# Semi-Automatic User Stories Generation

## To Measure User Experience


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*Abstract*— **User satisfaction with a certain product is affected by its usability and additional factors, such as user experience (UX) that determine if an application meets users' expectations. The quantitative measurement of UX relies on the fulfillment of psychological needs that can be addressed in user stories in order to create a context for a certain experience with a particular application. In this work, we present a framework to semi-automatically generate user stories to measure UX. Our character-centric approach consists of multiple agents that pursue goals and are able to express emotions. Additionally, we introduce a supportive agent that is in charge of generating a strong story line. The framework allows for further extension with avatars that give form to the character agents, and also story generation output in the form of video or comics that complement the current text generation.**



***Keyword-components; user stories generation; user experience; psychological needs***


## I. INTRODUCTION

User centered design implies knowledge of the future user and the intended context of use that can be modeled through user stories in order to represent use cases [1]. According to the authors in [2] a product can be used in different contexts such as technical, physical and social. The specific context will determine in which manner a product will be used. Defining the requirements of a certain product or application from a user's point of view enables reflection upon a palette of usage possibilities [3, 4]. Therefore, in the design phase of a product, different user stories which represent diverse application scenarios should be developed and be varied and adapted depending on the development phase.

User satisfaction with a certain product, is not only affected by usability [5]. Additional factors such as user experience (UX) determine if an application meets users' expectations. In this context, the authors in [6] presented a measurement procedure for the quantitative measurement of UX in connection with the automotive industry that went beyond typical usability measures. Satisfaction is important to achieving an ongoing sense of well-being and balance with a product [7]. Therefore, the user experience measurement methodology relied on the fulfillment of psychological needs, which were integrated into user stories in order to create a tailored context for a certain experience with a particular in-vehicle device. Similarly to the results presented in [8, 9] the stories helped to gain new insights on the product design at an early stage providing a real context as part of the user experience design.

Considering the extensive process of creating user stories, this paper presents a semi-automated system used to facilitate this task, by generating text-based user stories to measure user experience. In our framework the story author defines the characters' properties as needs, behaviors skills and goals as well as the story environment. The application uses then the data entered to generate a story. Our approach consists of an interactive story-centric interface that supports multilingual content (currently English, German and Arabic). It is based on the story planning UNIVERSE model [10, 11] and also allows for the storage of the created characters, needs, emotions and environments into a database, so that the objects that have previously been created can be reused for further stories. Additionally, the end user can add feedback related to the generated story for evaluation purposes.

## II. RELATED WORK

### A. Automatic stories generation

In [12] the authors claim the main goals of an automatically generated story are to create a character that seems authentic, as well as a story line that is coherent. According to the authors, there are two main approaches to reach these goals:

- Author-centric approach: a single authoring agent is used with intentions towards story outcome or plot structure.
- Character-centric approach: story represents the character actions in the virtual world, each character has certain roles.

While the author-centric approach allows for generating coherent stories, the characters do not develop as believably as they should. On the other hand, the character-centric approach seems to work the other way around: for lack of story coherence, the characters seem to be more authentic to the audience. Some existing frameworks for generating stories are

based on text, for example, in the story generation model in [13], where the authors use a top-down procedure: starting from the grammar instead of from the character development. A further analogy-based, story generation technique has been presented in [14]. The proposed approach generates both story content and text simultaneously.

The plots of these two approaches result from a character-centric approach that ensures consistency in the story [15, 16]. In this context, the multi-agent system for the automatic creation of stories in [17] combines intelligent agents, speech technology, character animation and virtual reality to create a plot as a consequence of the actions of the characters. The final story is then presented by an embodied, talking agent.

Our approach is character-centric and consists of multiple intelligent, semi-autonomous agents that simultaneously represent different characters that pursue goals and are able to express emotions adhering to the approach presented in [18]. As we aim to generate stories with a simple plot, an author agent controls the story line and story plot consistency in a similar manner to the Virtual Storyteller approach [19], in which multiple characters are assigned different goals and emotions and are then used to immerse readers in the story and make the story believable and authentic. Our approach differs from the Virtual Storyteller in the number of characters that have an assigned goal: the main character in our approach is the only one who has been assigned a main role as a driver with the goal of arriving to a specific destination. A further difference concerns the emotions that we have used as parameters to evaluate user experience with a product. These measure the effect of environment objects and/or events on the character. With our system, we allow characters to have control of the plot to match their personality (characterized by the level of skills/values/emotions), and the ability to achieve goals while fulfilling their needs. The environment settings define the boundaries of the story. Thus, the characters do their own planning within the structural limits. We do not use pre-scripted plots, but these can be added into the author agent if required.

