Term Assignment Specification and Documentation

TTM4115

Fire alarm system

Group 16

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Changelog:

* In the first version of the specification, in addition to the multiple and concurrent sensors, our idea was to also have several real time alarms. In the second version, due to time and implementation constraints, we had to change it to just one alarm connected to the central unit.

* In the first version, the warning messages were presented only in the display. In the second version, when the sensors detect a warning level, they notify the central, which not only shows the warning in the screen, but also sends an email to the operator. We introduced this change because we realized that it wasn't reasonable to display a warning in a place that probably no one is looking at (the display) at the exact moment it happens, specially in a system as critical as a fire alarm system. If the operator is equipped with a smart phone, he could know that there has been a warning almost immediately.

The purpose, goal and services of the system

- The main purpose of the system is to detect a fire, and warn everyone by sounding an alarm.
- The system should detect errors in the sensors and warn the operator(s).
- The systems state should be viewable on a display with a control panel.
- It should be possible to disable sensors in certain areas if needed by the use of the display and panel, in order to perform maintenance or construction work in the room of the disabled sensors.
- If the sensor detects values over the warning level it should send out notice to the operator.
- It should be possible to see what sensors are in error mode on the display.
- It should be possible to reset the system, which clears all the errors and sets the sensors back to normal mode.
- To get access to the system, it is necessary to input a password.

A dictionary of terms.

- Sensor — A device that detects heat and/or smoke. Used to detect potential fires.
- Central unit — The main hub between the user interface and peripherals that handles communication between the different parts of the system, and keeps record of past events.
- Panel — An input device used by the operator to provide user input to the central unit.
- Alarm — An appliance used to inform people that there is a potential fire, by making loud noises.
- Warning level — Value of heat and/or smoke that the sensor can detect that is higher than what is usual, but is lower than the fire alarm level. This value indicates that there is a potential fire.
- Alarm level — Value that the sensors detect that indicates that there is a fire.
- Reset system — Command that should stop all alarms and warnings to set the system back to initial state.
- Peripherals — Sensors that are distributed in the in different rooms, | connected to the central unit by Internet[1] for communication.

[1] Disclaimer: In a real system one should probably not use Internet, but a more secure and reliable communication protocol.

Functional specification:

a) A structural description of the system environment.

The system is a fire alarm system. The user can interact with it by entering a password on the panel. Then the operator can give input to the system by using the panel, and get feedback by looking at the display. These two are connected to the Central unit. It handles the communication between the peripherals and the user interface. Peripherals consist of sensors that are used for detecting fires. When they detect a warning value, an email is sent to the operator. There is one alarm connected to the central unit, which warns people in the building of a fire when one of the sensors detect fire levels (in that case, an email is also delivered to the operator).

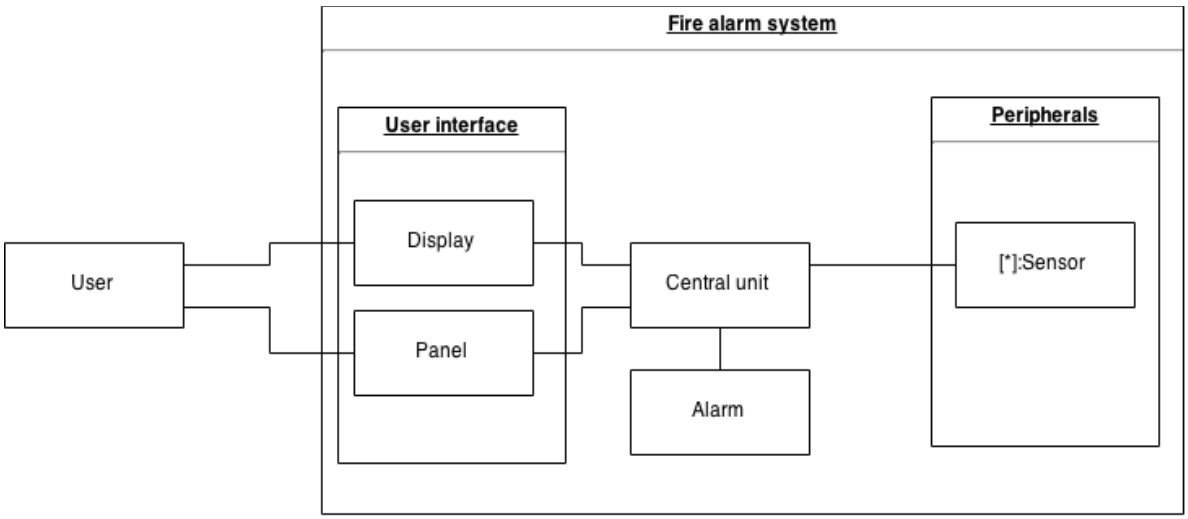


Figure 1: UML structure diagram

b) A specification of interface and service behaviors using textual use cases, sequence diagrams or activity diagrams.

