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USER REQUIREMENTS DOCUMENT

Creating a pipeline application

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Fontys – EI3T1 & EI3S1

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Table of Contents

Introduction.....	4
Glossary.....	4
Functional requirements.....	5
Use cases.....	6
Add a component (not being a pipeline) to the simulation.....	6
Add a pipeline to the simulation.....	6
Reshaping a pipeline.....	7
Deleting a component from the simulation plane (option 1).....	7
Deleting a component from the simulation plane (option 2).....	8
Editing a component's properties.....	8
Changing position of a component.....	9
New simulation.....	10

Open simulation.....	10
Save file.....	11
Save file as.....	11
Non-functional requirements.....	13
System requirements.....	13
All components.....	13
Pipelines.....	13
Mergers.....	13
Splitters (default).....	13
Splitters (adjustable) (X%,Y% where $X+Y = 100$).....	13
User interface.....	13
User interface description.....	14

Introduction

The object of this project is to create an application that allows the user to build a simulation of a pipeline network. The user can add and delete the different components of a pipeline network and check its flow and capacity.

Glossary

Component	A component is either a pump, a sink, a splitter, a merger or a connecting pipeline.
Joint	A position on a pipeline connecting two straight pipeline segments.
Menu bar	The bar in the upper area of the application which contains all buttons for actions needed for working with the flow simulation.
Merger	A component having two inputs and a single output. The incoming fluid flow will be combined into a single outgoing flow.
Pipeline	A pipe connecting two components in the simulation allowing fluid to flow in one single direction. To let the fluid flow in only one direction the pipeline can only be connect to an input and an output of a component (this cannot be of the same component). The pipe is set to a certain maximum capacity (changeable) and will show the current flow. A pipeline does not necessarily have to be a straight line but can be with corners.
Pump	A starting component for the origin of the flow. This component has only 1 output and no inputs. It has a

certain changeable maximum capacity and can be set to a certain current flow.

Simulation network.	The graphical representation of a to be simulated flow network.
Simulation plane	The area in the application under the toolbar on which the simulation can be drawn.
Sink	An ending component being the destination of the flow. It only has 1 input and no outputs and is not limited.
Splitter	A component dividing a single input flow into 2 outgoing flows. The component therefore has 1 input and 2 outputs. The splitter will by default divide the flow equally (50/50) over the 2 outgoing pipelines. It also has the option to change the ratio of the outgoing flows (for example 70/30).

Functional requirements

System must enable users to:

add different components to a network: pump, splitter, merger;	Must
see components (and their properties) of a network on the simulation plane;	Must
edit the properties of separate components of a network	Must
remove components;	Must
draw pipelines between components;	Must
reshape pipelines;	Should
reposition components	Could
save, open and create simulation files	Must
assess the status of the network: color codes, messages, warnings;	Must
select multiple components at the same time	Could

The simulation restricts that:

pipelines should not overlap each other	Could
components cannot overlap	Must
outputs cannot be connected as inputs cannot be connected	Must

Use cases

Add a component (not being a pipeline) to the simulation

Actors: User

Goal: Add a component to the simulation plane

Pre-conditions: None

MSS:

- 1) The user clicks on one of the components (not being a pipe) in the menu bar
- 2) The system changes the cursor to the selected component
- 3) The user chooses a location to place it at by clicking on the desired position on the simulation plane
- 4) The system checks if there is an overlap with another component
- 5) The system places the chosen object at the desired location and sets it to default values
- 6) The system changes the cursor to the arrow again

Extensions:

- 3a) The user hovers above an existing component
 - .1) The system grays out the to be placed component and disables clicking
 - .2) Resume with step 3 again
- 3b) The user clicks on another option from the menu bar
 - .1) The system ends the use case

Add a pipeline to the simulation

Actors: User

Goal: Add a pipeline

Pre-conditions: At least two components have been placed in the simulation plane

MSS:

- 1) The user clicks on the pipeline tool in the menu bar
- 2) The system changes the cursor to a plus symbol
- 3) The user clicks on an already existing component and holds the mouse button pressed and releases it on another component
- 4) The system changes the cursor back to the arrow
- 5) The system checks if this pipeline connects a free input with a free output and if the pipeline connects two components
- 6) The system permits the new pipeline
- 7) The system places a pipe with the provided coordinates on the simulation plane and sets it to default maximum capacity

Extensions:

- 3a) The users selects a location without an existing object
 - .1) The system doesn't start with drawing a pipeline
 - .2) The use case ends
- 3b) The user clicks on another option from the menu bar
 - .1) The system ends the use case

- 6a) The system doesn't allow the new pipeline
- .1) The system doesn't create the new pipeline
 - .2) Go back to step 2

