim 16, further comprising a step of notifying the at least one human in the elevator of the autonomous mobile robot’s intended motion by using the visual display on HMI/LED or the voice commands.