Vinter Semester 2016

Temperaturænderinger på vandledning

Gruppe 1

1. Semester IT-Teknolog

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Title:

Server Room Surveillance

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Group 4

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Pages: TBD

Appendices: TBD

Completed TBD

Introduction

In this report, an introduction to server room surveillance will be given. Focus point will be how to set up a surveillance system and developing a product suitable for most environments. To reach the goal for a suitable solution, certain parameters has to be met. This includes requirement specifications, development and design of the product. The report entails a description of hard- and software requirements such as setting up and designing the variety of parameters to measure and log needed information and data. Furthermore it is followed by the description of the development and design of the software needed for controlling the complete system. The product is based on monitoring a variety of issues and liabilities within a server room.

Project is written by:

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Table of Contents

Glossary

A/C	Air Condition
CPU	Central Processing Unit
I/O	Input/Output
PCB	Printed Circuit Board
UPS	Uninterruptible power supply

1 Requirements specification

The following section will give a short insight in how the requirements are set to meet the given parameters. The parameters are set according to meet the clients and the markets demands.

- The system shall be able to monitor the following parameters in a server room:
  - Temperature
  - Humidity
  - Flooding
  - Smoke
  - Power consumption
  - Video
  - Room Access
  - Vibrations
- Be accessible from both local and web based interface
- The access has to be safe and trustworthy but at the same time easily accessible and user friendly.
- The measuring data shall be stored for a two year period
  - To be sure you can go back and check any problems that the system may have encountered, and who had access to the room
- Power must be delivered by a reliable system
- The system must have an easy installment in server environments

In perspective of the requirements specifications the design and development of the hardware and software follows.

Hardware section 2

In the following section the hardware structure and functionality will be described. The focus point of this section is the variety of hardware needed and their functions within the surveillance system. Furthermore the hardware requirements will be specified followed by an in depth description of the different parameters used. This is followed by a bill of materials and a calculation of the price.

2.1 Specification of hardware requirements

- Real time controller
  - The real time controller is chosen for the use of precise and continuous logging.
- Data storing (SD-card)
  - For storing data from the different measurements that have been made by the entire sensor package.
- Redundant power supply with UPS backup
  - For safety measures and reliability a redundant setup with UPS backup is chosen. This guarantees and maximize the uptime of the system.
- Rack- and wall mountable
  - Easy compatible instalment

2.1.1 Hardware diagram

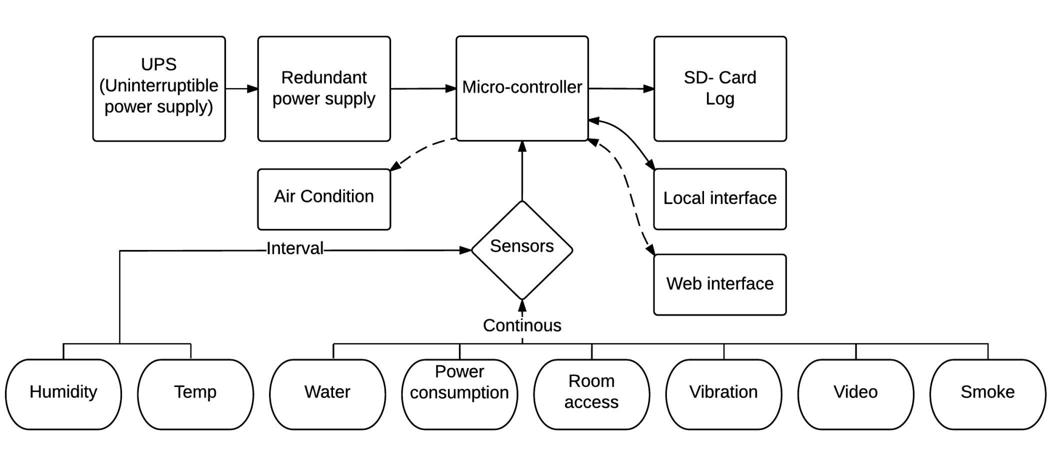

Figure 2.1: Diagram of the hardware architecture used

2.2 Description of the hardware structure and functionality

In the following section an in depth description of the structure used in designing the hardware and its functionality is presented.

