**Statechart as Formal Notation for Web Application**

Unified Modeling Language (UML) is a standardized modeling language designing software systems. State machines/ Statecharts are an important UML diagram that is used to represent the behavior of a class of objects in response to events or messages received from the other objects.

State refinement involved:

* simple state
* OR refinement: auxiliary state machine, only one active state
* AND refinement: concurrent regions (state machines), all regions are active parallel

In this thesis work, statecharts are being used as formal notation to create library of real scale models. These models will be used in developing tools and techniques which will help in automated verification of statecharts for web applications.

For our case-study we have taken Covid-19 vaccination system – Vaccin1st, which is to be modeled using state-based language (StaBL). In this work we are exploring the prospect of formally specifying and later formally verifying the data protection requirements. Presently, we are modeling the consent requirements in the vaccine1st system using StaBL.

**Vaccin1st – Covid-19 vaccination system**

It is an immunization platform. The primary objective of this platform is to ease and track covid-19 vaccine disbursal. To achieve this goal, citizens are registered, appointments booked, vaccination centers allotted, and citizens are vaccinated. In the process, personal data and sensitive personal data of the stakeholders are collected and processed.

The direct stakeholders are:

* Citizen/ Employee
* Tele Medicine Doctor
* Vaccinator
* Vaccine Center Administrator
* Vaccine Center Operators

**Statechart Models for Vaccin1st**

***Model v.01***

The model shows the login process for an individual and the related workflows based on the profile an individual is choosing. Fig 1 shows the process of raising a ticket (RaiseTicket State) which falls under the category of Adverse Effects Following Immunization (AEFI), viewing the ticket (MyOpenTickets state) details which has been recently opened, and tickets which has been closed (MyCompletedTickets state). The information taken while raising a ticket are person’s name who has taken vaccination, symptoms they are showing which they must choose from the list of symptoms provided, and detailed description to explain their predicament (optional).

Fig 2 shows the process of a viewing AEFI tickets which has been assigned to Tele Medicine Doctors and actions they must take for each ticket. The doctors can see the ticket details in “ViewTicket” state which is a substate of “AEFITickets” state present in “DoctorDashboard” state. There are self-transitions happening “ViewTicket” state such as a doctor asking for consent to the patient to see their medical/ personal data which then would raise a consent request on behalf on patient’s side, updating the ticket with prescription details.

Diagram

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*Figure1. Vaccin1st model when a user is logged in with an “employee” profile and the workflow for raising concerned ticket, seeing the details of open tickets, and tickets which are closed.*

**Diagram

Description automatically generated**

*Figure2. Vaccin1st model when a user is logged in with an “telemeddoc” profile and the workflow for viewing each ticket assigned to the doctor and taking necessary action related to the corresponding ticket.*

Diagram

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*Figure3. Vaccin1st model when a user is logged in with an “telemeddoc” profile and the workflow for viewing each ticket assigned to the doctor and taking necessary action related to the corresponding ticket.*

***Model v.1.2***

**Diagram

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***Fig1.***

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***Fig2.***

***Model v.1.3***

**Diagram

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**Table

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Resources:

<https://www.startertutorials.com/uml/state-machines.html>

<https://ptolemy.berkeley.edu/papers/98/InteractionFSM/InteractionFSM.pdf>

<https://formal.iti.kit.edu/~beckert/teaching/Spezifikation-SS04/10StateCharts.pdf>

<https://inf.mit.bme.hu/sites/default/files/materials/taxonomy/term/445/13/10_CES_Behavior-Modeling-with-StateMachines.pdf>