Service Provision in the Hospital of the Future

Developers

Final version (presented here) by Daniel Stroud and Peer-Olaf Siebers. Based on initial work from Penny Siebert, Elvira Perez Vallejos, Tommy Nilsson, and Peer-Olaf Siebers.

EABSS Version

1.0

Related Publication(s)

- Stroud D, Wagner C, and Siebers PO (2019) 'Agent-Based Simulation Modelling for Reflecting on Consequences of Digital Mental Health'. Working Paper.
- Siebert P, Siebers PO, Vallejos EP, and Nilsson T (2020) 'Driving complementarity in interdisciplinary research: A reflection', International Journal of Social Research Methodology, DOI: 10.1080/13645579.2020.1743545.

Focus

Initially just for discussion (PhiloLab), as describe in Siebert et al (2020). Afterwards, updated for implementation (EABSS), as described in Stroud et al (2019).

Motivation

Proactive machines are an idea that in the future hospitals will have automated machines as well as Doctors and Nurses that can help and treat patients. This project uses the idea of proactive machines to test the impact of technology on mental state and opinions of hospital patients.

Gathering Knowledge

Discussion with multi-disciplinary team. Revision and implementation by modeller.

Step 1: Define Objectives

Aim

- Reflect on the consequences of digital mental healthcare

Hypotheses

- Trust between machines/humans will affect human-human relationships in a negative way
- Machine-look influences our decisions

Experimental factors

- Number of doctors, proactive machines, and patients
- Number of beds

Responses

- Mental state of patients, e.g. happiness
- Opinions of each patient on the doctors and robots
- The trust of the patients on the robots

Step 2: Define Scope

Key driver(s): Focus on fictive operational level

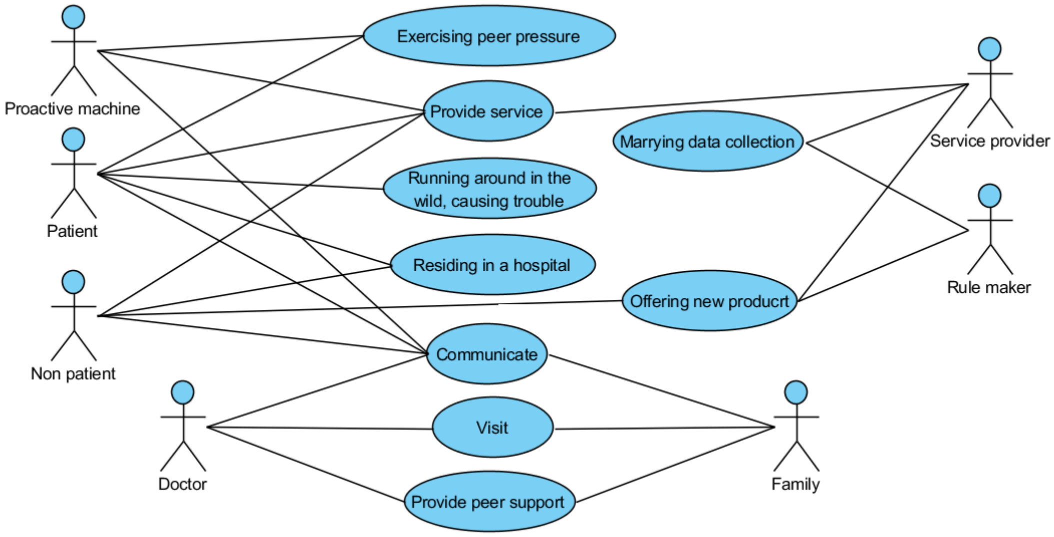
Category		Element	Decision	Justification
Actor	Human	Patient	Include	Patients are the ones who are being tested
		Doctor	Include	Doctors need to be compared against the Robot doctors
		Visitor	Include	Visitors can be used to influence patients
		Nurse	Exclude	Nurse can be viewed as the same as doctors in the simulation
	Proactive machine	Robot doctor	Include	Need to be compared against doctors
Physical Environment	Buildings	Hospital	Include	Location where the model is held
		Home	Include	Location where agents are held when they are being used
	Furniture	Beds	Include	Patients need somewhere to stay
	Structure	Walls	Exclude	Not needed because we are not interested in agents movements or collisions
		Doors	Exclude	Not needed to test the hypotheses