The sequence diagram pictured below shows a use case where one of the sensors detects a value in the warning range, notifying the central unit which will then send a email to the operator. In this case, the operator will be notified by the warning and confirm that it is nothing serious, for example caused by slightly burned food while cooking. The operator can the reset the system (and probably open some windows).

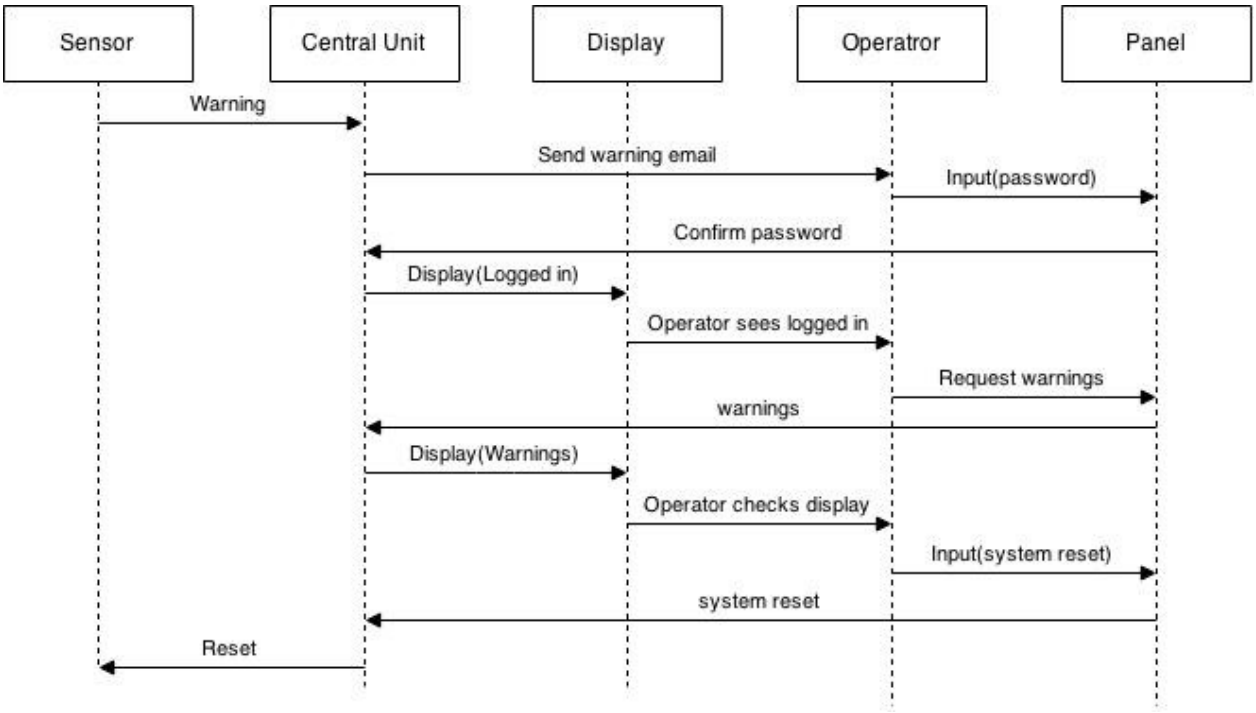


Figure 2: Sequence diagram of a warning

The second sequence diagram in figure 3 shows the use case in the event of a fire. Here the sensors detect values at or above alarm levels, causing the central to start the alarms to notify everyone in the building. When the fire is no longer a threat, the operator will log on to the system and reset it to disable the alarm clocks. If the system is reset while a sensor is still sensing an alarm level, the alarm will immediately start again. The operator can also choose to disable a sensor while he opens a window to clear away steam, smoke or dust, and then enable it again later.

