

# DIGITAL INTERACTIVE STORYTELLING APPROACHES: A SYSTEMATIC REVIEW

Islam Sharaha<sup>1</sup> and Amal AL Dweik<sup>2</sup>

<sup>1</sup>Master of Informatics  
islamsharaha@gmail.com

<sup>2</sup>Dept. of Computer Engineering and Sciences  
Palestine Polytechnic University (PPU) Hebron, Palestine  
amal@ppu.edu

## **ABSTRACT**

*Interactive Digital Storytelling (IDS) is concerned with the creation of a new media art form that allows real-time interaction with a developing narratives. IDS is important learning, training, testing and entertainment tool. This paper makes a systematic review that compares several approaches used in (IDs) in terms of user interaction type, degree of interaction importance, classification of approaches types, and comparing approaches in terms of some performance factors.*

## **KEYWORDS**

*Digital Interactive Story Telling, time- interaction, degree of interaction.*

## **1. INTRODUCTION AND THEORETICAL BACKGROUND**

Storytelling is the process of creating narrative structures or engaging with them, which is pervasive in many aspects of children's life. It has different definitions such as: "Storytelling is one of the oldest methods of communication and learning" [Tharrenos et al, 2015]. As [Nuri et al, 2013], the storytelling is an important way to share experiences, thoughts, and imaginations between people in term of verbal statements. In a child's world, the storytelling is a great tool to reflect children's feelings. A storytelling is a good way for learning about identity and communication as it enables the exploration of one's inner world [Benjamin, 1998]

Interactive Digital Storytelling (IDS) is concerned with the creation of a new media art form that allows real-time interaction with a developing narrative [Stefan Rank et al, 2012]. [Lathem SA, 2005] defined Digital storytelling as a combination of traditional, oral narration with different types of multimedia (like: image, text, video and music) with communication tools. As [Benjamin, 1998], there are three functions that narrative should serve, and must be carefully analyzed to produce a good story: cognitive, social and emotional function.

There are three levels of the story creation. The first level is the storyline or plot; which is a series of chronology and causally related events that make up the story's content. Storyline can be a

script-based or a character-based. The second level is the narrative, which is a representation of the plot from a particular point of view. The third level is the presentation, which is a realization of the story in a particular medium [Mariat et al, 2002]. Good story line should adhere of Fraytiys triangle [Jeroen, 2012].

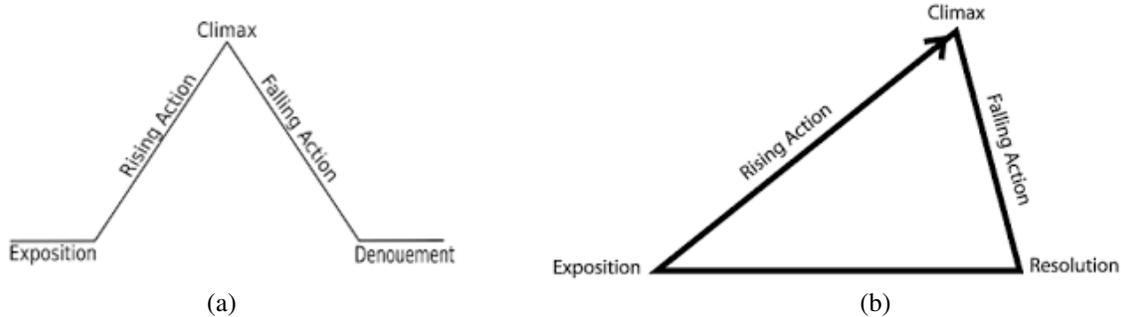


Figure 1: (a) Standard Fraytiys triangle. (b) Another form of Fraytiys triangle.

As shown in figure 1, rising action describes the events that occur and actions that are undertaken previous to the story's climax. The climax features the highest peak in dramatic tension. Thereafter, there is a falling action. Lastly, denouement addresses the resolution of the conflict and the final release of tension.

As [Edrilei, 2014], the story telling systems can follow three basic approaches: plot-based, character-based and hybrid approach.

The rest of the paper is organized as follows: the next section introduced the literature review. A discussion of storytelling approaches in terms of types, user interactivity types, approaches tools, implementation and testing, and performance factors are presented next. In the final section, the conclusion and future work is introduced.