Reshaping a pipeline

Actors: User

Goal: Reshaping a pipeline

Pre-conditions: At least one pipeline exists and the arrow cursor is selected

MSS:

- 1) The user clicks on a random position along a pipeline segment (line from A to B)
- 2) The system checks if there is already a joint in this position
- 3) The system determines there is no joint
- 4) The system creates a joint (C) along the line segment on the clicked position
- 5) The user moves around the joint (C) to the new position
- 6) The system draws the pipeline from the beginning of the line segment (A) through the joint (C) to the end of the line segment (B)
- 7) The user clicks on the new position of the joint (C)
- 8) The system checks if the position of the joint (C) is not overlapping with another joint or a component
- 9) The system creates two new line segments (A to C and C to B)

Extensions:

- 1a) The user doesn't click on a pipeline
 - .1) The use case ends
- 3a) The system finds an existing joint
 - .1) The system selects the underlying joint
 - .2) Resume with step 5 till 8
 - .3) The system saves the new position of the joint
- 7a) The user clicks somewhere along the already existing line
 - .1) The joint is not created and the use case ends

Deleting a component from the simulation plane (option 1)

Actors: User

Goal: Delete a component

Pre-conditions: The arrow cursor has been selected from the menu bar

MSS:

- 1) The user chooses a single component to be deleted by left-clicking on it
- 2) The system checks if there is a component at the given location
- 3) The system finds the component at the provided location
- 4) The system selects the component
- 5) The user presses the delete button located in the toolbar menu
- 6) The system checks if the component is a pipe
- 7) The system finds out that the component is not a pipe
- 8) The system checks if there are any pipes connected to the component
- 9) The system finds no pipes connected to the component
- 10) The system deletes the component
- 11) The system re-calculates the simulation flow

Extensions:

* Selecting multiple components is considered as a Could on our MoSCoW list

1a) The user clicks on a non-component

.1) The use case ends

3a) The system doesn't find a component at the given location

.1) The system deselects any previously selected components

5a) The user presses another button from the toolbar or anywhere on the simulation plane

.1) The components get deselected

7a) The system finds out that the component is a pipe

.1) Return to step 10 of the MSS

9a) The system finds pipes connected to the component

.1) The system deletes all pipes connected to the component

.2) Return to step 10 of the MSS

Deleting a component from the simulation plane (option 2)

Actors: User

Goal: Delete a component

Pre-conditions: None

MSS:

1) The user selects the delete button from the menu bar by left clicking on it

2) The user selects an item to delete by left-clicking on it

3) The system checks if there is a component at the click location

4) The system finds the component at the provided location

5) The system checks if the component is a pipe

6) The system finds out that the component is not a pipe

7) The system checks if there are any pipes connected to the component

8) The system finds no pipes connected to the component

9) The system deletes the component

10) The system re-calculates the simulation flow

Extensions:

* Selecting multiple components is considered as a Could on our MoSCoW list

4a) The system doesn't find a component at the given location

.1) The system performs no action

6a) The system finds out that the component is a pipe

.1) Return to step 9 of the MSS

8a) The system finds pipes connected to the component

.1) The system deletes all pipes connected to the component

.2) Return to step 9 of the MSS

Editing a component's properties

Actors: User

Goal: Changing the properties of a component

Pre-conditions: None

MSS:

- 1) The user double clicks on the desired component
- 2) The system checks for the component type
- 3) The system finds out that the selected component is of type pipe/pump/splitter
- 4) The system opens-up a Property window
- 5) The system loads all properties of the selected component and displays it in the window
- 6) The user changes the desired values
- 7) The user clicks on the Save button from the Property window
- 8) The system updates the component's values and recalculates the simulation flow
- 9) The system closes the properties window

Extensions:

- 1a) The user right-clicks on an empty space on the simulation plane
 - .1) The system performs no action
- 3a) The systems finds out that the component is of type merger/sink
 - .1) No action is performed

Changing positon of a component

Actors: User

Goal: Repositioning a component

Pre-conditions: The arrow cursor has been selected from the menu bar

MSS:

- 1) The user choses a component to be repositioned by holding the left mouse button pressed down
- 2) The system checks if there is a component at the given location
- 3) The system finds an existing component at the provided location
- 4) The system selects the component at the given location
- 5) The system changes the cursor image to the image of icon of the selected item
- 6) The user drags the component to a new position in the simulation plane by moving the mouse
- 7) The user selects the new location by releasing the mouse button
- 8) The system checks if there is an already existing component at the given location
- 9) The system doesn't find any existing component at the provided location
- 10) The system changes the location of the component to the newly provided one

Extensions:

- 3a) The system doesn't find a component at the given location
 - .1) No action is performed
- 9a) The system finds an already existing component at the provided location
 - .1) The system returns the selected component to its' original location
 - .2) The selected component gets deselected

New simulation

Actors: User

Goal: A new empty simulation to be started

Pre-conditions: None

MSS:

- 1) The user clicks on "File"
- 2) The system shows a dropdown menu
- 3) The user clicks on "New"
- 4) The system checks if there already is an open simulation
- 5) The system doesn't find any open simulations
- 6) The system creates an empty simulation plane
- 7) The system creates a new pump and sink object with default values

Extensions:

- 5a) The system finds an open simulation
 - .1) The system prompts the user what to do with the open simulation
- .2a) The user clicks "Cancel"
 - .1) The system doesn't create a new simulation
 - .2) The system goes back to the open simulation
- .2b) The user clicks "Save"
 - .1) The system checks if the open simulation already exists
 - .2a) The system doesn't find an existing file
 - .1) The system performs the "Save as" use case
 - .2b) The system finds an existing file
 - .1) The system performs the "Save" use case
 - .3) Resume with step 6 of the MSS
- .2c) The user clicks "Don't save"
 - .1) The system disregards the open simulation
 - .2) Resume with step 6 of the MSS

Open simulation

Actors: User

Goal: An already existing simulation to be loaded into the application

Pre-conditions: None

MSS:

- 1) The user clicks on "File"
- 2) The system shows a dropdown menu
- 3) The user clicks on "Open"
- 4) The system opens a dialog window, requiring a simulation file to be selected
- 5) The user selects the desired simulation file
- 6) The user clicks "Open" or double clicks on the simulation file
- 7) The system checks if the file is a simulation file
- 8) The system checks if there already is an open simulation
- 9) The system doesn't find any open simulations
- 10) The system loads the simulation from the simulation file

Extensions:

- 6a) The user clicks on cancel
 - .1) The system cancels the open action and returns to the main screen
- 7a) The system determines that the file is not a simulation file
 - .1) The system asks the user to select a different file
 - .2) Back to step 6 of the MSS
- 9a) The system finds an open simulation
 - .1) The system prompts the user what to do with the open simulation
 - .2a) The user clicks "Cancel"
 - .1) The system doesn't create a new simulation
 - .2) The system goes back to the open simulation
 - .2b) The user clicks "Save"
 - .1) The system checks if the open simulation already exists
 - .2a) The system doesn't find an existing file
 - .1) The system performs the "Save as" use case
 - .2b) The system finds an existing file
 - .1) The system performs the "Save" use case
 - .3) Resume with step 6 of the MSS
 - .2c) The user clicks "Don't save"
 - .1) The system disregards the open simulation
 - .2) Resume with step 6 of the MSS

Save file

Actors: User

Goal: Saving the currently shown simulation to file

Pre-conditions: A simulation is currently open

MSS:

- 1) The user clicks on "File"
- 2) The system shows a dropdown menu
- 3) The user clicks on "Save"
- 4) The system checks if the currently opened project is linked to a file location
- 5) The system overrides the file with the currently opened project

Extensions:

4a) If the currently opened project hasn't been linked to a file, the "Save file as" operation is performed

Save file as

Actors: User

Goal: The opened project to be saved as a new file

Pre-conditions: None

MSS:

- 1) The user clicks on "File"
- 2) The system shows a dropdown menu
- 3) The user clicks on "Save as"
- 4) The system opens a file browsing window

- 5) The user selects the desired directory and enters a file name
- 6) The user clicks on "Save" or presses enter
- 7) The system checks if the filename is allowed
- 8) The system saves the opened project to the provided new file

Extensions:

- 6a) The user clicks on "Cancel"
 - .1) The system closes the current window and returns to the main application window
- 7a) The filename has unpermitted characters; the system asks the user to enter a proper filename
 - .1) Back to step 5
- 7b) If the directory + filename already exists, the system will ask the user if the existing file can be overwritten
 - .1a) User clicks "Continue"
 - .1) The system overwrites the existing file
 - .1b) User clicks "Cancel"
 - .1) Back to step 5

Non-functional requirements

System requirements

- 1) OS should run at least JRE 8
- 2) Device cannot be a mobile device or tablet

All components

- 1) Must be placed within the simulation plane.
- 2) Not overlapping each other and other components.
- 3) All input boxes only allow numeric values.
- 4) No output of a component following by an input of other component (except pipelines).
- 5) Before system running:
 - a) There must be at least 1 pump and 1 sink with a connection between them.
 - b) There are no output/input with no connection to any network.

