CPSwarm

Final Workshop

Towards Smart Autonomous Cyber-Physical Systems:
Unmanned Aerial/Ground Vehicles and Robots

Search & Rescue Scenario

Swarm of drones & rovers

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CPSwarm implementation

- Description of work from Official Documentation (D2.1):
  - *“We will consider heterogeneous swarms of ground robots/ rovers and UAVs to conduct certain missions in the surveillance of critical infrastructure e.g., industrial or power plants as well as in Search and Rescue (SAR) tasks.”*

- Swarms can be exploited for:
  - Generating a situation overview of the disaster scene in case of an industrial plant accident including real-time images (VIS, IR), toxic and explosive gas leakage detection.
  - Finding human casualties or persons trapped in the disaster area.

SAR SCENARIO

SWARM OF DRONES & ROVERS

Search & Rescue Scenario

- In CPSwarm we consider heterogeneous swarms of ground robots/rovers and UAVs to conduct certain missions in the surveillance of critical infrastructure like industrial or power plants, search and rescue (SAR) and fire detection.

- The use case exploits different types of robots to approach an area and support rescuers/guardians by: mapping the actual state with a 3D map, finding people, tracking them and checking on their condition using computer vision, identifying safe passages for rescuers.

- Smaller robots (rover/UAV) in the swarm are employed to map the environment and possibly move inside narrow passages whereas "bigger" robots could either guide rescuers to people.

Search & Rescue Scenario

- The test setting will be composed by a mixed swarm of **5 drones** and **3 rovers**.
- The scenario will take place in an industrial or power plant where the swarm will conduct a SAR task.
- A **control station** will be used to configure some parameters of the mission (e.g. the extension of the area to monitor) and to collect data coming from the sensors placed on the CPSs.
- During the mission, drones and rovers will collaborate in order to find persons trapped in the industrial area (represented by graphical markers, e.g. QR codes) and help them to reach the exits of the plant.
- **Unexpected events** will be introduced in the scenario in order to simulate a dynamic situation (e.g. one of the exits will be blocked by some obstacles).
- We would like to demonstrate that the swarm can **reduce** the inspection/detection times compared to a single UAV/rover application.

Mission description

- At the beginning of the mission:
  - The drones patrol the selected area using an optimized swarm strategy.
  - The rovers wait for a call for intervention.
  - Every fixed amount of time (e.g. 500ms) all the members of the swarm communicate each other (and to the control station) their position in a broadcast channel.

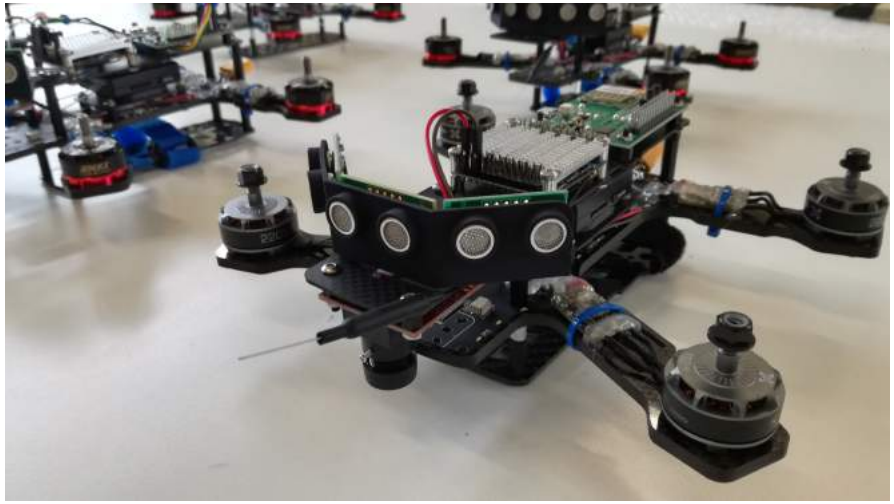
- When a drone discovers one of the casualties (markers):
  - The drone communicate the position of the marker to the rovers (and the control station) and start to hover above the marker communicating possible changes of position.
  - The rovers decide which one is more suitable to reach the casualty (e.g. the closest rover is selected).
  - The selected rover reach the marker using an emergency exit strategy exploiting is current knowledge of the area and information coming from other CPSs.
  - After reaching the selected point, the rover will reach the closest exit.

