UML for Embedded Systems

Retake Exam FALL 2024

Survey Mapping System for Land Surveyors

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During an exam, you are not supposed to talk with anyone else, by any means (including mobile phones, chat, etc.), see assignment A below. If you are on site, you have to use a Eurecom Desktop. You can use only TTool or the website of UMLEmb, and a local edition software for your report (no web-based edition software). NOTHING ELSE.

A grade is provided for each question. 1 bonus point is awarded for writing quality (report and models).

1 Objective

Your objective is to model a **Survey Mapping System for Land Surveyors**.

You have exactly 3 hours to model this system and answer various questions: the time is very short. This means that **you have to make modeling assumptions**. **Keep your diagrams simple and readable**, in particular the analysis diagrams.

Your grade takes into account your report and your models. At the end of the exam, **reports** (in **pdf** format) and one **model** file (in **TTool XML** format) **must be sent to me by email**, with Alexia Cepero and Romain Duplan in cc. The report is optional if you decide to put all explanations in your TTool model. If you were to send me a report, the report should contain explanations concerning your models, as well as relevant screen captures of models (e.g., interesting simulation traces, formal verification results).

2 System specification

Again, the system to model is a Survey Mapping System for Land Surveyors.

2.1 Description

2.1.1 Overall description

The system is designed to support land surveyors in conducting precise mapping operations using a variety of field equipment, including total stations[1], differential GPS units, and LIDAR-enabled drones. A ruggedized tablet application serves as the central interface, enabling real-time acquisition, synchronization, and visualization of geospatial data.

[1]A Total Station is a modern surveying instrument that integrates an electronic theodolite with an electronic distance meter. A theodolite uses a movable telescope to measure angles in both the horizontal and vertical planes.

The system must support seamless connection to measurement devices via secure Bluetooth, USB, or Wi-Fi protocols. Each survey session is uniquely identified, timestamped, and associated with a registered operator. Collected measurements are automatically integrated into a georeferenced 2D or 3D model, with real-time validation checks ensuring spatial consistency and measurement integrity.
Device communication must adhere to strict timing constraints: position data from GPS and total stations must be received and processed within 200 milliseconds, and LIDAR frame data within 400 milliseconds to maintain spatial coherence. Data from all sources must be synchronized with an internal clock using a tolerance window of plus/minus 50 milliseconds. Packet loss must remain below 0.1% during active acquisition phases, and reconnection mechanisms must recover dropped links within 2 seconds without data corruption.
The system is required to detect and flag anomalies such as signal loss, alignment errors, or duplicate entries. All data must be exportable in standardized formats (e.g., DXF, SHP, CSV) to a certified remote server. Operations are logged in a tamper-proof audit trail to ensure traceability.
End-to-end encryption (AES-256) is mandatory for all data transmissions, and access must be protected by multi-factor authentication.

3 Assignments

A. Personal work

Mandatory: Recopy the following text at the beginning of your report or as a note in your TTool model.

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I pledge on my honor that I will not
receive any unauthorized help on this
exam, that I will not help others in any
way on this exam, and that all my
answers will be my own personal work.
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B. Assumptions

1. Your assumptions should be clear. Do list them in the report: that list might evolve according to the models you make afterwards. Make a clear separation between environment and system assumptions. [2 points]

C. Requirements

1. Create a requirement diagram. [3 points]

D. Analysis

1. Make a use case diagram. [3 points]
2. Continue the analysis in the form you want: activity diagrams, nominal scenario, error scenarios, . . . : you are free to use the diagrams you want. Of course, the idea here is to show important points of the specification. [3 points]

E. Design and validation

1. Make a block diagram. Put the emphasis on which blocks are used to model the system being designed, and which ones are used either to model the environment, or to prove properties (observers). [2 points]
2. Draw state machines, and provide a nominal simulation trace, as well as an error trace. [3 points]
3. Select one timing constraint of your choice and prove that it is always satisfied (or not always satisfied). Also, from requirements, define a property of your choice, and prove whether it is satisfied (or not!). And obviously, explain how you have modeled these two properties [3 points]

Good luck!