2.2.1 UPS

A UPS (Uninterruptible power supply) is a backup system to the power supply. The UPS is a backup that takes over when the power from the main source fails. The UPS will give you a few minutes to properly shutdown the system, to prevent data loss.

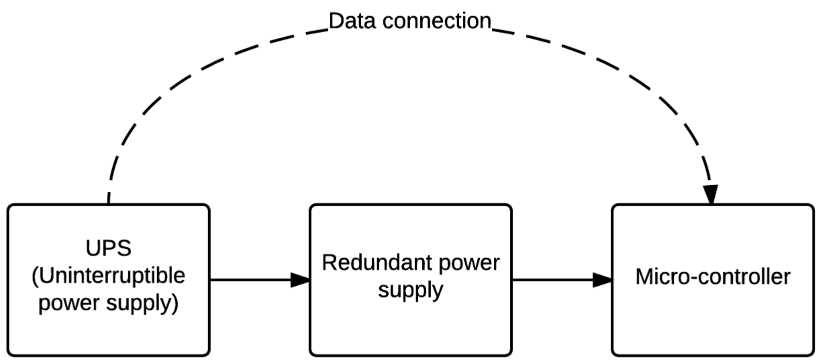

Figure 2.2: Diagram of the UPS function the system

The diagram in fig. 2.2. indicates what function the UPS has in the system (ref. fig 2.1). In case of power failure the UPS will inform the microcontroller over a data connection, which allows the microcontroller to do a proper shutdown.

2.2.2 Power supply

For maximizing the runtime of the surveillance system in the server room, a redundant power supply is selected. A redundant power supply contains either two or more power supplies inside it (ref. figure 2.3). Each unit is capable of powering the entire system. Only one unit will run at a time but if it fails, the other takes over. This is called hot swapping. The second power supply is always running on standby, so if the powering unit fails the switch to the second unit will be unnoticeable when the system is running.
The redundant power supply and the UPS is chosen for their ability to complement each other. The redundant power supply provides insurance against the power supply failing and the UPS provides insurance against power outage.

Figure 2.3: A redundant power supply with two power units

2.2.3 Microcontroller

The microcontroller is a small computer which comes in a variety of packages and sizes. Compared to a personal computer that performs a variety of tasks in the background. A microcontroller is typically dedicated to a simple task.

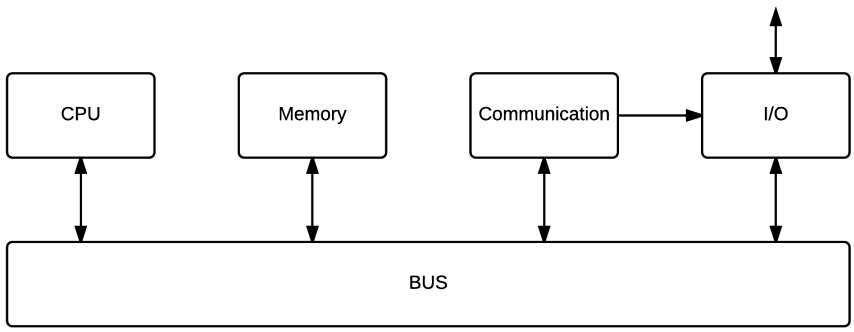

Figure 2.4: The different components connected to a BUS on a microcontroller

The microcontroller contains a CPU (central processing unit) as the brain of the unit that does all the calculations and logical operations which allows the software to function. The microcontroller also contains memory, which allows the microcontroller to store information so it can be used at a later time. Together with the CPU and the memory is the system clock. The system clock can be thought of as the engine to the microcontroller unit. Without it nothing will work. It is also a system clock which determines what speed the microcontroller will run. Communication with the microcontroller is done through the I/O (Input/output) which interconnects with the BUS. The BUS is a subsystem used to connect the different components and transfer data between them. A communication device can be attached to either the I/O or connected directly to the BUS (ref. fig. 2.4). To meet the hardware requirement specification for a microcontroller (hardware requirement p. 7), a real time microcontroller i chosen. A real time microcontroller is defined by measuring in real time, which means the time is precise. That also means when looking through previous logged data, it creates an opportunity to see precisely where i.e. spikes in power consumption has happened or exactly when the spikes occur.

