***Flight path planning*:**

For this problem we propose solution that uses the tags situated on astronaut's suites to map the space-station area and to use the drone itself, equipped with proximity and distance measurement sensors to help mapping 3D space.

As the astronauts/drone move around, their position can be stored in the database, thus creating 3D routing path maps.

***Problems:***

Planning flight paths, for drone to follow, in order to find payload and to get the object to its destination. Deviation from the path due to danger of collision (moving objects or obstacles).

***Solution(s):***

**Path finding:**

Using the same algorithms to find position (in real-time) of drone, we can apply the same to astronaut's, thus, them helping us to map the hallways of the space-station and help us plan the flight paths.

Similar projects have already been done [1], [2] by companies and researchers.

With incorporation of other sensors like proximity detectors and (laser) distance measurement sensors, we could even create a map of 3D space inside space-station like in example referenced with [3].

The database, with the routing paths, can be stored on device, but in order to have better scalability because of possible data storage problems (size will grow with time), this database should be stored elsewhere.

With each of the compartments having it's own id, querying of the pathway/mapping database would be done only for the compartment that drone is currently in.

**Collision preventing and maneuvering around obstacles:**

When one of multiple proximity/distance measuring sensors detects that distance to an object is being reduced, the flight control software should activate in order to compensate for environmental changes. When successful in avoiding collision, the drone should try to get back to predefined path.

Our solution would be based upon the article [4] with these modifications: the predefined path will act as “manual” control, in this case, while the collision detection and avoidance will work to compensate and help maneuver the drone around the obstacle.

Predefined path will be controlled and calculated with knowledge of orientation and position of the drone (by having at least 4 tags on the drone itself).

The algorithms will work in terms, and doing differential corrections, thus adapting the new path to deviate as little as possible from the original flight plan. Also, the effect of these algorithms will be weighted. The bigger possibility of collision is – the longer the period for path corrections of the avoidance control will be. And vice versa – the less the collision threat is, the “more drone will try to get back to predefined route. In order to allow this to work in no-atmosphere surrounding – we will try not to use the sound-based sensors, but rather rf ones.

**Additional problems we solve (as a bi-product):**

Backtracking positions of astronauts which can be used for black-box recording and/or in case of hazardous situations, giving us ability to quickly locate and help astronaut in danger.

[1] <http://www.ion.org/jnc/abstracts.cfm?paperID=1596>

[2] <https://www.xsens.com/customer-cases/mapping-indoor-environments-based-human-activity/>

[3] <https://www.youtube.com/watch?t=88&v=IMSozUpFFkU>

[4] http://arl.cs.utah.edu/pubs/ICRA2014-aca.pdf