Category		Element	Decision	Justification
Social and psychological aspects	Robot doctor behaviour	Decide how long to treat patient for	Include	Needed for more accurate results
		Accurate movement of robot	Exclude	Movement is not needed to test the hypotheses
	Doctor behaviour	Decide how long to treat patient for	Include	Needed for more accurate results
		Accurate movement of doctor	Exclude	Movement is not needed to test the hypotheses
	Patient behaviour	Random hospital visits	Include	Needed for more accurate results
	Visitor behaviour	Decide whether the visitor should visit the patient	Include	Needed for more accurate results
		Accurate movement of visitor	Exclude	Movement is not needed to test the hypotheses
Other		N/A	N/A	N/A

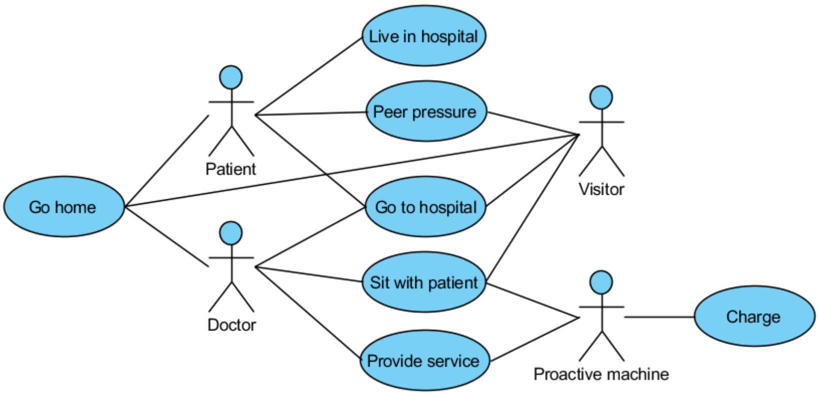
Step 3: Define Key Activities

Actor roles and related use cases

Initial diagram:

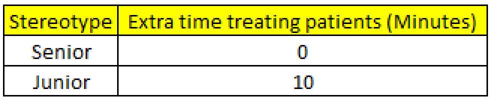


Final diagram (generated after completing Step 5):