2.2.4 Sensors

Air Condition

The A/C (air conditioner) is not a part of our product solution, but a lot of server rooms has air conditioners and this opens up for a dynamic regulated system where it's possible to adjust the temperature and humidity in the server room.
The A/C is a system that controls the temperature, the humidity, and the airflow. If the temperature in the room gets above the desired threshold, it can transfer the air outside the server room. The A/C can cool the room down to a desired temperature which the customer can regulate and is able to control. The A/C will control the airflow in a way to prevent i.e. humidity in the server which can result in a short circuit.

Humidity

Normally when having an air conditioner a humidity sensor is not needed, but it is chosen so the humidity can be logged and the A/C's effect can be monitored.

Temperature

The temperature sensor will measure the temperature in the server room. Temperature sensors will be placed in different locations within the room to measure the different values. These values are defined through measurement of the room and the servers in conjunction with the client.

Smoke

Smoke is generally a thing you don't want inside a server room, it can be from burning electronics, or any kind of fire. For this reason it is essential to have a smoke detector in the server room. The smoke sensor measures through two different parameters. It senses the visible particle change in the air density as well as the invisible.

Flood sensor

The flood sensor consists of a cable that relies on electrical conductivity from water, this means the flood sensor constantly checks the resistance. If the resistances drops the sensor will go off and alarm the system admin.

Power consumption

To measure instability in the power consumption a sensor is needed. The sensor measures the consumption of the server clusters. The values measured indicates when and if spikes occur in the main power grid. It is therefore essential to be able to monitor the power grid to prevent data loss.

Room access

To know when someone enters the server room, there will be a magnetic switch connected to the door and a reed switch to the doorway. A reed switch is an electrical switch operated by a magnetic field.

Video Surveillance

The video surveillance is a basic function to add to a server room, it will monitor the server room both inside and outside. The surveillance camera outside will be active at all times, whereas the inside camera will be activated when someone accesses the room.

2.3 Bill of Materials

In this section a brief overview will be given of the different components, their parameters and a display of their prices.

Sensor	Parameters	Price	Link
Water		$255	http://avtech.com/Products/Sensors/Flood_Sensor_8_Cable.htm
Temperature	+/- 0.125 degrees	$55	http://avtech.com/Products/Sensors/Digital_Temperature_(50')).htm
Humidity	+/- 3.5%	$105	http://avtech.com/Products/Sensors/Digital_Temperature_Humidity_(50').htm
Power Consumption	0-250A	$85	http://avtech.com/Products/Sensors/Current_Loop_2.htm
Room Access		$25	http://avtech.com/Products/Sensors/Room_Entry.htm
Vibration(2)		$101	https://www.serverscheck.com/sensors/sensor_vibration.asp
Video		$349	http://avtech.com/Products/Network_Cameras/AXIS_M1103.htm
Smoke		$75	http://avtech.com/Products/Sensors/Smoke.htm

Table 2.1: Bill of Materials
Prices are taken from http://avtech.com/
2. Price taken from https://www.serverscheck.com/

2.4 Calculation of the price

Based on the prices of the different components, a total price and calculation can be presented.
The product consists of the following parts:

- Main board
- Power supply
- Enclosure
- Production man hours
- Unit test

The production cost is estimated that the controller will take 100 hours to develop and construct, and after then another 50 hours for testing the system.