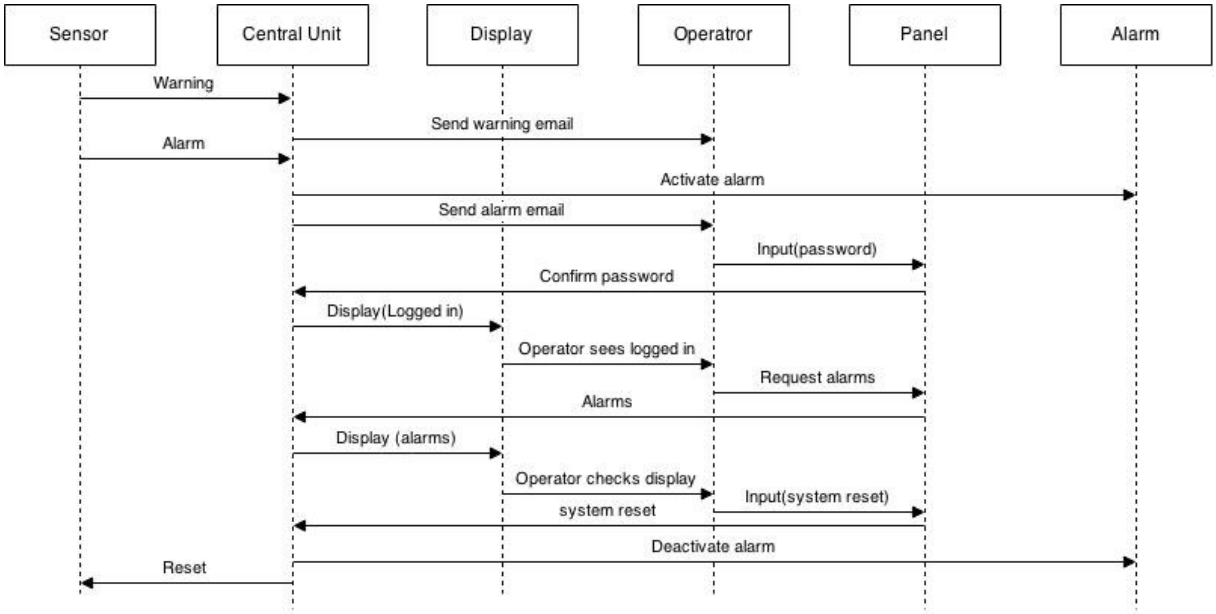
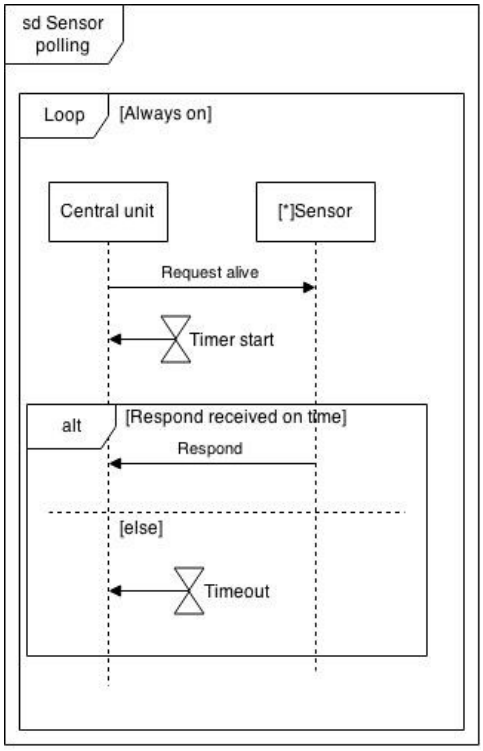


Figure 3: Sequence diagram for an alarm

The system should also poll the sensors. If one of the sensors does not respond within a certain amount of time, the central should send a email to the operator, and save the error along with the corresponding sensor on its display. The operator can see that there is an error by using the user interface, and then act accordingly. When the error has been fixed the operator can reset the system to clean the system of the errors.



Architectural specification:

a. A sketch of the architectural design showing distribution on nodes and networks.

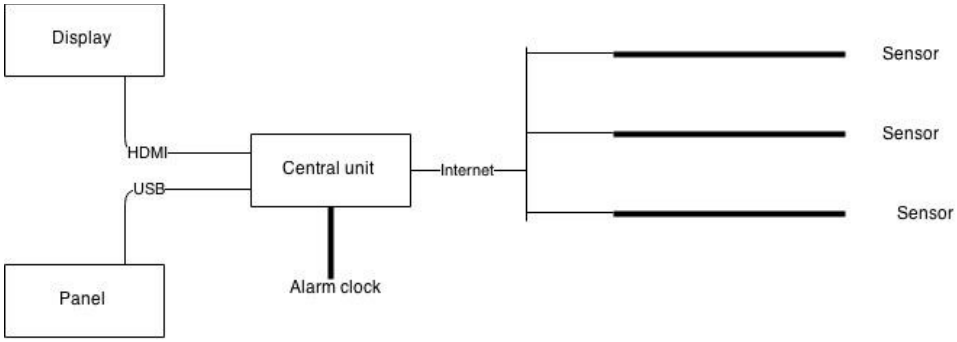


Figure 4: architectural design of the system

b. Brief statements concerning non-functional requirements.

