UMLEmb: UML for Embedded Systems V. Exercices

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Outline

Advice

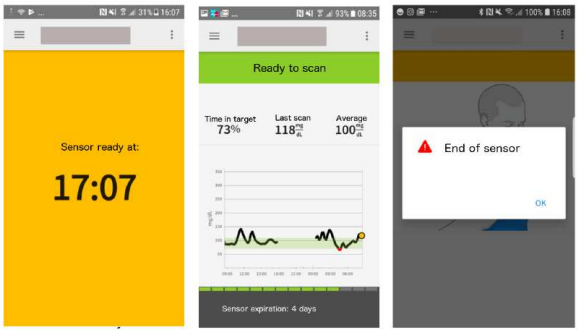
- The goal of this exercise is to model the **software of a glucose monitoring system**.
  - This application gets information from sensors, and accordingly produces outputs
  - The full system specification is given in the next slide
- The time is always too short to perform a modeling!
  - You can omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones
- Don't forget to comment your diagrams, in exams, grading takes into account at the same level comments and diagrams
  - And this is also true as an engineer: You are expected to provide a report, itself including diagrams, and not diagrams including notes!

The Glucose Monitoring System

The system to model is the software which monitors blood sugar level, i.e. the software embedded into the glucose sensor and the one of the mobile application. The following system intends to simplify the life of diabetics by helping them in determining their blood sugar level, without having to regularly analyse a blood drop. The system is built upon two main components:

1. A glucose sensor that must be stuck on the skin. The sensor has one electrode that measures blood sugar level. Moreover, this sensor can transmit every 1 mn, via Bluetooth, glycemia level in mg/dL. The battery of this sensor can last up to 7 days after which the whole sensor must be replaced.
2. A mobile application can be downloaded from major marketplaces. The mobile app records all glycemia values sent by the sensor. It also monitors battery level by informing on the number of remaining days before the sensor is deactivated. Glycemia values are stored locally in the application for one month. Also, if the user registers into the website of the company, values can be stored remotely for as long as desired. Statistics are displayed in the app, as shown below in the middle figure.

The Glucose Monitoring System (Cont.)



Screen captures of the mobile app

- Right figure: sensor is initializing, so it cannot yet be used to monitor blood sugar level.
- Middle figure: the curve has a discontinuity because the sensor cannot internally save more than 4h of measurements: since the user hasn't connected to the sensor for more than 4h, data has been lost. The "time in target" indicates that the user was in the correct blood sugar level for 73% of the time.
- Right figure: a message informs that the sensor has expired. A new one must therefore be installed before new measures can be performed.

Work to Do

I. Requirements
   a) Make the requirement diagram of the system

II. Analysis
   a) Make a use case diagram of this machine
   b) Make an activity diagram
   c) Make two scenarios, one for the nominal case, and one for an error case

III. Design
   a) From your analysis diagrams, propose a block diagram
   b) Make the state diagram of the most important / complex block of your system

Outline

Advice

- The goal of this exercise is to model the **software application** in charge of controlling a Foscam webcam.
  - This application gets information from sensors, and accordingly produces outputs
  - The full system specification is given in the next slide
- The time is always too short to perform a modeling!
  - You can omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones
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The Foscam Webcam

Overview.
The FI9900P combines a high-quality HD digital video camera with a powerful built-in web server to provide live video anywhere. All that's required is an internet connection and viewing device such as a smartphone or desktop computer. The "Plug and Play" setup process is easy: simply scan the camera's QR sticker with your smartphone and it syncs with the camera automatically. This IP camera comes equipped with 30 high powered IR LEDs for night vision up to 65ft.
Features

- 1080P (1920x1080) display resolution for crystal-clear video and images.
- Super-Wide 106 degrees Viewing Angle
- The FI9900P comes equipped with external RCA jacks for two-way audio.
- 30 high powered IR LEDs provide you night vision range up to 65 feet.
- The FI9900P automatically detects moving objects and can trigger various alarms. Get an email sent to you, or upload the pictures to an ftp server. Protect your loved ones easily and effectively.

Work to Do

I. Requirements
   a) Make the requirement diagram of the system
II. Analysis
   a) Make a use case diagram of this machine
   b) Make an activity diagram
   c) Make two scenarios, one for the nominal case, and one for an error case
III. Design
   a) From your analysis diagrams, propose a block diagram
   b) Make the state diagram of the most important / complex block of your system

Outline

Advice

- The goal of this exercise is to model a **software application** in charge of controlling a railroad crossing.
  - This application gets information from sensors, and accordingly produces outputs
  - The full system specification is given in the next slide
- The time is always too short to perform a modeling!
  - You can omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones
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The Railroad Crossing Application

The railroad crossing system manages three train sensors, a 3-color light (green, amber, red), and a barrier. This system manages a one-way track, with only one lane. The three train sensors are:

- **approach**. Signals that a train is getting towards the crossing. The light is set to amber for 2 seconds, then to red. At that moment, barriers are lowered. This process takes 5 seconds.
- **in**. Signals that a train is about to enter the crossing. If the barriers are not yet at their most down position, an error message is sent to the crossing's maintenance headquarters, and a special blinking red light is lit on a panel visible from the train.
- **leave**. Signals that a train has just left the crossing. The barriers are opened (this process also takes 5 seconds) and the 3-color light is set to green. Moreover, the system should take the safest decision in all circumstances. This means that if a decision needs to be taken, we assume the system selects the one with maximal safety

Work to Do

I. Requirements
   a) Make the requirement diagram of the system (the "system" being the software in charge of the railroad corssing)

II. Analysis
   a) Make a use case diagram of this machine
   b) Make an activity diagram
   c) Make two scenarios, one for the nominal case, and one for an error case

III. Design
   a) From your analysis diagrams, propose a block diagram
   b) Make the state diagram of the most important / complex block of your system

Outline

Advice

- The goal of this exercise is to model a **drone software application** in charge of autonomously piloting a drone.
  - This application is made of two subparts: one running in the drone, and one running in a remote computer
  - The full system specification is given in the next slide
- The time is always too short to perform a modeling!
  - You can omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones
- Don't forget to comment your diagrams, in exams, grading takes into account at the same level comments and diagrams
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A Drone Application

The drone is expected to follow a red line located on the floor. It is assumed that it is stabilized with another embedded application that is not meant to be designed. The drone has two cameras: a front camera, and a bottom camera producing 640×480 *pictures at 30 frames per second. Both video streams are wirelessly sent - with WIFI - to a remote computer on which a video stream analyzer runs. Signs can be placed along the red line to tell the drone to turn right, left or to continue forward at the next crossing. Also, signs can be placed on doors to signal the drone that the door is closed. A given path to be followed by the drone is first entered in the remote computer (e.g., turn right at the first crossing, then go forward at the next, etc.). The analyzer running on the computer decodes the two video streams and recognizes the lines and signs to follow the pre-entered path. Flight orders (turn right/left of a given angle, go forward, takeoff, land) are sent back to the drone once the pictures have been analyzed. The application which is onboard of the drone forwards the orders to the stabilizing application. When it reaches its destination, the drone lands. If the PC is loaded, then only a subset of pictures of the two video streams shall be analyzed so as to keep the latency as low as possible. In particular, orders shall be sent back to the drone at least every 10ms.*
Each time a problem occurs while the drone is following a path, the drone should simply immediately land.

Work to Do

I. Requirements
   a) Make the requirement diagram of the system

II. Analysis
   a) Make the use case diagram of this machine
   b) Make two scenarios, one for the nominal case, and one for an error case

III. Design
   a) From your analysis diagrams, propose a block diagram
   b) Make the state diagram of the most important / complex block of your system

Outline

Advice

- The goal of this exercise is to model a smartphone software application in charge of managing photos. The specification of this application is provided in next slides
- The time is always too short to perform a modeling!
  - you may omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones
- Don't forget to comment your diagrams, in exams, grading takes into account at the same level comments and diagrams
  - And this is also true as an engineer: You are expected to provide a report, itself including diagrams, and not diagrams including notes!

A Smartphone Photo Application

The application handles photos stored in a smartphone. Those photos may have been taken with the integrated camera, may have been received by MMS or email, or may have been downloaded from Internet. Photos may also be sent back by MMS, email, or stored in a cloud system for which a user id and a password are necessary. Each month, the user is charged a price corresponding to the amount of photos stored in the cloud.
The application makes it possible to search for photos stored locally or in the cloud, and according to three criteria: face, location or date. Each time a new photo is received by the application, a background process computes whether it contains known faces or not. The time it takes to compute the faces on a picture depends on the number of faces registered in the system, and the number of faces the picture contains. For each picture, a user may also manually indicate a name for each face a picture contains.
For a fast browsing of photos, thumbnails are computed as a background process. Computing a thumbnail takes between 5 and 10 ms. Also, when displaying photos, the next photo in the list is pre-loaded so as to display it more quickly when the user scrolls to it. Loading a full-size photo takes 50 ms. Displaying it shall not take more than 30 ms.

Work to Do

I. Requirements
   a) Make the requirement diagram of the system
II. Analysis
   a) Make the use case diagram of this machine
   b) Make two scenarios, one for the nominal case, and one for an error case
III. Design
   a) From your analysis diagrams, propose a block diagram
   b) Make the state diagram of the most important / complex block of your system

Outline

Ping-Pong Game

Description

- Two players P1 and P2
- P1
  - Sends value k to P2
  - Waits for value k
  - Increment k
  - And so on ...
- P2
  - Waits for a value x
  - Returns x to the sender

- Make the design of this system