For the development hours it will cost $\tilde{3}50$ kr per hour and $\tilde{2}50$ kr,- per hour for the testing of the system. This results in the following pricing:

$$(R\&Dprice * hours) + (testprice * hours) = cost$$

Which result in the following:

$$(350kr * 100) + (250kr * 50) = 47500kr$$

An important factor for the controller is the sensor scalability, and in this system the controller is capable of communicating with a large amount sensors before needed another controller.
For the calculation of a price for a complete system, a fictive server room will form the base for the setup of the calculation. The server room that will be used will be set up the following way:

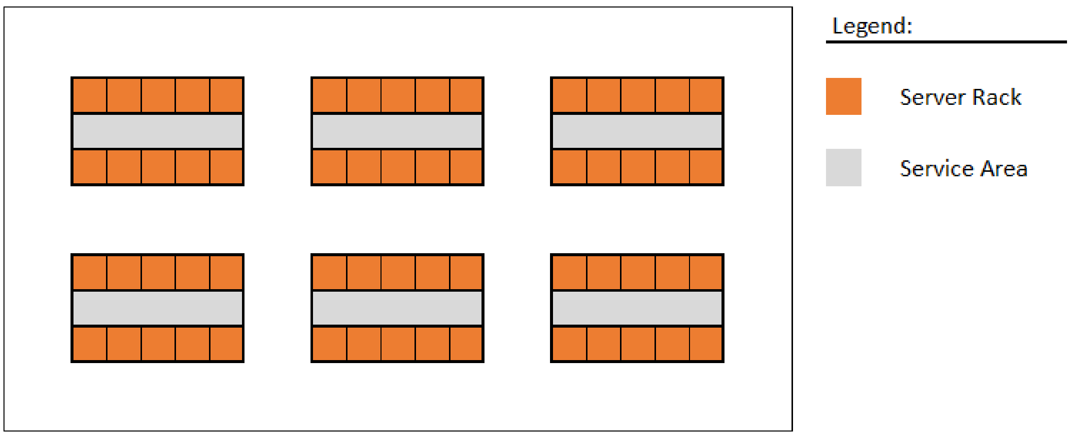

Figure 2.5: The server room setup

For a server room with this size and setup the following figure displays the optimal sensor placements:

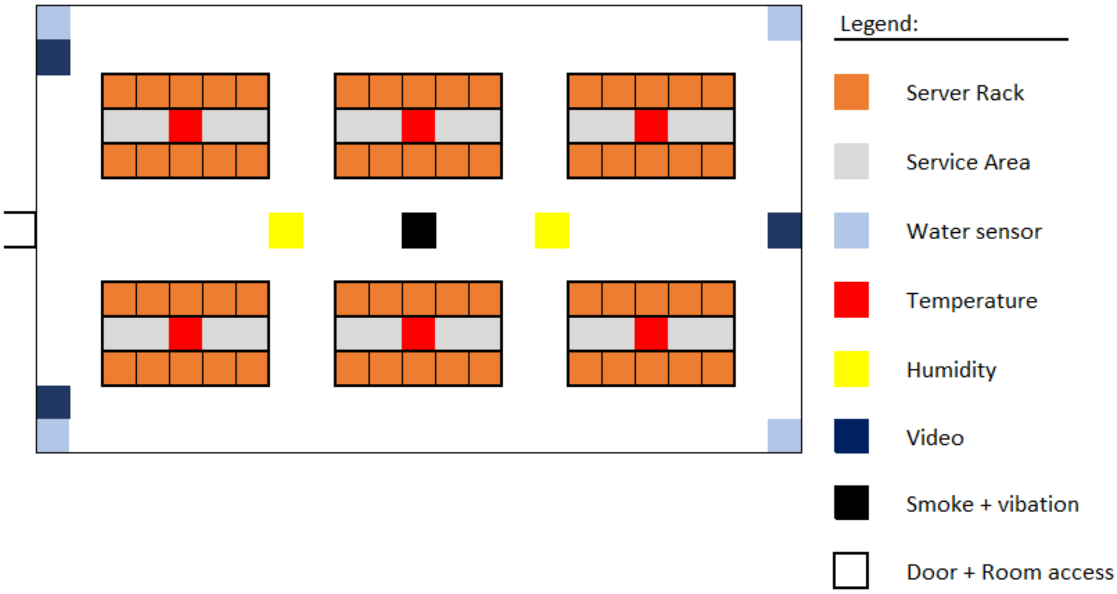

Figure 2.6: Figures showing optimal sensor placement

This setup will be at the price of:

Sensors	Unit price	Number of Units	Total	
Water	$255	4	$1020	
Temperature	$55	6	$330	
Humidity	$105	2	$210	
Power consumption	$85	6	$510	
Room Access	$25	1	$25	
Vibration	$101	1	$101	
Video	$349	3	$1047	
Smoke	$75	1	$75	
Controller	$500	1	$500	
			$3818	Total

Table 2.2: Calculation of the price

Software section 3

3.1 Specification of the software requirements

The following section will introduce the necessary requirements for developing the software for a server room surveillance system.

- Intuitively interface.
  - User friendly to reach a broader audience.
- Logging in Intervals of 60 seconds.
  - The reason for measuring data in intervals of 60 seconds is that some readings are close to constant which means there is no need for continuous logging.
- Dynamic regulation.
  - If the temperature or humidity rises above the predetermined degrees, the A/C will automatically regulate.
- Alarming.
  - If the alarm is triggered, the product needs to inform the server-responsible and technicians.

3.1.1 Software diagram

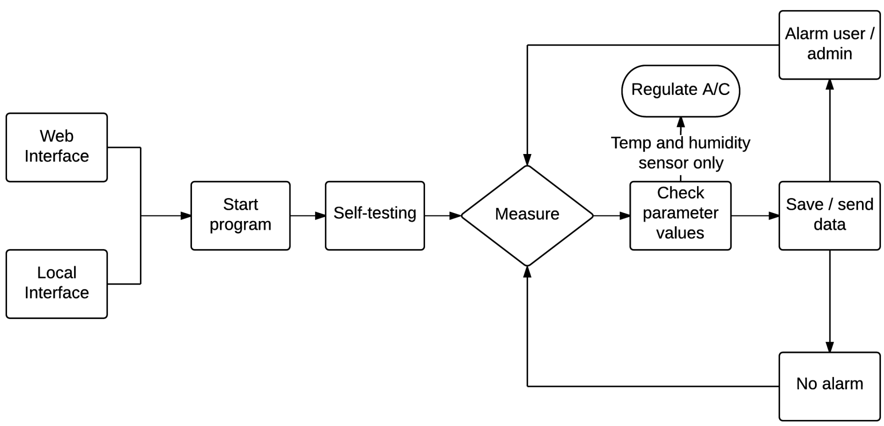

Figure 3.1: Diagram of the software architecture used.

3.2 Description of the software structure and functionality

Based on the previously established requirement specifications and software specifications, a design has been made which is shown in the flowchart above (ref. figure 3.1). It shows the different pathways, the program is able to take throughout the code with the different functions being shown.

3.2.1 Interface

The product will have two ways to interface it, both a local and a web based interface. The program can be initialized through either of those two interfaces which can be seen on the left side of figure 3.1. The first thing that happens when the program is initialized is that it performs a self diagnostics. Here it tests if all the sensors are functioning correctly. It is important that the interface is user friendly, so the product is easily accessible by a wide spectrum of users.

3.2.2 Main program

The main program consists of three functions, **measure, compare** and **send/save** as seen on figure 3.2 below.

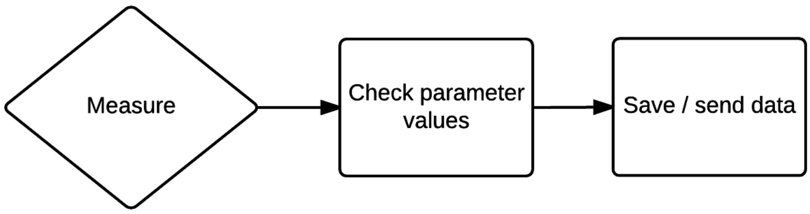

Figure 3.2: Diagram of the main function in the software.