Performance:

The system should be fast enough to poll all the sensors and handle input/output to the user. Handling user interactions should not block the central from polling the sensors and handling incoming messages.

Reliability:

Seeing as this is a fire alarm system, it should have a very high reliability. Anything else may put people in danger, and in worst case, death.

Security:

Security is important for this system. It is necessary to prevent abuse or sabotage of the system. A simple password or lock so that the system is only accessible by staff/ people living in the building (depending on where the fire alarm system is located) will be needed.

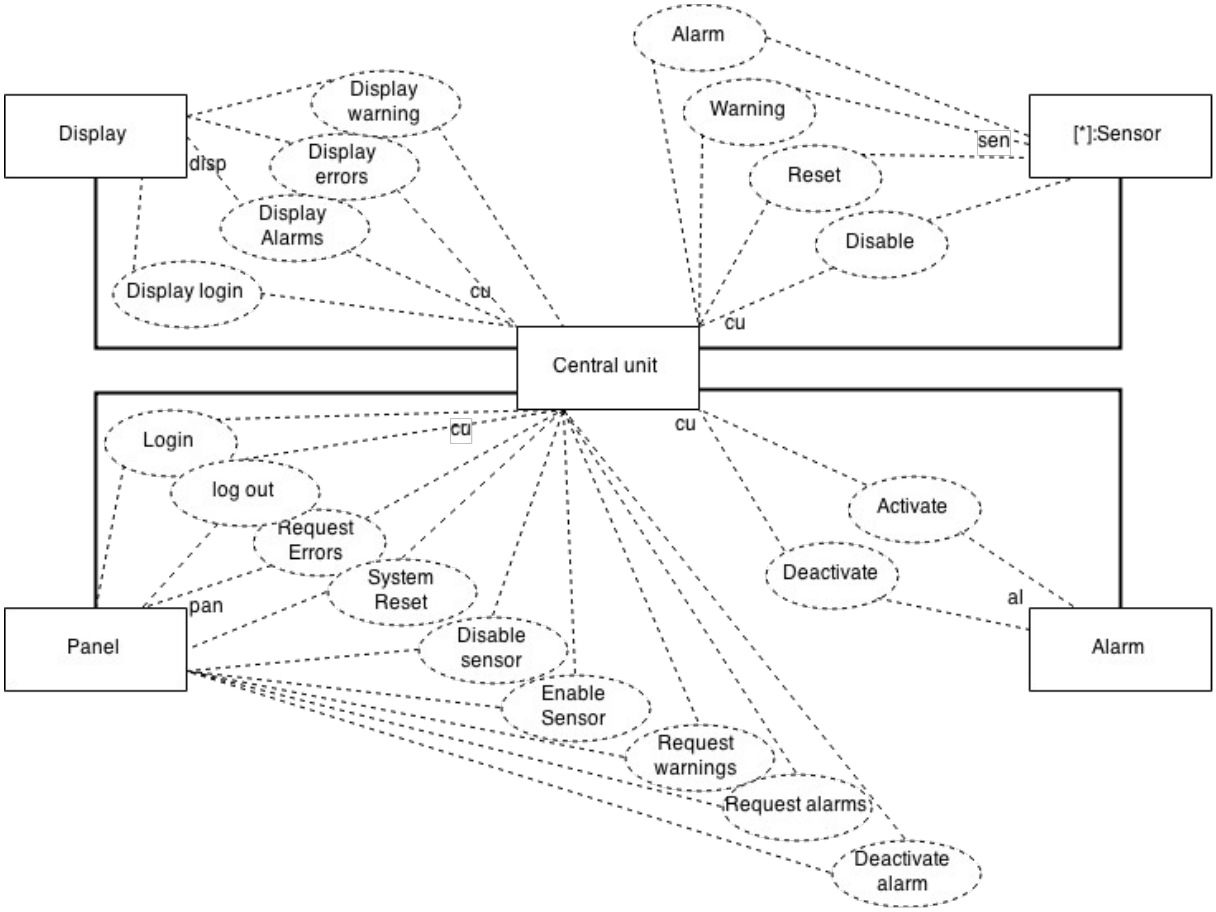
A brief statement concerning how this application makes use of what you are going to learn in the course?

