UML for Embedded Systems

Exam FALL 2023

Software of the mobile application of a bike reservation system

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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.

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 the **software** of the mobile application of a bike reservation system.

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 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 the software of the mobile application of a bike reservation system, as described below. This system somehow ressembles the bike reservation system formerly available in Sophia-Antipolis.

2.1 Description

2.1.1 Overall description

The software of the mobile application is designed to facilitate a seamless bike-sharing experience, enabling registered users to easily borrow bikes for flexible durations. To get started, users are required to sign up in the app by providing a standard identification (e.g. a copy of identity card) and phone number, along with a payment method (choices include credit card or online payment platforms).
After registration, users can access a map pinpointing their current location to find and select available bikes. Each selected bike is held in reservation for 5 minutes, allowing users time to

reach the bike. Through the app, users can then unlock their chosen bike—via Bluetooth—with a simple tap on the unlock button of the mobile application, initiating their ride. The pricing is straightforward: unlocking a bike costs 1 euro, followed by a price of 0.15 euro per minute until the bike is securely locked at the end of the ride. It's important to note that bikes must be placed along public roads within Sophia-Antipolis and then locked to end the rental period.
Throughout their journey, the app provides users with real-time updates on the bike's location, the distance covered, the elapsed time, and even the riding speed, thanks to GPS tracking. When users are ready to conclude their ride, they can lock the bike using the app, which then calculates and displays the final cost of the trip. The mobile phone must run the app all along the ride, and the Bluetooth connection with the bike must be maintained. Location and Bluetooth rights must thus be given to the application by users.
Should an incident arise during the ride, users can promptly report the incident to a control center through the application. Following a report, a technician will assess the bike, and if the incident is verified, the ride's cost is refunded to the user.
This comprehensive mobile application is designed to offer a user-friendly, efficient, and secure bike-sharing service, enhancing urban mobility.
Last but not least, the same user id can be used to rent several bikes simultaneously.

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. Prove that an incident during a ride always results in a warning to the control center and possibly to a refund. 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!