The main job for the software is to measure the surroundings inside the server room which is done by sensors. These sensors will record values which will be compared to parameters corresponding to safe margins for the different sensors. They can be predefined or set by a user on a later point. Then the recorded values will be stored on a local storage, and sent to an offsite server and stored there as well for extra redundancy in the system.

3.2.3 No alarm

If the measured data in the main program matches the parameters set beforehand by the technicians, no alarm will be given and the program will return to the main program, where it will continue to run the loop.

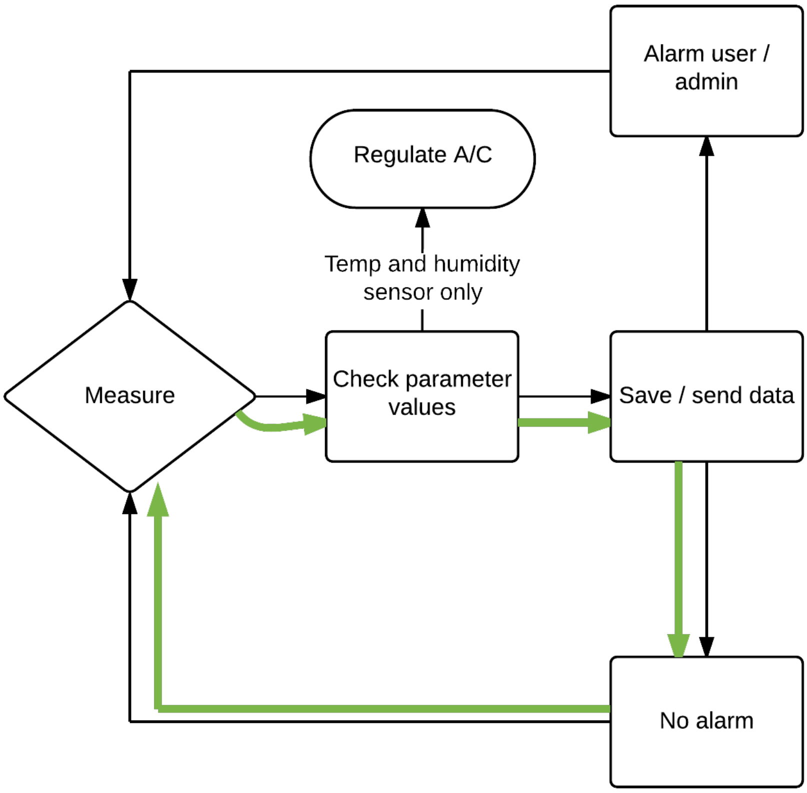

Figure 3.3: Diagram of no alarm loop.

The green arrows in figure 3.3. shows the loop that will be running if there are no measurements outside the given parameters. This loop will be running unless there is an alarm.

3.2.4 Alarm

If the measured data on the sensors does not match the predetermined set of parameters, an alarm will be triggered. This alarm will give notice to the user / admin and the technician via email and text message. The email will contain information about which sensors are above the threshold, so the user and the technicians know which precautions they need to take.

After the program has given notice about the alarm, it will return to the main program, and start measuring the data from the sensors again.