### *B. Authoring tools for stories generation*

In previous work, a large number of authoring tools to support the author in planning and creating stories have been presented. They provide functions for visualizing and editing the story structure or storyline [20]. Some of them are based on story graphs [21-23] that need to be explicitly created and imply extensive preliminary work. Others are based on illustrations that map collections of places or situations through methods for the semi-automated creation of spatial slideshows with geotagged photographs [24, 25].

A digital lifetime capture system that permitted storytelling based on digital personal lifetime data was introduced in [26] where an slide show authoring tool allowed images in the query results to be dragged and dropped into a story. The story could be later shared through an available hyperlink.

Additionally, a novel user interface for multi-user interactive, informal storytelling was presented in [27] and was based on a natural face-to-face conversation, sharing a convenient physical sharing device, that was simple and enjoyable to use, which also enabled interactive and exploratory storytelling, blending authoring and presentation. In additional approaches author goals can be reused to create a variable output depending on the state of the story [28]. In light of this, we support the author to create stories through a similar approach and present our stories in the form of sequential text generated by any system components that display text [29], enabling a low complexity plot.

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## III. STORY CREATION PROCESS

In our character-centric approach, character agents interact with each other and plan accordingly to the known actions. The author agent ensures plot coherence and the text generator presents the plots. In order to overcome potential weaknesses of this approach related to story line coherency, we have introduced a supportive author agent that is in charge of generating a strong story line. This framework allows for a later extension with avatars that give form to the character agents and story generation output in the form of video or comics that complement the current text generation. Fig.1 illustrates this process.

### *A. Intelligent agent platform implementation*

We use JADE+JESS as our platform for intelligent agents to generate the stories [30, 31]. The JESS shell is used to add rules and constrains to the intelligent agents so that they can gain knowledge. Additionally, the rules will describe the characters goals and needs as well as their environment relying on the approach presented in [18].

We have pre-defined interaction sequences between characters and environments, and represent character and environment agents as JADE (Java Agent DEvelopment Framework) agents. Additionally, we have integrated this phase into the character/environment defining system that was implemented in a previous phase in order to develop the rules for the auto generation of the story. Finally, we created a database support system for the character/environment definition.

The JADE agents are implemented as follows:

#### *1) Character agents*

Character agents are defined as those representing the characters in the story. They contain information in the form of attributes or properties expressed in the following categories, which might vary depending on the context of the user story:

- Personal information (i.e. name, age, profession, etc.)
- Hobbies, such as some kind of sport, reading, driving, playing music, etc.
- Goals, following the bottom up hierarchical classification by the authors in [32]: self-referential be-goal, or goal that motivate the user actions and give them meaning; do-goals that represent a concrete outcome of an action; and motor-goals, which are executed tasks.
- Current environment is set up according to the character agent's definition.

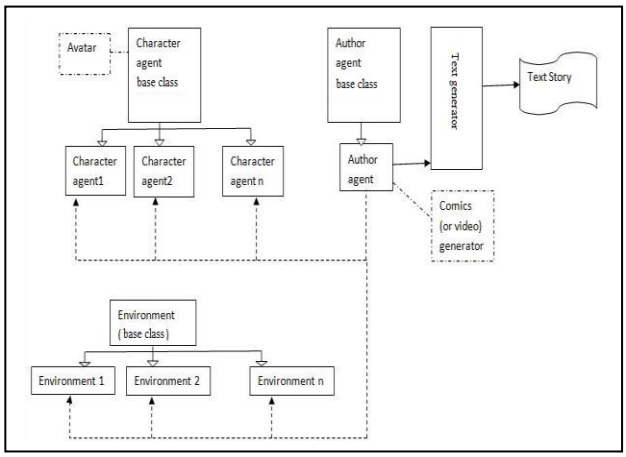


Figure 1. Character-centric approach based on multiple agents for a semi-automatic story generation

- Psychological needs, such as competence, relatedness, popularity, stimulation, meaning, security, and autonomy as described in [32].
- Behavior or any character response to an action, environment, other character, or stimulus. Actions of the character agents are represented according to their behaviors (through messages). Behaviors are allowed for a certain environment. If the agents move to a new environment, it is possible for them to perform actions allowed in this new environment as well.
- Personality characteristics, represented through a scale from 0 (minimum value, meaning that it does not apply to the character) to 10 (maximum value, meaning that it definitely applies to the character). These characteristics are expressed in the form of skills, emotions and values. Character agents reflect both the characters and their actions. Details of each category might change according to the context of the specific user story. Changes applied to the parameters of character agents affect the rules for the auto generation of the story resulting in a new story. For example a higher degree of the security need results in a decrease of the travel speed or the selection of a different car for the route by the character agent.
- Allowed actions are also contained in the character agent's definition.

