Simultaneous Localization and Mapping (SLAM) for Indoor Navigation

When we humans enter and discover an unknown environment we are implicitly performing SLAM.

Mapping:

With our senses we detect features, e.g. landmarks like street name signs, crossroads, remarkable buildings or trees, parks, lakes, etc. We memorize these “features” and set them in a spatial relationship: “The parking lot is behind the tall building. The street leading to it is framed with these beautiful linden trees. We have to take the third turn to the right.” This is mapping. This implicit map in our head is slowly growing, densified, corrected and improved as we are roaming around.

Localization:
We are positioning ourselves in that map: “I am close to the windmill, three minutes away from the museum.”

SLAM in Robotics:
This simplified behavioral model can be transferred to autonomous mobile robots. To make them really autonomous they have do do something link SLAM. It is a standard problem in robotics.

The System:
Our research assistant Harley Lara built the first flying robot (drone) in our team which is capable of SLAM. The flight attitude and stability of the drone is controlled by the standard open source flight controller PX4. This is responsible for the core functionality of the flying platform. It makes it flyable. The SLAM algorithm is run on a companion computer (here NVIDIA Jetson Xavier NX) which at the final stage of development will be responsible for the mission, i.e. the autonomous navigation, path decision as well as other higher level mission intention such as search and rescue (SAR) of people in disaster areas. This mission control computer tells the flight controller where to go.

The video shows the first experiment.

Fig.: First SLAM test by Harley Lara.

Our self-made drone (a flying robot) for SLAM demonstration consists of:

- PX4 flight controller
- NVIDIA Jetson Xavier NX as companion computer running ROS2
- Intel T265 Tracking Camera
- Intel D435i Depth Camera
- Hexacopter frame DJI Flamewheel F550