Bachelor's Thesis

Project Description

Software Engineering 6th Semester 20th March 2020

Reduction of Physical Supervision / Herning Vand

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herningvand

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2. Background description

Since the dawn of civilization water supply and sanitation have been the logistical challenges to provide clean water and sanitation systems. Where water resources, infrastructure or sanitation systems were insufficient, diseases spread and people fell sick or died prematurely.

Major human settlements could initially develop near rivers or natural springs. Throughout history, people have devised systems to make getting water into their communities and disposing of wastewater more convenient.

The principle of sewage treatment throughout history was on the conveyance of raw sewage to a natural body of water, e.g. a river or ocean. Early human habitations were often built next to water sources (f.eks rivers) which would often serve as a crude form of natural sewage disposal. (The History of Clean Drinking Water | APEC Water, 2020)

Over the millennia, technology has dramatically increased the distances across which water can be relocated. Furthermore, treatment processes to purify drinking water and to treat wastewater have been improved.

Wastewater treatment is used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle with minimum impact on the environment, or directly reused. The latter is called water reclamation because treated wastewater can be used for other purposes. The treatment process takes place in a wastewater treatment plant (WWTP), often referred to as a Water Resource Recovery Facility (WRRF) or a Sewage Treatment Plant (STP). Pollutants in municipal wastewater (households and small industries) are removed or broken down. (How Wastewater Treatment Works | USEPA, 1998)

The whole population of Denmark has continuous access to an improved water supply and improved sanitation. According to the European Environment and Health Committee the Danish national microbial failure rate (measured against E. coli) among large water supply systems is generally zero. Very occasionally, large water supply plants have microbiological failures during a limited period. The national chemical failure rate (measured against nitrate ions or against other ions of local importance) among large water supply systems is near zero. The average availability of 20 companies participating in an analysis done by DANVA benchmarked 99.9933% ,which means that customers only had to be without water on average 35 minutes a year. (Water in Figures | DANVA, 2020)

Such water quality is achieved through continuous monitoring and treating of pumps, treatment facilities and pipes. The water cycle monitoring is usually performed physically, by sending an employee to check the quality of the device and take a

sample. The task is fairly simple but the simplicity is foreshadowed by the number of checkups that have to be executed.

Herning Vand is a utility company that operates 170 pumping stations for ground water and 14 WWTPs. The spanning network of their apparatus is of a substantial length and their supervision is done both physically - by their employees and through an IoT system they have in place. The difference is that the latter is adopted as a collection of readings which are not analyzed continuously.

3. Definition of purpose

To analyze and expand the current tools that Hernign Vand operates by looking at patterns through the available collection of readings and implementing new methods of monitoring that realise the potential of IoT.

4. Problem statement

Herning Vand operates 170 pumping stations and 14 wastewater treatment plants and this project will focus on reducing the frequency of sending crews to check on various apparatus. The project will put an emphasis on research, determining the types of measurements, number of devices, frequency of scans and system architecture.

5. Delimitation

1. We will not consider video recording devices such as video cameras.
2. We will not consider the general public as potential users.
3. We will not consider the marketability of the system.

6. Choice of models and methods

What is the partial problem?	Why study this problem?	Which level of outcome is expected?	Which methods, models and theories are used?	Who in the group is responsible?
How will the collected data about the pumping stations be stored?	To make sure that the datasets remain organized and stable despite the amount of data collected.	As conditional data is collected from the various pumping stations it will be organized and stored for on-demand retrieval.	Data Persistence/Data Design API Kanban/Unified Process	Mihail
When should the client be notified that a physical check is recommended?	To ensure that physical crews are only sent when something is wrong.	Station data is monitored within a threshold and a notice is sent when that threshold is exceeded.	Design Patterns Separation of concerns Kanban/Unified Process	Amahdya Dominika
How can the reliability of the system be ensured?	To keep the system functional despite dirty conditions.	Within reason, will collect data on a continual basis.	Embedded/Hardware Deployment Design Patterns Kanban/Unified Process	Whole Group
What type of sensors should be integrated?	To find the most accurate measurement.	Once the contents under analysis are known, a thorough research of available sensors will be done.	Embedded/Hardware Deployment Kanban/Unified Process	Dominika
How would the system interface with the user?	To design an effective and readable user experience.	A thorough and simple to operate user interface.	Cross-media Kanban/Unified Process	Amahdya

Table 1 - Choices of models and methods

7. Time schedule

The workload of the project is divided into two semesters: 6th (Spring 2020) and 7th (Autumn 2020). With the Spring semester being for the planning for the project and the Fall semester being for the realization of the project.