Character agents will be allowed to receive the following messages: "fulfill need", "satisfy goal", and "affect emotion".

The story main character is called the persona. Since the approach to generate the story is extendable, it allows for a user-defined addition of new characters. The diagram in Fig. 2A illustrates the design of the character agents. Each goal contains requirements that need to be fulfilled in order for the character to achieve the goals. Only one element of the fulfilledBy list can fulfill the needs.

*2) Author agent and text generation component*

This agent is responsible for the story line and story plot. It is in charge of assigning tasks to the character agents if any conflict with the story exists, and the action is justified from the author's perspective. The text generation component is responsible for generating the text that describes the generated story.

*3) Environment agents*

We define environment as the place where the story takes place. A story can involve more than one environment. At the same time, different story parts can take place in different environments. Environment agents contain the following attributes: name, objects and events and also include a pointer to nextEnvironment(s). Additionally, agents are able to send the message: "event happened", which will result in the triggered event "affect emotion". Moreover the agents are able to receive the message "action" from the character agent, meaning that a character agent has performed an action within the environment.

They consist of the following parts:

*a) Objects*

Characters can perform an action to deal with them, for example fulfilling a need or as part of the process of achieving a goal (e.g. arriving to an electric charging station).

*b) Events*

Unexpected event that can occur within the environment without any interaction from any character (e.g. an accident or traffic jam). These events can affect characters emotions.

*c) Next environment*

A character can move from a starting environment into a new one. Each of these new environments may contain different requirements, such as driving 100 km to arrive to the beach (next environment). The diagram in Fig. 2B illustrates the design of the environment agents.

## *B. Graphical user interface*

A start screen enables the user to enter the following information selecting the appropriate option from a menu bar:

- Add new character, by selecting Character -> Add new character.
- Add new goal, by selecting Goals -> Add new goal.
- Add new need, by choosing Needs->Add new need.
- Add new hobby, by selecting the menu item Hobbies - >Add new hobby.
- Add new personality criteria, by selecting between the following menu items: Personality-> Add new skill, Personality-> Add new emotion or Personality-> Add new value.
- Add new environment by selecting the menu item Environments->Add new Environment.
- Connect a character and environment from one of both menu items Character->Connect to an Environment or Environment->Connect to a character.

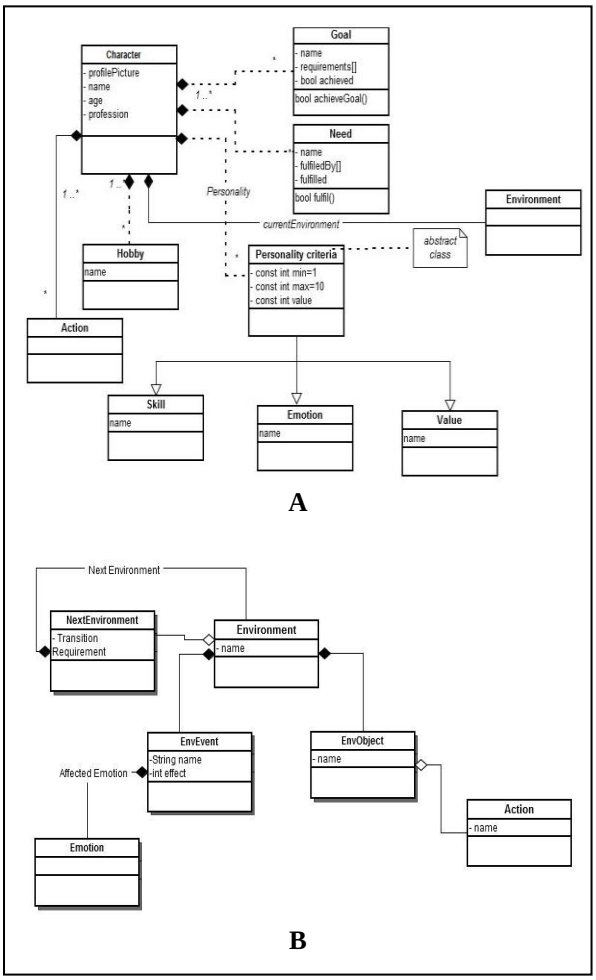


Figure 2. Design process of the agents. A) Character agents; B) Environment agents

