

Stockbot

The collaborative robot for inventory management



Stockbot enables...



- **Automatic** in-store item **localization**
- **Planogram** compliance
- Increase sales by **reducing OOS** situations
- **Optimization** of inventory management
- **Automatic In-store** item localization (1m accuracy)
- Better **data-driven decisions** & big data opportunities



Stockbot

Autonomous inventory-taking robot



-  0.45m x 0.45m x 1.8m
-  **RFID** enabled
-  **Vision** recognition
-  **3D location** of items
-  Advanced Autonomous Navigation



Vision Cameras System:

- **RFID** and/or **Vision** in one single device
- **Picture-taking** is automated and includes image localization



Risks: Environment and people's behaviour

Environment:

- Things at different heights: tables (even tables where the table top is more protruding than the table legs), shelves and clothes hangers, things dropped off, lights from the ceiling
- Narrow corridors between furniture
- Structural obstructions: stairs, elevators, mirrors, tables and escalators

People description:

- People not aware of the robot, static or moving
- Old, young, kids, animals (usually dogs)

People behaviour:

- Normally the robot is ignored, people are focused on purchasing
- Kids can try to interact with the robot
- Most people move and let the robot continue
- People not move fast



List of “dangerous situations” according to tests

Dangerous situations in the retail domain

1. Obstacles at different heights that can impact on the robot



2. Materials that are not visible by sensors



List of “dangerous situations” according to tests

Dangerous situations in the retail domain

3. Light conditions
4. Robot not localized
5. Uneven surfaces



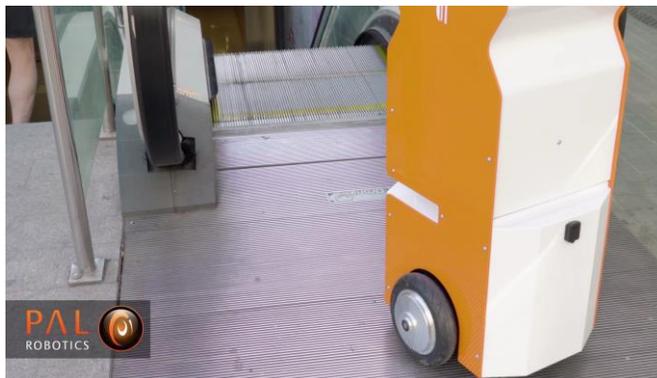
List of “dangerous situations” according to tests

Dangerous situations in the retail domain

6. Dynamic obstacles



7. Structural handicap of the environment



- In the **COVR toolkit** Stockbot falls in the category of mobile robot in the domain of Consumer.
- The standard suggested is the **ISO 13482** that describes safety requirements for personal care robots.
- Experimental safety measures that we want to test for a robot in the retail domain:
 - **Avoid different static obstacles at different heights.** Obstacles at different heights and different materials. Robot navigating autonomously.
 - **Avoid dynamic obstacles.** A dynamic obstacle crosses the path of the robot at different speeds in different directions.
 - **Deal with steps and gaps.** The robot has to be able to deal with different steps and gaps and it has not to fall.
 - **Maximum inclination.** Measure the inclination angle that makes the robot fall.
 - **Impacts.** With the robot navigating linearly or rotating at maximum working speed measure the impact generated at different heights.



Early risk mitigation measures

The risk mitigation measures depend on the specific robot, on his structure, on the environment where it has to work. The list of the early risk mitigation measures adopted by Stockbot after an early risk analysis is (before the safety tests):

1. **Speed limits and acceleration lowering.** Limitate the velocity and acceleration of the robot to navigate, to reduce the impact when collisions occur.
2. **Bigger deceleration.** The deceleration is bigger than the acceleration such as to stop faster. Thus to make the robot faster to break in case of obstacles and possible dangerous events.
3. **More sensors and devices.** Installation on the robot of specific devices useful to detect a specific dangerous situation, like for example infrared or depth cameras pointing to the floor to detect “holes” like escalators going downwards. Devices like cameras to better detect people and static and dynamic obstacles as well.
4. **Lowering the center of gravity.** Lowered the center of gravity of the Stockbot robot to reduce the possibility to fall in case of slop or because somebody is pushing it. It was very important for our robot due to its height is about up to 1.8 meters.



A close-up photograph of a white, articulated robotic hand gently holding a human hand. The background is a soft, out-of-focus grey. The text 'Thank you!' is overlaid in large white font across the center of the image.

Thank you!

PAL

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