We are going to learn how to design and implement a distributed real time system top-down instead of first focusing on the small details that are closer to the hardware. We are going to do that by using different kinds of UML diagrams that are useful to describe interactions, behavior and functionality of our system. We hope to find and correct as many errors as possible during the design part of the project, in order to reduce errors to a minimum when we will have to actually implement our design.

In this particular project, we are going to learn how different sensors and alarms interact with each other in a real time fashion. This application is a true real-time system with hard deadlines. The system must have a high reliability. To achieve that it is very important that the system specification and design Is correct.

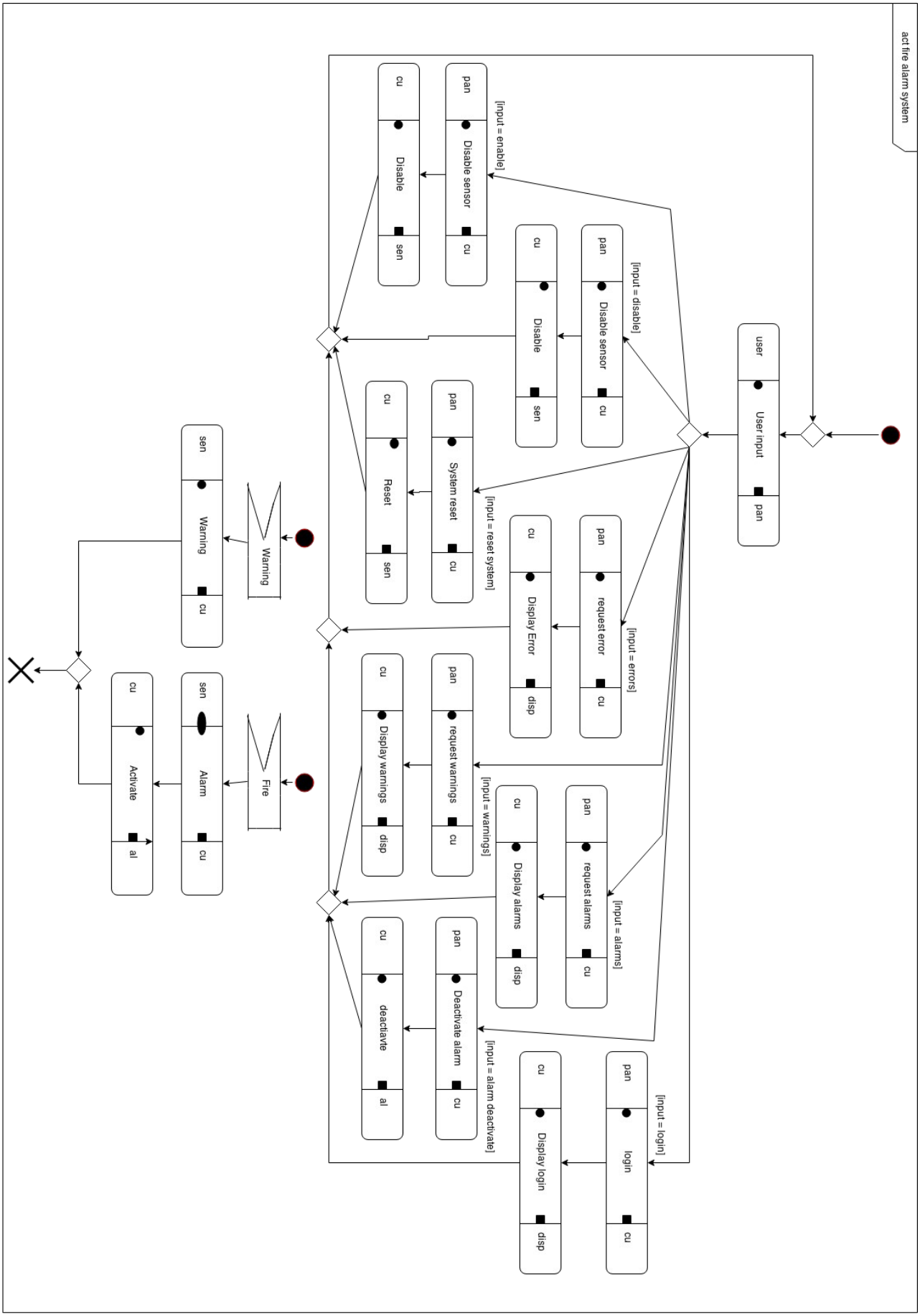
Documentation

The following is the collaboration diagram of the system:



The system responds to two things: events from the sensor or input from the operator. The sensors informs the central unit in case they detect a warning or fire value. If there is a fire, the central unit activates the alarm and sends an email to the operator. If a sensor sends a warning, it just sends an email. The operator can then act according.