*1) New character*

A new character can be added from the menu bar by entering a name, age and profession. Afterwards, the user will be able to add personalities, needs, hobbies or goals to the character, as well as visualize the character profile through the corresponding buttons: "Personality" to add skills, emotions or values; "Needs", "Hobbies" and "Goals" and "View character". Fig. 3A depicts the user interface for entering a new character.

*2) Character viewer*

This screen can be reached by clicking "View character" in the start screen. Here the user can check the value of specific personality criteria (e.g. skills, values or emotions). Additionally, the user can view details of the available goals or needs by clicking on the node to expand the view. Fig. 3B depicts the user interface to visualize the personality criteria of a certain character.

*3) New personality criteria, needs, hobbies or goals*

By clicking "Personality" on the main screen users can access the screen to add new personality criteria or alternatively through the menu items Personality-> Add new skill, Personality-> Add new value or Personality-> Add new emotion. The user can also edit or delete personality criteria, by clicking on the "Edit" and "Delete" buttons. Through the menu bar in the main screen, a new need, hobby, or goal can be added, edited or deleted. Additionally, the menu enables users to determine how certain needs can be fulfilled and to specify the requirements needed to achieve a certain goal. Fig. 3C depicts the user interface for entering new personality criteria.

*4) New environment*

To add a new environment objects belonging to this new environment need to be added first. This can be achieved through a + button located below the list of objects. Additionally, the user can add actions and events in this screen. The user can later visualize, edit or delete the created environment by selecting the corresponding environment from a list.

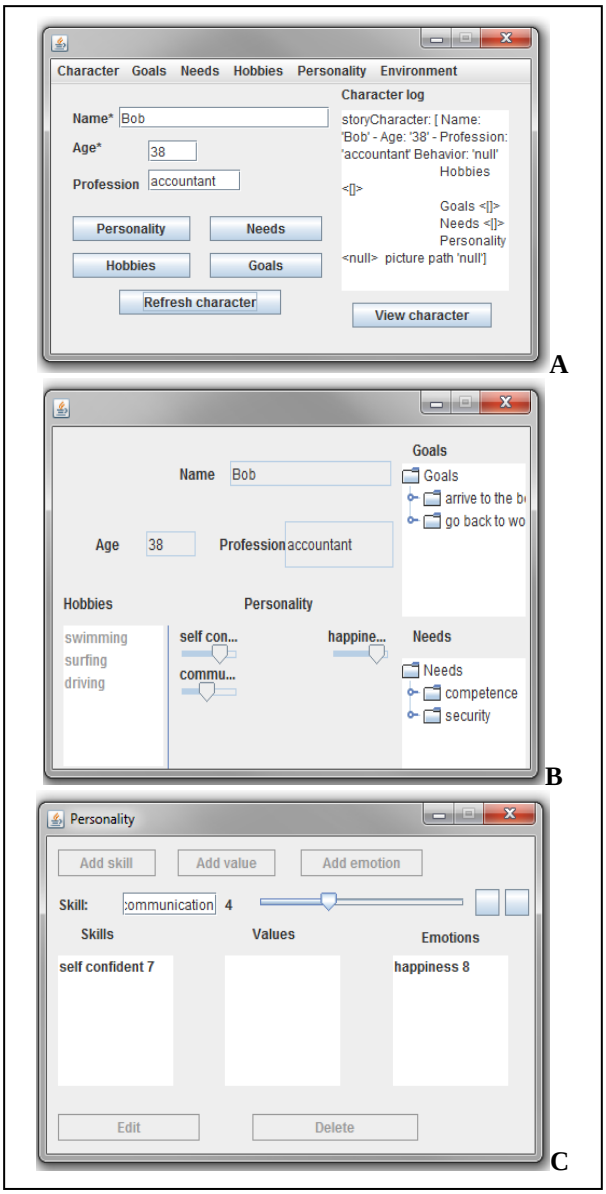


Figure 3. Section of the user interface to A) enter a new story character; B) to visualize the character's personality criteria and C) to visualize the character's personality criteria

*5) Relationship between character and environment*

The connection between the characters and the environment is specified as follows:

*a) Character-Current Environment*

The character is connected to an initial environment. For example we define the first environment as the following:

character->currentEnvironment is Home.

