Towards the development of a user interface to model scenarios on driving simulators

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Introduction

Scenario Modeling on driving simulators require careful consideration and controlled environment (depending on the research objectives) to achieve the desired goal of the experiment. It is one of the critical steps while designing and implementing an experiment on a driving simulator. It specifies where and what happens in the simulator by specifying, where to place the virtual objects and what those objects will be doing during the experimental trials. But the complex and technical nature of driving simulator makes it difficult for the end-users (behavioral researchers/trainers) to design and execute and experimental protocol.

Scenario Modeling includes specifying and controlling the ambient traffic, simulation conditions and manipulating the real-world traffic situations [Pap2003]. It is sometimes used to specify both the layout and activities during the experimental trial. Some authors use the term “Scene” to specify the layout (driving environment/terrain) and the term “Scenario” to specify critical events [Fis2011].

In the case of scenario programming on driving simulators, there are two main factors, which make scenario modeling a difficult problem [Fis2011]. First, the driving behavior is complicated and not well-understood; this makes it difficult to simulate realistic traffic. Second factor is the variability of human driving behavior, as they change their speed position, tactical decisions with the time during the trial, which leads to variance in drivers’ behavior to be studied.

Different approaches, systems and interaction environments have been proposed and used in the past for modeling scenarios on driving simulators. In SCANeR [Rey2000], scenario objects are placed directly on the map and use condition/action pair for scripting. In ARCHISIM [Esp1994], specification of objects positions and construction of script (condition/ action pair) is done using textual statements in a text editor like ‘Notepad’. In STI SIM [Par2011] objects and scenarios are specified by the route traveled by the driver during the simulation trial. A Tile-based approach [Pap2003] is also used, where tiles are configured with objects and then integrated. But these systems still do not fill the gap between user skills and objectives; they want to achieve with simulator.

In order to address the above mentioned problem, we have conducted a user survey [Bha2011], in which we interviewed 19 driving simulator users with various backgrounds about their problems requirements and the help they take from the technical persons while modeling scenarios. During this survey, users have described their problems as well as have given some ideas.

Proposed Approach

Traditionally, in order to configure an experimental protocol, a user (technical person or researcher) uses the functions offered by the simulator software to model scenarios regardless of what level of his programming skills. In the proposed design, we have split the scenario modeling activity by dividing the Interface into 3 sub-interfaces based on the set of skills and the roles users have to perform to implement an experiment protocol. The 3 roles *Experiment Operator*, *Template Designer* and *Experiment Designer* will correspond to the skills that users have, to design and implement the experimental protocol. We can explain this new interface using an example scenario to study drivers’ behavior. The scenario contains two situations. i.e. *Accident (Vehicle ‘A’ crosses the participant vehicle and apply brakes in front of the participant)* and *Pedestrian Crossing (A Pedestrian crosses the road as the participant vehicle approaches the Intersection)*. The proposed UI with an example is described in Fig 1.

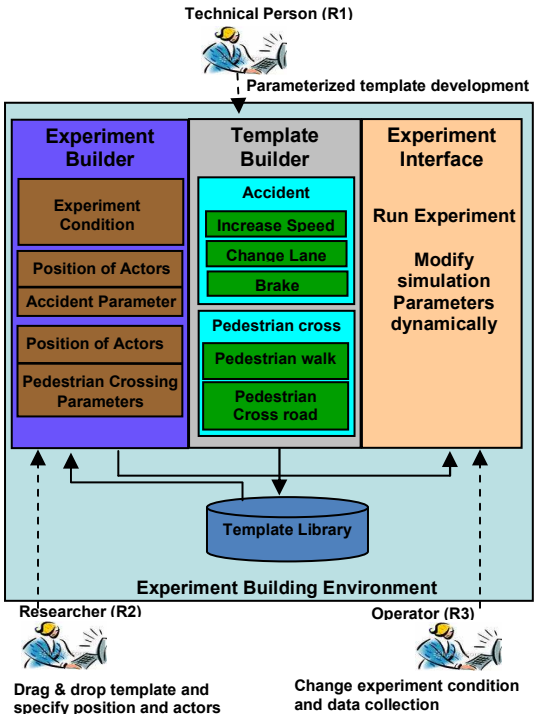

Fig 1: Experiment development process

Template Builder

This sub-interface will be used by technical persons performing role R1. R1 will design the GUI (Graphical user Interface)-based parameterized templates of the scenario events. Template builder will let R1 to use existing functions offered by the scenario-modeling environment of the driving simulator. For example, at back-end of the template "Accident", Template Builder will let R1 to program a vehicle 'A' to cross the participant vehicle, changes the lane and applies brakes in front of the participant vehicle and same for the "Pedestrian crossing". At the front end, there would be different text fields to specify the parameters for "Accident" and "Pedestrian crossing" actions.

Experiment Builder

This sub-interface will be used by researcher/trainer performing role R2 having no or low programming skills. R2 will specify the conditions of the experiment along with the data to be collected and studied to answer the research questions. R2 will access the Template library already developed using Template builder. R2 will drag and drop the templates on the experiment builder Interface. As described in the figure 1, using the experiment designer sub-interface, R2 will specify the position and actors involved in the templates "Accident" and "Pedestrian crossing" besides the template parameters. In this way, R2 person can quickly and easily develop the experimental protocol.

Experiment Interface

Experiment Operator will be used by researcher performing role R3. Using this interface, R3 will load and execute the scenario on the driving simulator. R3 can change the parameters of the scenario or template (if needed), and finally collect the data.

Conclusion

We have focused on the problem of one class of users (Behavioral researchers), who are primary users of driving simulators. The objective is to fill the gap between user skills and the goals they want to achieve in an efficient way. As we are working on user-centered design, we are developing a prototype of this interaction concept that will be evaluated by the users. In the near future, we are looking forward to implement this concept after user evaluation.

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