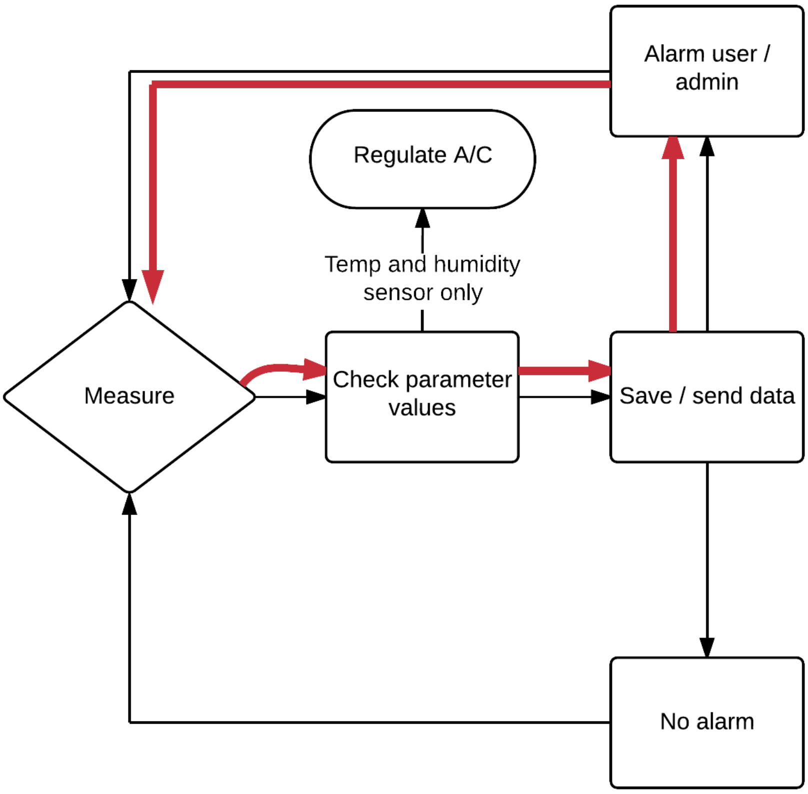

Figure 3.4: Diagram of loop if there is an alarm.

The red arrows in diagram 3.4. shows the loop that will be running if an alarm is necessary. This loop will only be running if any of the measurements is outside the given parameters.

3.2.5 Regulate

If the temperature sensors has readings outside the predetermined parameters, the system itself is able to adjust the A/C. This is a precaution the system has to be able to run if the server room gets a temperature that's higher than the predetermined values.

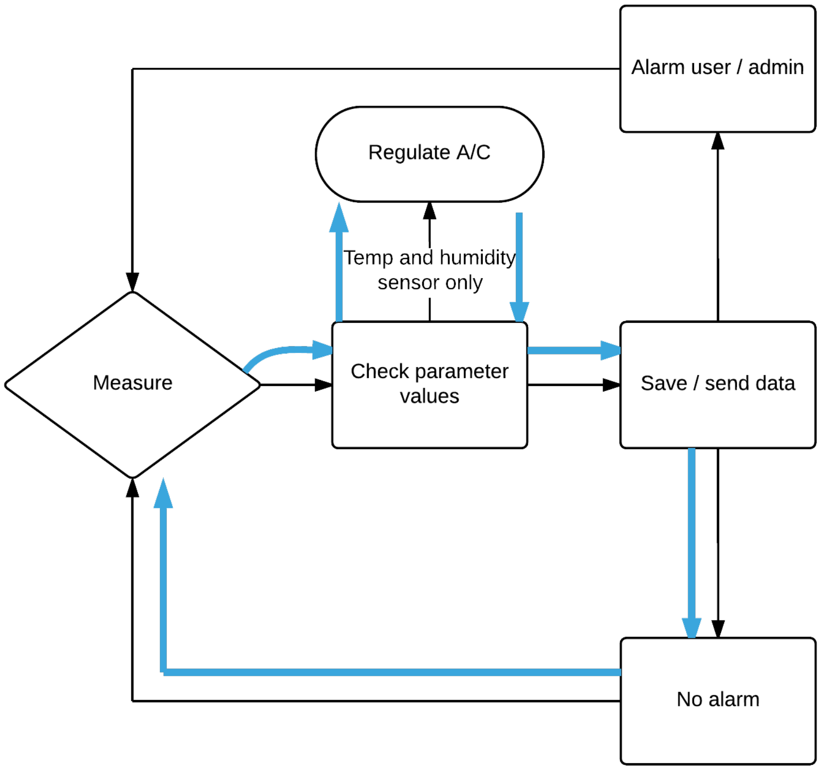

Figure 3.5: Diagram of the loop when the program regulates the A/C.