The project group will be working on the project according to the Kanban Agile method and the Unified Process. Time will be allotted based on the Unified Process to ensure that organization and understanding of progress is maintained during Kanban's freeform, singular workflow.

When the project officially begins during the Autumn Semester 2020, it will require a minimum of 1237.5 hours to complete. Meetings will be conducted on an "as needed" basis however there will be more mandatory meetings every two weeks, starting on week 36, based on the Unified Process to ensure that the time-base goals of the project are understood and are being kept despite Kanban's task-based focus.

Tasks will be assigned and worked on based on Kanban's WIP limits meaning that only a set amount of tasks will be selected to be active on the Kanban board at a single time. The limit is planned to start out at 3, one task per group member. The Kanban Lead Time, or time spent on completing a task, will be expected to not exceed a week starting out. This means that 6 tasks should be completed every two weeks however, this is expected to vary greatly depending on the tasks.

Week	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Requirements																		
Analysis and Design																		
Implementation																		
Testing																		
Deployment																		

Table 2 - Time schedule 7th semester

Milestones

- Milestone 1: Gathering of Tasks (End of Week 36)
  The end of Week 36 will mark the end of the project's Inception phase based on the Unified process.
  By this point in the project the group should be done with gathering the initial Kanban tasks to be worked on and updated throughout the project.

- Milestone 2: Design and Critical Kanban Tasks (End of Week 38)
  The end of Week 38 will mark the end of the project's Elaboration phase and the beginning of the Construction phase based on the Unified Process. Documentation and design for the overall system architecture should be completed. Kanban tasks should also be given priority to designate the tasks that are most relevant to completing the system's basic functionality first.

- Milestone 3: End of Critical Kanban (Between Week 44 and Week 46)
  Depending on the progress made and by the end of Week 46 at the very latest, this milestone will mark the intended completion for most high priority tasks needed to complete the basic system architecture and functionality. Work can now begin on less important Kanban tasks.

- Milestone 4: End of Construction Phase and Kanban Cleanup (End of Week 48)
  The end of Week 48 will mark the end of the project's Construction phase and the beginning of the Transition phase based on the Unified Process. Most project tasks should be nearing completion and any leftover tasks on the Kanban board should be miscellaneous functionality.

- Milestone 5: Testing and Delivery of the Final System (Between Week 49 and Week 52)
  Starting at Week 49 until the end of Week 52 the project will be in its Transition or deployment phase according to the Unified Process where the system will be prepared for final delivery to the client. Final testing and finishing changes will be done here.

8. Risk assessment

Risk	Description	Likelihood Scale 1-5 5 = high risk	Severity Scale 1-5 5 = high risk	Risk mitigation e.g. Preventive & Responsive actions	Identifiers	Responsible
Risk not meeting the client's requirements	Poor schedule, bad communication with the client, lack of knowledge	3	5	Preventive: Continuous communication with the client, respect the schedule Responsive: Contact the client, respect the agreement	Not meeting the deadlines	Amahdya
Technical issues	Software crashes, hardware failures, damaged sensors	2	5	Preventive: Use GitHub for backup, being careful with the hardware Responsive: Restore data from GitHub, order new hardware	Corrupt data, unexpected hardware behaviour	Dominika
Injuries or illness	COVID-19, bicycle or skateboard accidents, seasonal viruses, mental health	4	3	Preventive: Respect the COVID-19 preventive guidelines Responsive: Work from home	Not feeling well	Mihail
Insufficient knowledge	Lack of knowledge in hardware development	3	4	Preventive: Attend classes, reading extra materials Responsive: Ask supervisor or the company for help	Not being able to find solutions to problems	Dominika
Group conflicts	Fights and disagreements between members	2	4	Preventive: Follow the group contract Responsive: Try to compromise	Not moving forward with work	Mihail

Table 3 - Risk assessment

9. References

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Atlassian Agile Coach, 2020. Kanban [online] Available at: <https://www.atlassian.com/agile/kanban> [Accessed 27 March 2020].

Wikipedia, 2019. Unified Process [online] Available at: <https://en.wikipedia.org/wiki/Unified_Process> [Accesssed 27 March 2020].

● Appendixes

- Effluent is an outflowing of water or gas to a natural body of water, from a structure such as a wastewater treatment plant, sewer pipe, or industrial outfall

- Escherichia coli, also known as E. coli, is a Gram-negative, facultative anaerobic, rod-shaped, coliform bacteria of the genus Escherichia that is commonly found in the lower intestine of warm-blooded organisms.

- Information on substances monitored in drinking water *.