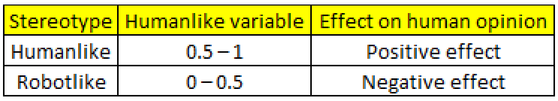
Step 4: Define Stereotypes

Doctor



Stereotype	Extra time treating patients (Minutes)
Senior	0
Junior	10

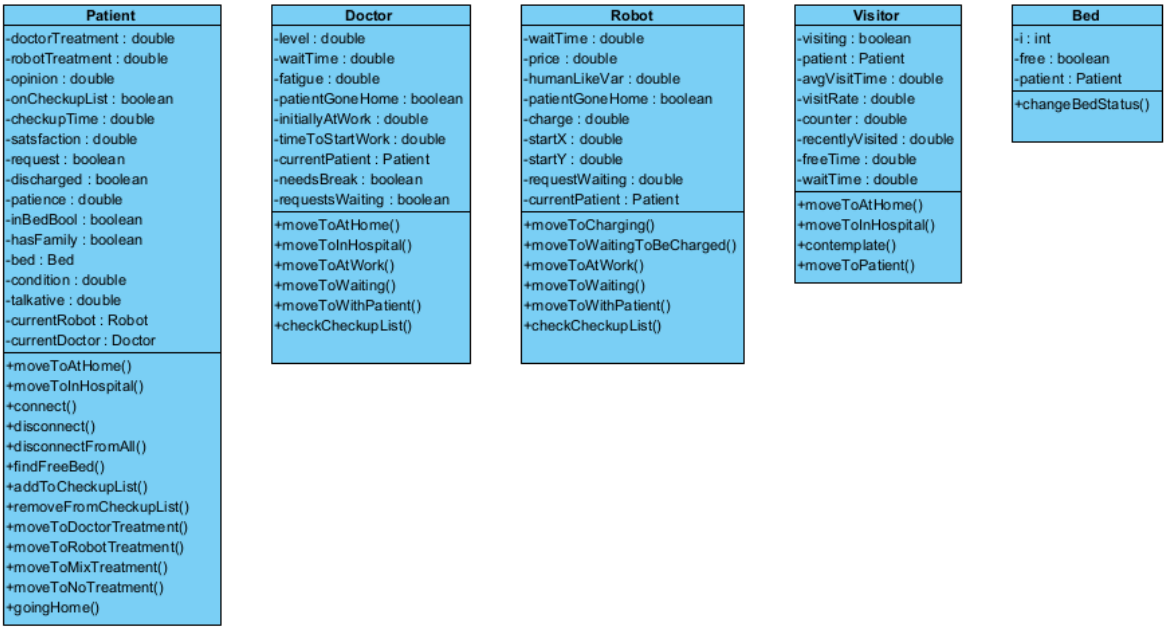
Robot



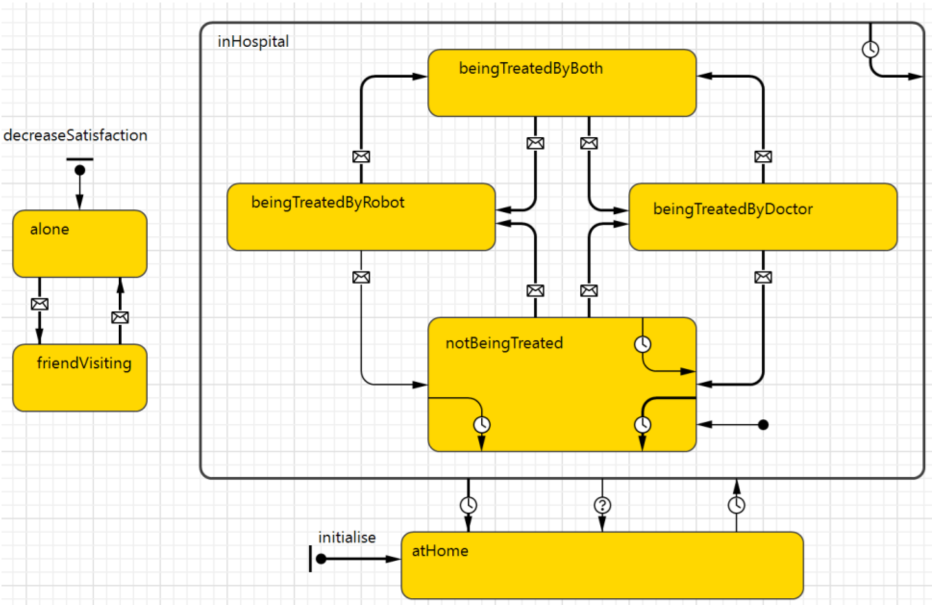
Stereotype	Humanlike variable	Effect on human opinion
Humanlike	0.5 – 1	Positive effect
Robotlike	0 – 0.5	Negative effect