Drone architecture - hardware

Single Board Computer (companion)
- Ubuntu 16.04, kernel Linux 4.11Real-Time
- CPU Quad-core Cortex-A7 1.2 GHz
- Storage 32GB eMMC Storage
- Wifi 802.11b/g/n, Bluetooth 4.0 dual mode
- DVP Camera Interface
- GPIO, UART, PWM, I2C, SPI

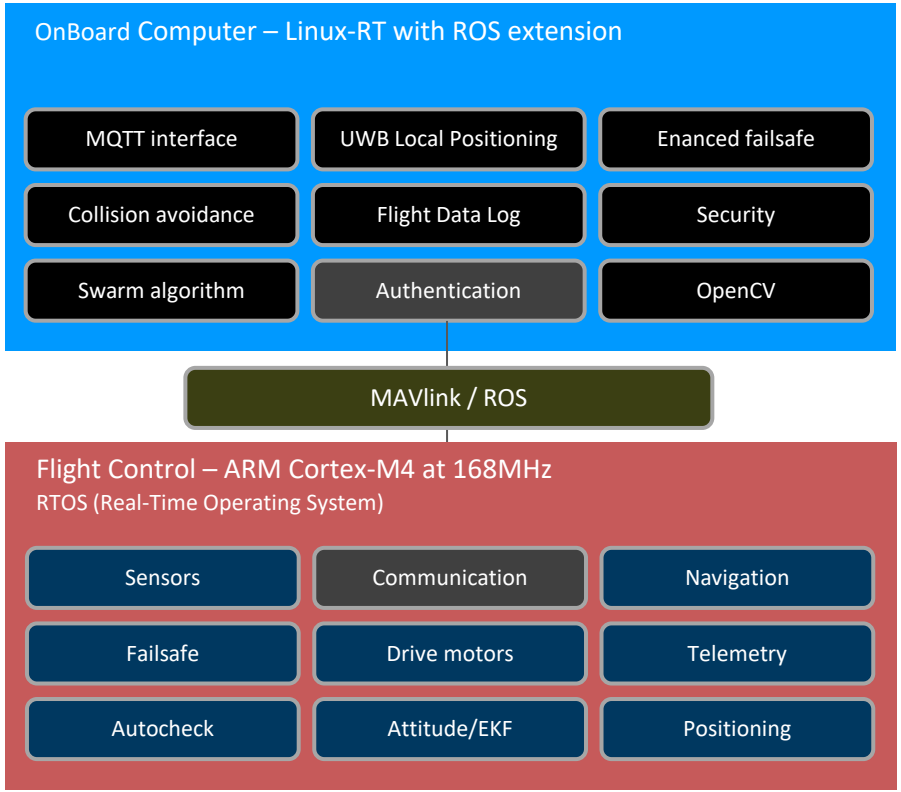
Proximity sensors
- ultrasonic range finder (3 sonars)
- 0 to 6.5 meters, accuracy: 2.5 cm

Ultra-Wideband Local Positioning
- DecaWave DWM1001
- Ranging precision of 10 cm
- Up to 100 m Line Of Sight

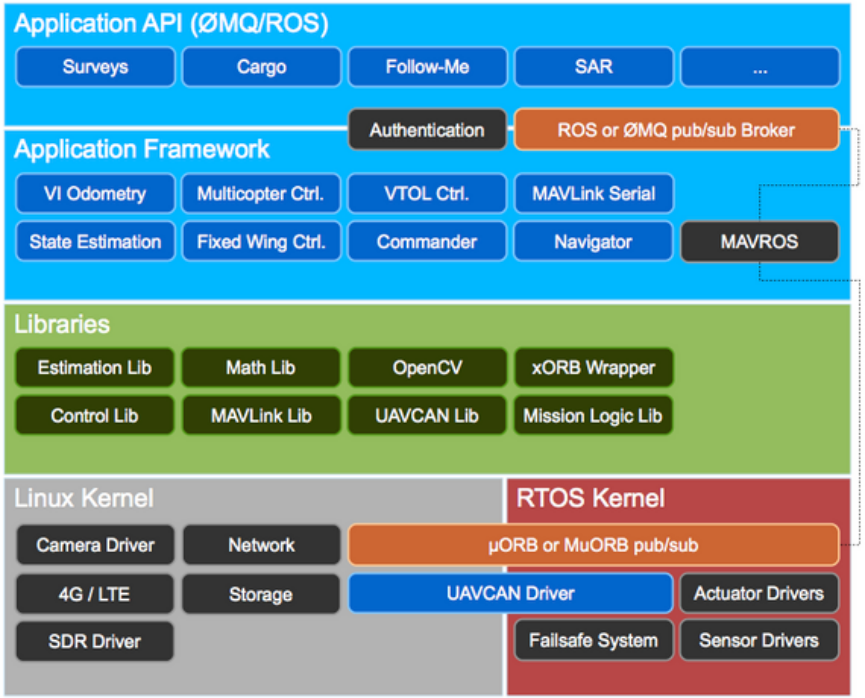


Camera
- CMOS OV5640 chipset
- 5M-pixel (2.592 x 1.944)
- Transfer rate: 1080P@30fps, 720P@60fps
- DVP Camera Interface

Drone architecture - hardware



Drone architecture - software



VIDEO

SAR SCENARIO

THANKS!
ANY QUESTIONs?

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