SURPRISE

SUPER-RESOLVED COMPRESSIVE INSTRUMENT IN THE VISIBLE AND MEDIUM INFRARED FOR EARTH OBSERVATION APPLICATIONS

Summary of Deliverables “Sync Electronics Board” [D6.2] & “Data Handling System” [D6.4]

CSEM with participation of CNR – IFAC, SAITEC, PoliTo

1. Summary of Deliverable content

The scope of the Sync Electronics Board deliverable (D6.2) is to provide a detailed description of the control electronics, also referred to as the Master Unit (MU), that drives the different subsystems of the SURPRISE demonstrator. Together with the data handling system deliverable (D6.4), a complete description of the control electronics and software of the demonstrator is given.

As illustrated in Figure 1, the demonstrator architecture comprises several actuators and sensors to be controlled and monitored by the MU. Deliverables 6.2 and 6.4 describe the selected hardware and designed software for the MU to communicate with the scanning system, the DMD, both MWIR detectors, the high-resolution camera and the spectrometer.

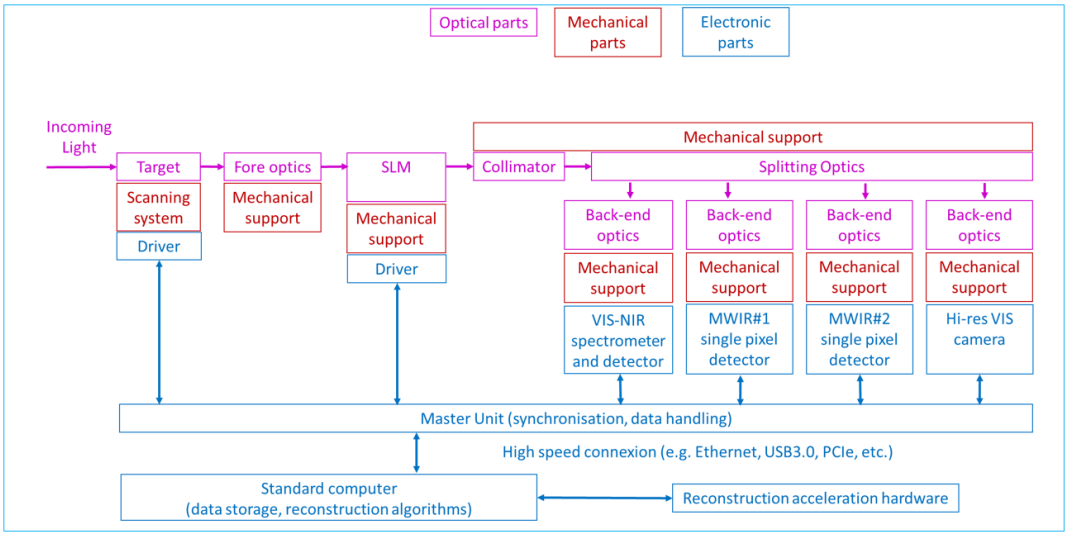

Figure 1: Block diagram of the SURPRISE demonstrator's overall architecture

While an FGPA was originally foreseen to be used to drive all the different subsystems, it appeared more optimal to rely on a standard industrial PC at this prototype validation phase. This choice eased the integration of subsystems' communication protocols since most of manufacturers deliver libraries for high-level communication protocols. Nevertheless, an emphasis on custom electronics for space is foreseen in the tasks of WP6.

Almost all devices are communicating with the MU via USB, except for the scanning system that communicates via Ethernet. The MU can either be operated locally through a command prompt interface or remotely via Ethernet through a client-server interface.

The MU software is coded in C++ compiled with Visual Studio 2019 16.9.4 (compiler MSVC 14.28) and is organised as follows:

- A "StateMachine" class and its child are responsible for the general behavior of the master unit, the core application logic.
- A "Device" class and its children are responsible for device-specific logic and communication, interfaces to the different hardware.

2. Main Innovations / New knowledge

The hardware and software architecture of the MU are relatively specific to our demonstrator. Nevertheless, the use of a generic approach to communicate with all devices allows future adaptations with minor effort and possible use of the knowledge for other systems. The key concepts that were applied during the development of the MU are listed in the table below.

Concept	Selected architecture
Software classes	Separation of code between a “StateMachine” and “Device” classes facilitates the integration or replacement of hardware subsystems. Also, it allows a common communication protocol for all devices independently from their nature (actuators or sensors), simplifying importantly the code.
State Machine	The definition of a data acquisition sequence in a state machine allowed ensuring a proper synchronisation of all devices, with a certain complexity.
JSON files	Communication and configuration of all devices is performed via files in a JSON format. This offers a simplified and standard protocol each device. The scanning system developed within the project relies on the same protocol, facilitating the integration.
Measurements storage	All measurement data files are saved in a folder comprising a time-stamp and composed of sub-folders for the different devices. The nominal path can be changed by the user during MU execution.

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