Chair of Spacecraft Systems
TUM School of Engineering and Design
Technical University of Munich

Engineering Project

Student: Team of up to 3 Students

Start date: As soon as possible

Topic: *Development of a Raspberry Pi-Based Multi-Sensor Bus Unit for Stratospheric Balloon Missions*

Goals

Develop a ready-made bus unit based on a Raspberry Pi 4B or 5 that integrates a power bank, temperature sensors, pressure sensors, IMU, cameras, and external communication interfaces.

Primary Objectives:

- Capture sensor data at specified intervals:
    - Temperature and pressure every 1 second.
    - IMU data every 0.1 second
- Record continuous FullHD video using two cameras, with start/stop control.
- Enable communication with external devices via UART, SPI, and I2C.
- Standardize data output into formatted packages.
- Ensure reliable operation powered by a standard 20,000 mAh power bank

Tasks

Requirement Definition:

- Analyze the project requirements and document specifications for hardware and software components.

Hardware Setup and Integration:

- Configure the Raspberry Pi for interfacing with temperature, pressure sensors, IMU, and cameras.
- Set up power management with a 20,000 mAh power bank.

Software Development:

- Write Python scripts to:
    - Read and log sensor data at the required intervals.
    - Manage camera operations and video recording control.
- Implement protocols for external communication via UART, SPI, and I2C.
- Package data into a standardized format for easy interpretation.

Testing and Validation:

- Validate the functionality of sensor readings, video recording, and external communication.

- Conduct endurance tests to ensure reliability under continuous operation.

Documentation and Wiki Creation:

- Prepare a GitLab repository with:

    o Well-commented source code.

    o Detailed README for setup, usage, and troubleshooting.

- Create a wiki with images and tutorials for easier replication and understanding.

Final Report and Presentation:

- Write a concise report summarizing the approach, results, and challenges.

- Prepare and deliver a presentation to showcase the project outcome.

Requirements

- Knowledge of Python, C/C++ or another programming language used to implement embedded system sensors

- Basic familiarity with sensors and embedded systems

Expected results:

- A Raspberry Pi-based bus unit capable of meeting the specified requirements.

- Source code, documentation, and a detailed wiki hosted on a GitLab repository.

- A short report and presentation summarizing the project's objectives, methodology, and results.

Supervisor

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