This is the activity diagram corresponding to the global flow of the system:



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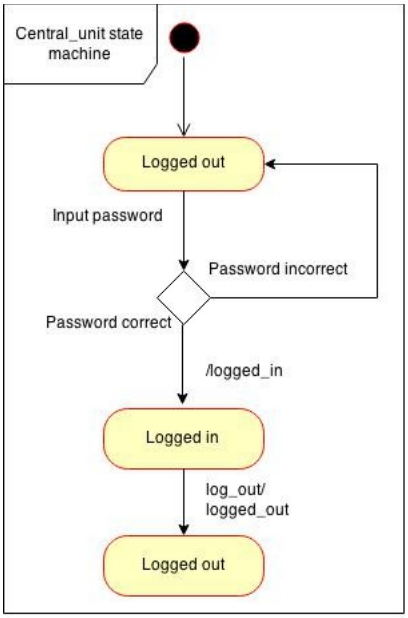
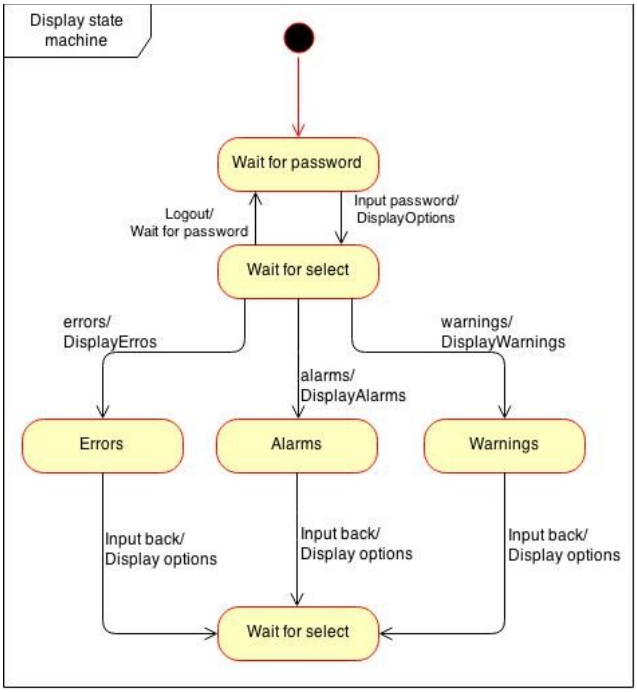
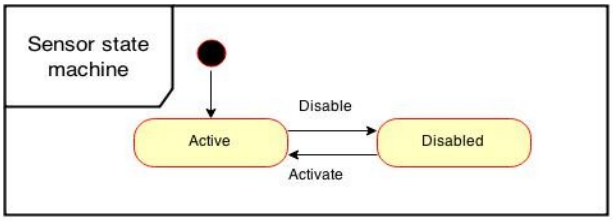
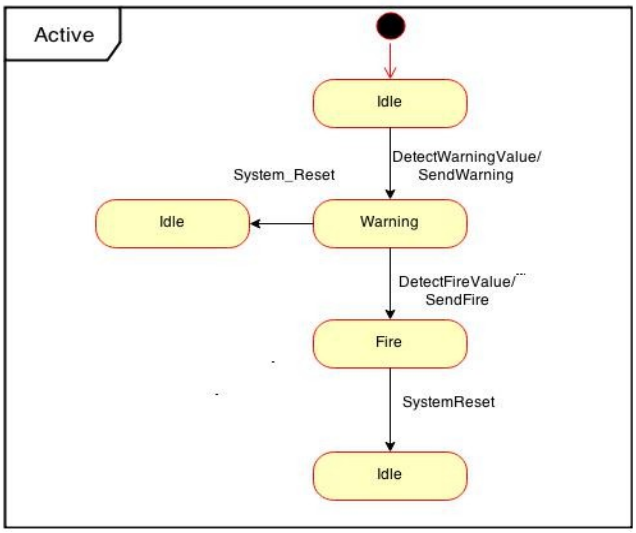








Operation guidelines:

To begin using the system, the operator needs to input the password “ttm4115” in the central unit. After that, the user will be prompted the following screen:

```
You are now logged In
Type 'errors'           to see errors
Type 'warnings'         to see warnings
Type 'alarms'           to see alarms
Type 'disable'+ID       to disable a sensor
Type 'enable'+ID        to enable a sensor
Type 'system reset'     to reset the system
Type 'log out'          to see log out
Type 'alarm deactivate' to deactivate the alarm
Please, give your input
```

For example, the operator can type “errors” to get all the errors in the system. Or, as in the example below, “alarms” to get all the alarms in the system. The program then lists all the sensors followed with a 0 (in case they are not detecting a fire level) or a 1 (in case they do).

```
Alarms on sensors:
Sensor Sanntidslabben: 0
Sensor fiske: 1
Sensor Cantina: 0
Sensor Ã…pen: 0
Sensor Eirik: 0
Sensor Sahara: 0
type 'back' to go back to menu
```

Operation guidelines for warnings:

In case one of the sensors detects a warning level value, the operator will first receive an email. After that, the employee should go to the central unit and check which sensor detected the warning. This can be done by typing “warnings” in the menu, after he has logged on. Then he should go to the room where the sensor is located. The operator can then act according. After the situation has been handled, the user can then either disable the sensor (for example, while the smoke/steam is being cleared away by opening a window), or reset the system.

Operation guidelines for fire alarm:

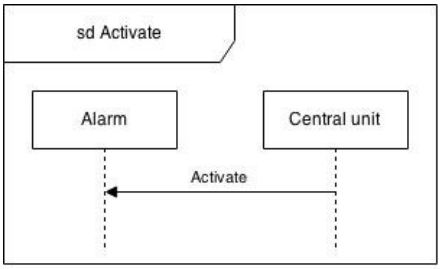
In case one of the sensors detects a fire level value, the operator will first receive an email. After that, he should contact the fire department. Then the employee should go to the central unit and check which sensor detected the fire. This can be done by typing “alarms” in the menu, after he has logged on. The operator should *not* go to that room, but wait for the firemen to come while monitoring the situation from the central unit. After the situation has been handled, the user has to disable the alarm manually by reseting the system or typing “alarm deactivate” in the menu.

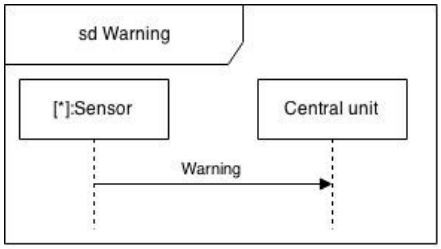
Operation guidelines for installing a new sensor:

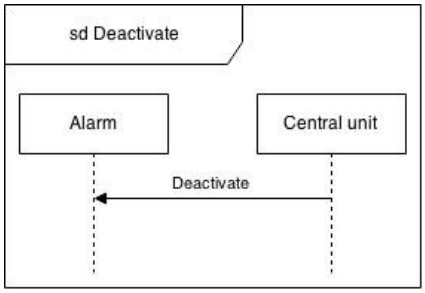
When installing a new sensor, the only thing that the operator has to do is to specify a sensor ID. Everything else (for example, connecting the system to the central unit via internet) is done automatically. It is strongly advised to give the sensor an informative name, so the operators can quickly know the location of the sensor if needed (for example, to name the sensor after the room it is located).

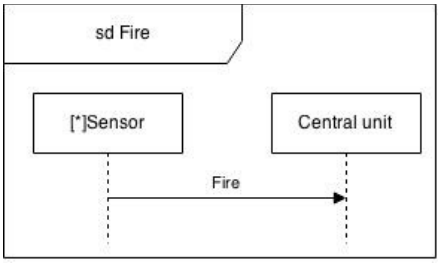
Appendix:

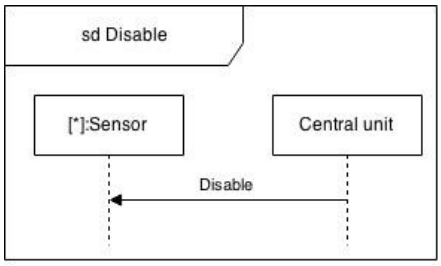
Sequence diagrams of the system interactions:

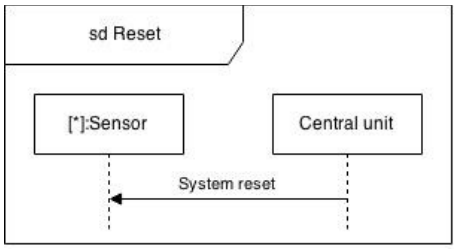


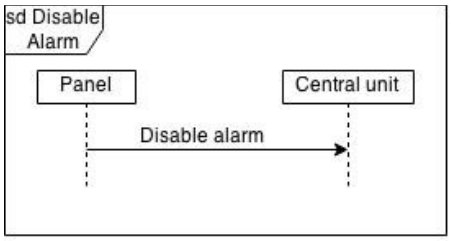


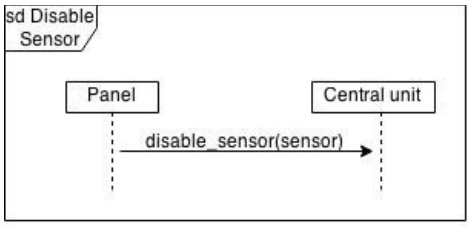


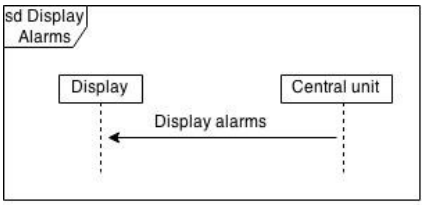


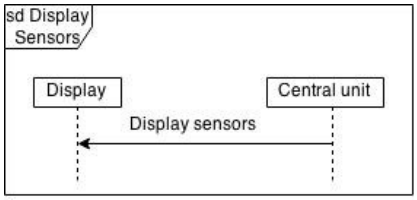


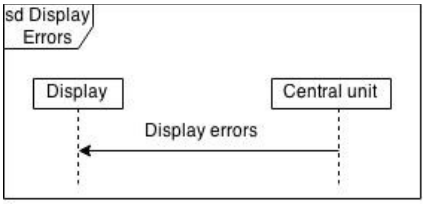


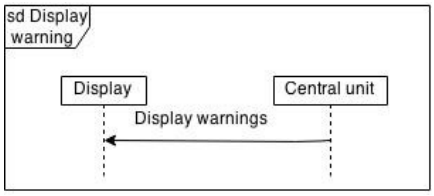


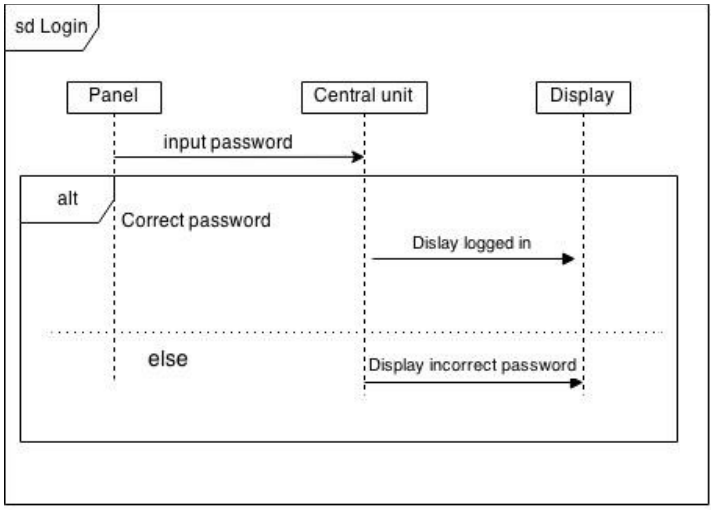







sd Display Errors
Display
Central unit
Display errors


sd Display warning
Display
Central unit
Display warnings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Panel
Central unit
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Correct password
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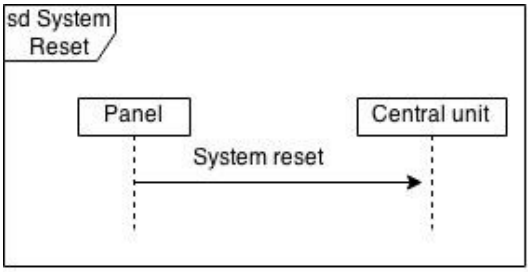
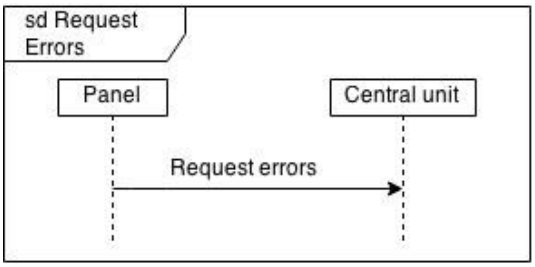
Display incorrect password


sd System Reset
Panel
Central unit
System reset


sd Request Errors
Panel
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Request errors