Figure 3.5 show the loop the program normally will be running when the sensors log a temperature that does not match the parameters. As shown by the blue arrows in the diagram 3.5, the program checks the values and if they do not match the given parameters, it will regulate the A/C. The program will then use the same loop as if no alarm.
In some circumstances the program will need to give an alarm and thereby deviate from the loop that normally runs. This loop sequence will only be initialized, when the program has tried to regulate the A/C for a predetermined amount of time without getting the temperature to fit the predetermined values. This is determined by the size of the room in order to specify how long it takes to apply the regulation.

3.3 Calculation of the price developing the software

To develop the program for the microcontroller, we have estimated the man hours of making the program to be around 300-350 hours and the programmer will be paid 300 kr/h. For testing we have estimated that the tester will need around 150-200 hours and be paid 200kr/h.

This will result in the calculated price:

$$\textbf{Work hours} * \textbf{Hourly salary} = \textbf{Price}$$

This gives a total estimated price for the development of the program:

$$350 * 300\textbf{kr} = 105000\textbf{kr}$$

The total price for testing the devices is:

$$200 * 200\textbf{kr} = 40000\textbf{kr}$$

To find the total cost, the individual estimates are added together:

$$105000\textbf{kr} + 40000\textbf{kr} = 145000\textbf{kr}$$

4 Conclusion

During the design process of the project we have learned how the different parts of the surveillance system works.
Through the project description a specification of requirements has been made. With the requirements specified an example of a server room was made (2.6).
A block diagram of the hardware architecture was made with the subsystems further explained. A software flowchart has been made in order to to display the functionality of the system. This is done to show the different pathways, the program is able to take throughout the code.
Furthermore we have calculated a total price for designing and developing a functional product.

Appendices 5

5.1 Group collaboration agreement

5.1.1 Contact Information

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Table 5.1: Contact Information

5.1.2 Workflow

- Every friday after 12:00 is expected work consisting of three hours.
- If you aren't able of attending for scheduled study day. - Notice must be given to the project team.

5.1.3 Milestones and goals

- Trello. `https://trello.com/b/kADLInRf/p1-it-teknolog`
- Hardware and software. Due date: 23-10-15
- Introduction and conclusion. Due date: 30-10-15
- Powerpoint and presentation. Due date: 6-11-15

5.1.4 Deadline

- Hand in november 9th.
- Presentation november 12th.

5.1.5 Budget

- 5 half study days of 3 hours, and 2 full days of 6.5 hours. Giving us a total of 28 hours. We're 6 people, resulting in 168 hours in total.
- Budget also includes hardware contents and software.
- Changes within the budget can occur in connection to workshop 1.

5.2 User guide

The following includes a description to set up and install the system.

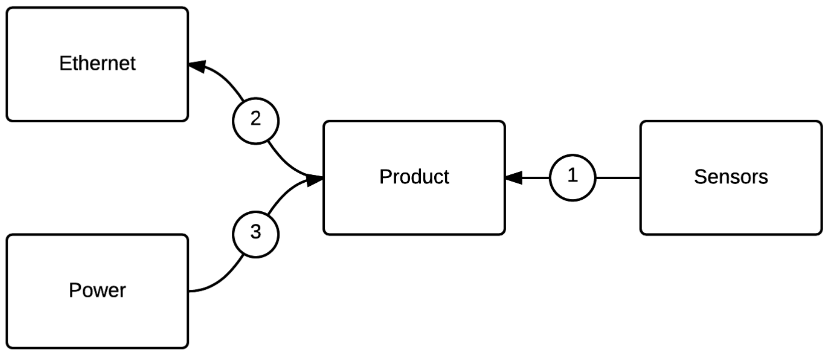

Figure 5.1: User guide diagram

Step 1

- Connect the sensors to the product.

Step 2

- Connect the product to the ethernet.

Step 3

- Connect the product to a power source.

List of references 6

- https://en.wikipedia.org/wiki/Microcontroller
- https://en.wikipedia.org/wiki/Uninterruptible_power_supply
- http://www.pcguide.com/ref/power/sup/outputRedundant-c.html
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- http://avtech.com/Products/Sensors/Room_Entry.htm
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