Pipelines

- 1) Only inputs and outputs can be connected by pipes.
- 2) If any of pipelines have the current flow higher than the capacity, it must warn the user.
- 3) Cannot place 2 or more pipes at the same output/input component.
- 4) The value of fluid must match the color. (green $\leq 50\%$, $50\% < \text{orange} \leq 100\%$, red $> 100\%$)

Mergers

- 1) The value of output must be no different from the total of 2 input values.

Splitters (default)

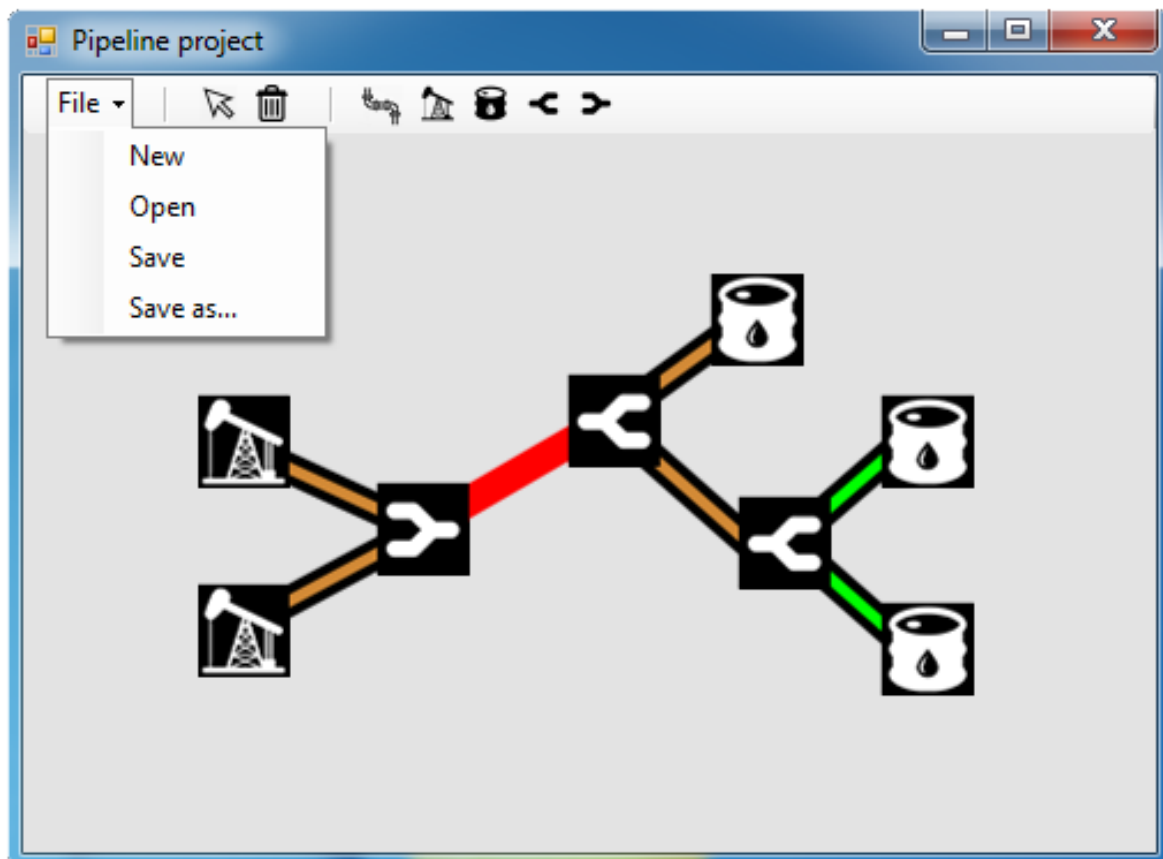
1) The value of 2 output must be the same and equal to 1/2 of input value.

Splitters (adjustable) (X%,Y% where $X+Y = 100$)

- 1) The 2 output values must be X% and Y% of the input value.
- 2) User decides X, Y will be calculated by the system.
- 3) X must be between 0 and 100.

User interface



The user interface will be as the following image:



* The graphics are subject to change towards the final application

User interface description

The application will have a menu bar with all necessary options. Under "file" options will be found to create a new project and to open and save existing projects. The three options directly after that are for navigation, editing and deleting. The last four buttons are for adding objects to the field.

- | | | |
|---|---------------|--|
|  | Mouse pointer | Dragging for repositioning, selecting and right clicking |
|  | Delete | Deleting the selected item or selecting delete mode |



Pipe
plus sign)



Pump



Sink



Splitter



Merger

Draw pipes between objects (changes cursor to

Change cursor in a pump to add a new pump

Change cursor in a sink to add a new sink

Change cursor in a splitter to add a new splitter

Change cursor in a merger to add a new merger