Step 5: Define Agent and Object Templates

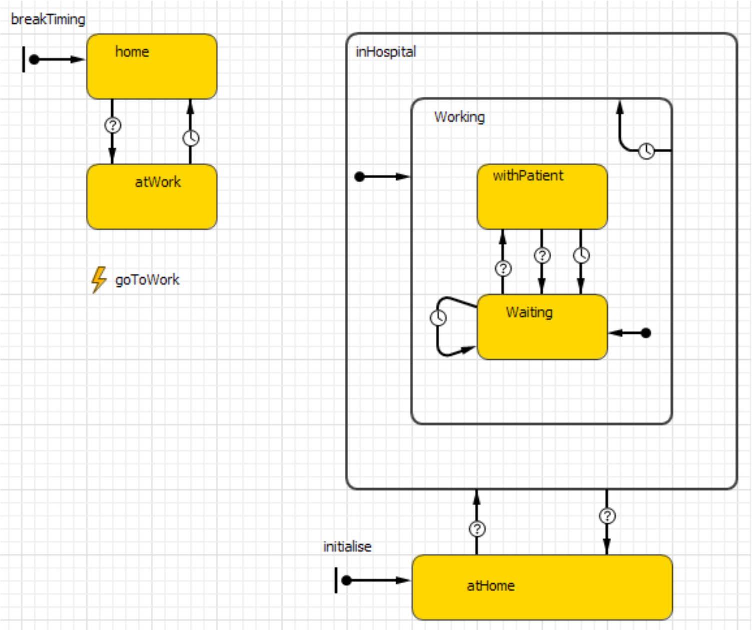
Relevant classes



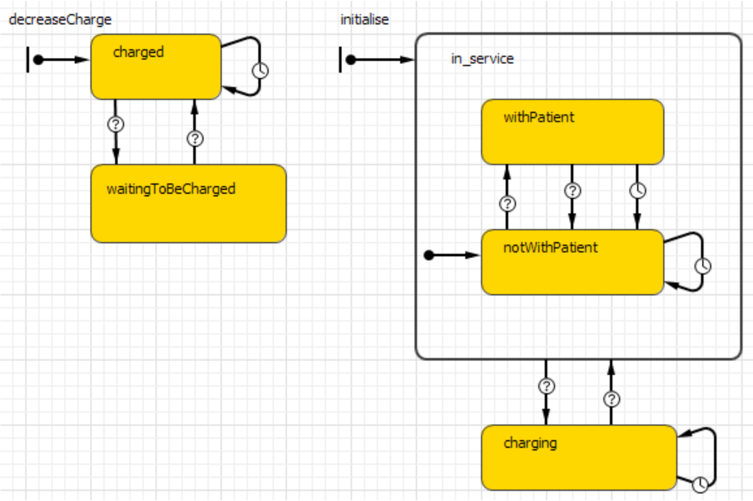
Patient state chart



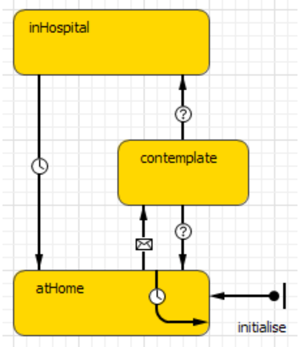
Doctor state chart



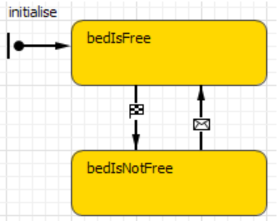
Robot state chart



Visitor state chart

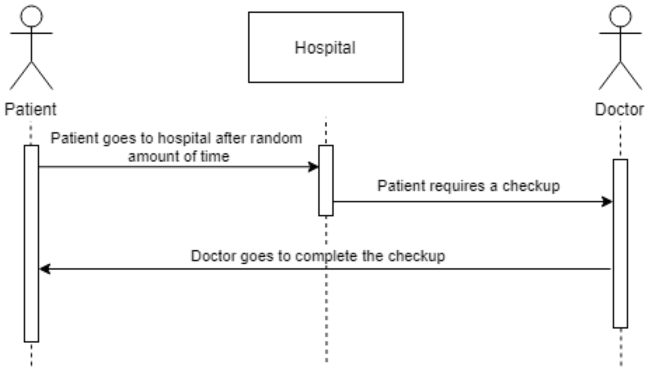


Bed state chart

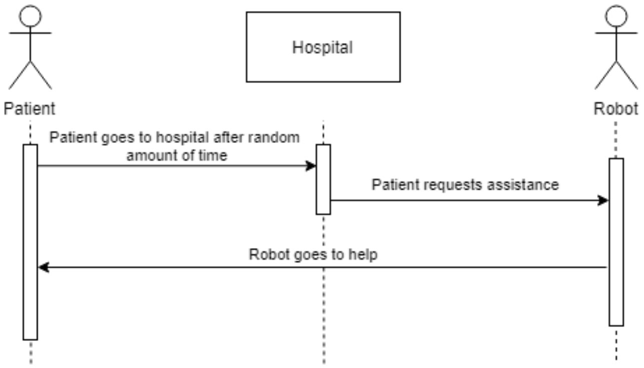


Step 6: Define Interactions

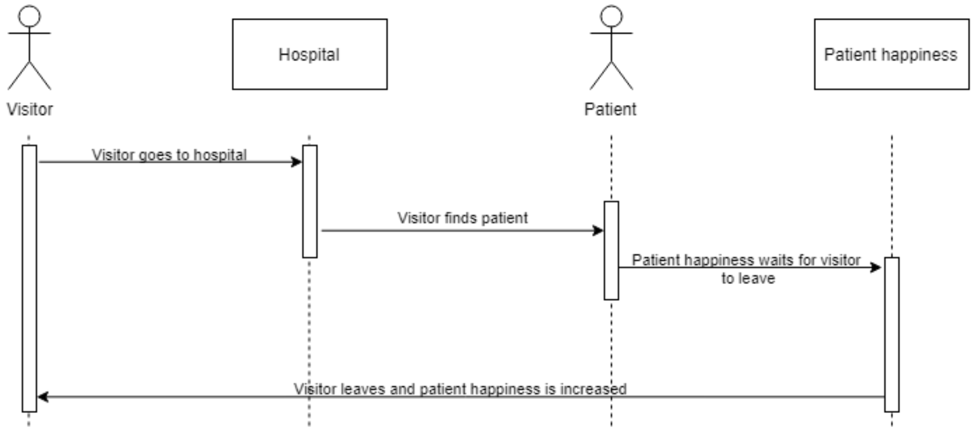
Sequence diagram for the use case "patient getting treated by doctor"


Patient
Hospital
Doctor
Patient goes to hospital after random amount of time
Patient requires a checkup
Doctor goes to complete the checkup

Sequence diagram for the use case "patient getting treated by robot"