*b) Character-Actions*

The user can interact with objects in the environment through actions. For example, a character can interact with a charging station (object) by charging his/her car (action). We define this relationship as:

Environment->object->AllowedAction.

*c) Environment-Events*

This type of relationship can be expressed as an emotion that affects the character's personality. Character->Personality->Emotion

## C. Text Generation

After the characters, environments and its relationship have been defined, this knowledge is applied in the form of rules and constrains for each character agent. The author agent will then activate the character agents so that they interact with each other to achieve their goals, thus creating the individual user story. The text generator uses stored templates to generate text sentences that represent character actions and emotions.

This technique differs from pre-scripted story plots in its aim to only "teach" the system how a story text can be generated, and then be enhanced and evaluated through user feedback input in a later phase.

Fig. 4 shows an example of a generated user story with a character agent, or persona, named "Bob", and two environment agents: "Home" and "Road". The current environment of "Bob" (Bob-> currentEnvironment) has been set to "Home", and the next environment of "Home" (Home->nextEnvironment) to "Road". The sentences written in upper case letters are not part of the output story, but messages from the multi-agent system that show the agents' status. The following messages were received during the generation of the user story example:

- <agent> STARTED
- <agent> RECEIVED <MESSAGE> FROM <agent>
- <agent> SENT <MESSAGE> MESSAGE
- <agent> CREATED AND STARTED NEW AGENT: <agent> ON CONTAINER <Container>
- <agent> REGISTERED WITH THE Directory Facilitator (DF)

In this output, <agent> and <MESSAGE> represent the exact instance of the agent or message used. <Container> is part of the multi-agent system that contains agents. The Directory Facilitator (DF) agent, as specified by the Foundation for Intelligent Physical Agents (FIPA), plays a similar role to the "Yellow Pages" phone book: agents wishing

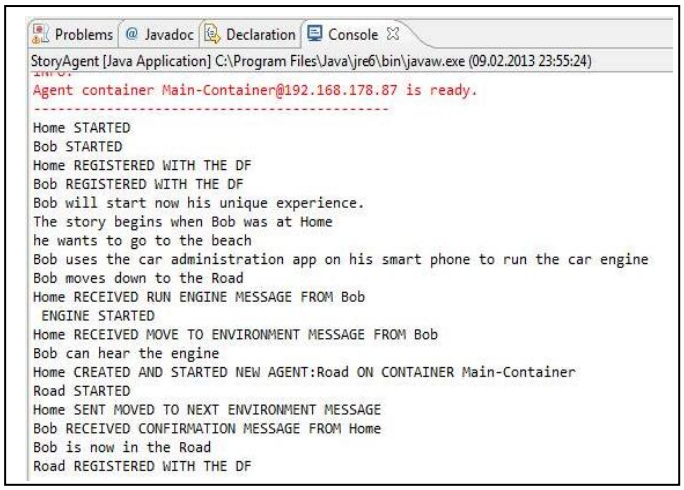


Figure 4. Generated user story in form of text output

to advertise their services register with the DF. Visiting agents can then look for local agents which provide the services they desire in the DF.

## D. User Feedback Evaluation

The main purpose of this work is to measure user experience with a certain device providing the user with a tailored context through user stories. As part of the system, we have allowed users to evaluate generated stories by providing their feedback on the following criteria:

- Is the story emotionally effective?
- Is the plot coherent?
- Are the characters believable?
- Is the message/goal of the user story clear?
- Do the following elements exist in the story (yes/no?)
- Features/Issues to be solved, integrated and rationale

After having read the generated story, users are asked to state if reading the story has affected them emotionally and if they can relate to the story. Users can also evaluate the story plot: was it coherent, was the story well connected? Also, as character believability is an important aspect of any good story, users have the opportunity to classify the grade of realism of the characters as well as the clarity of the message or goal that the story intends to achieve. The last element of the evaluation criteria is a check of all required elements, such as a specific role that a persona has to play to achieve a goal, show a certain feature and the rationale for the requirement of the specific feature.

# IV. CONCLUSION AND FUTURE WORK

In this paper we have presented a system to semi-automatically generate text-based user stories to measure user experience. The combination of the character-centric approach and the supportive author agent is able to produce a strong story line. Future work aims to access the already created

characters, needs, emotions and environments from the database to be able to reuse them in further stories.

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