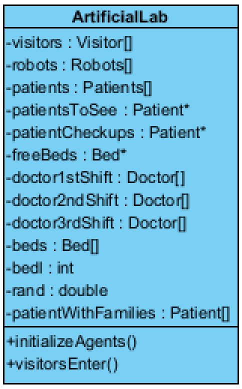

Patient
Hospital
Robot
Patient goes to hospital after random amount of time
Patient requests assistance
Robot goes to help

Sequence diagram for the use case "visitor visits patient"


Visitor
Hospital
Patient
Patient happiness
Visitor goes to hospital
Visitor finds patient
Patient happiness waits for visitor to leave
Visitor leaves and patient happiness is increased

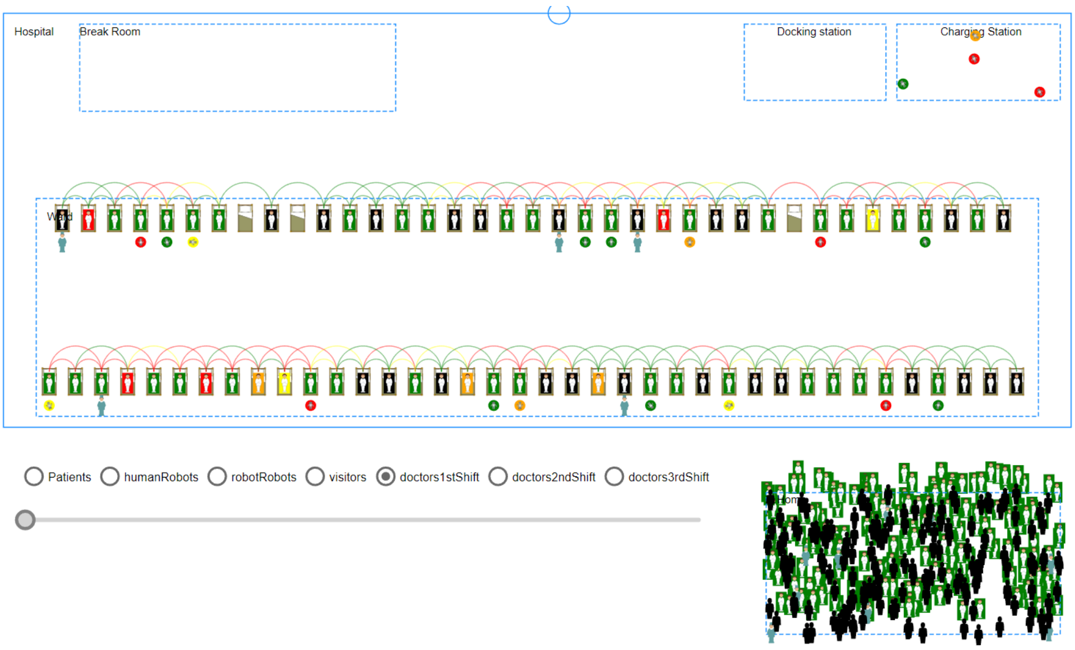
Step 7: Define Artificial Lab

Artificial Lab class definition



Implementation

Implementation in AnyLogic


Hospital
Break Room
Docking station
Charging Station
Ward
○ Patients
○ humanRobots
○ robotRobots
○ visitors
● doctors1stShift
○ doctors2ndShift
○ doctors3rdShift