## 2. RELATED WORK

Several researchers interested in the interactive storytelling field. Some of them considered the interactive storytelling as a good entertainment tool as [Edirlie, 2014]. This is accomplished by allowing the user easily to interact with the system through the "paper and pencil" approach. Other researchers used interactive stories as an educational tool, such as [Nuri, 2013]. They proposed StoryTech, which is a smart storytelling toy that features a virtual space and a real space. [Raidle, 2007] proposed an approach that combines believable agents and intelligent scenario direction. This was used for social and cultural training, which consider the use of the storytelling techniques as a training tool. [M. Seif Al-Nasr, 2013] made questioner on narrative interactive to determine the user background in interactive storytelling. The user interpretations, emotions and behavioral response to Façade are analyzed. Where Façade, which is one of the most well-known interactive storytelling systems, depends on the drama manager that manages the narrative progression. It does so by trying to module the narrative so that it corresponds to a desired story arc such as the one of Freytag's triangle

Marc Gavazza and others described the planning techniques to control autonomous characters in order to make interaction with virtual character [M Gavvzza et al, 2005].

Rafael Perez described a computer model for plot generation based on emotion and tension between characters, implemented using MEXICA which is a computer model of a cognitive account of creative writing purposed by Rafael Perez in 2001 [P.Y Perez, 2007].

Edirilie Soares presented paper and pencil approach as a storytelling system that is based on augmented reality and used SVM to recognize the user sketches [Edirlie et al, 2014].

Nuri Kara introduced StoryTech, which is a smart storytelling toy that features a virtual space that includes computer based graphics and characters, and a real space, which includes plush toys, background cards, and a communication interfaces based on mixed reality [Nuri et al, 2013].

Mariet et al used agent techniques to produce a virtual storyteller, where the storyline created by the action of characters is guided by director agent. Yundong et al used agent technology to present DIRACT, which is an approach to create characters that do not make a difference between director or actors' characters [Yundong et al, 2010], [Mariat et al, 2002].

### 3. DISCUSSION

The following section discusses the different digital story telling approaches.

#### 3.1. Interactive Storytelling Approaches Types.

As shown in table 1, the digital story telling approaches are classified into three types: Character-based approaches, Plot-based approaches and Hybrid approaches.

Table.1 interactive storytelling approaches.

Author	Approach Title	Storytelling approach type	Application based app
[Yundong et al, 2010]	DIRACT	Character-based	Real-time
[Edirlie et al, 2014]	Paper and pencil	Hybrid approach	Real-time
[Polbo et al, 2005]	CBR Plot Generation	Character-based	Natural language recognition
[P.Y Perez, 2007]	MEXICA	Character-based	Natural language recognition
[Nuri et al, 2013]	StoryTech	Plot-based	Real-time

The approaches were classified based on the story derivative way. In the Character- based approaches, the story development depends on character decision. The main disadvantage of this system is that it is less adhere of Fraytyis triangle. In Plot-based approach, the characters have no autonomy and they are less consistence in the scene since the characters are often

interchangeable. The Hybrid approaches are used to bridge the gap between the plot-based approach and character-based approach.

### 3.2 User Interactivity Types

As [Linssen, 2012] Interactivity means having at least some control over the narratives. From this definition, we can say that interactivity has different degrees. As shown in the table 2, the user interaction types are divided into three levels or degrees: limited, medium and high. By limited interaction, we mean that the user influences little parts in the story or storytelling level. Where in medium interaction, the user influences a whole level of the storytelling. High interaction means that the user can influence all the story levels or parts.

The user interaction in most approaches compared in table 2 is limited or low in the approaches that are used or meant by speech recognition. This is due to the difficulties in the recognitions of different languages and child's speech. Where the interaction is high in real time approaches, such as: [Edirlie et al, 2014],[Yundong et al, 2010] and [Nuri et al, 2013].

Table 2. Comparison between interactive storytelling approaches in terms of user interaction.

<b>Author</b>	<b>Approach title</b>	<b>User interaction type</b>	<b>Degree of importance</b>
[Y.- G Cheongh et al ,2008]	Framework for authoring interactive narrative	Participants (Speech)	Limited
		Author (authoring tool)	Medium
[Han YU et al, 2008]	Goal-oriented system	Character creation (as agents)	Medium
[M Riadle et al, 2003]	Automated Scenario Director	Speech to be changed	Limited
[M Gavazza et al, 2004]	Interacting with Virtual Characters	Physical interaction Speech	Medium
[M Gavazza et al, 2005]	Dialogue Generation in Character-based Interactive Storytelling	(Future work) Embodying the user as one of virtual characters	High
[Edirlie et al, 2014]	Paper and pencil	Drawing on paper	High: real-time
[M.O Raidle et al, 2007]	Interactive narrative system	As one of virtual characters	High

[P.Y Perez, 2007]	MEXICA	Give the initial state	Limited
[C.B Callaway, 2002]	Narrative prose generation	Give the story request	Limited
[Nuri et al, 2013]	StoryTech	Put objects on the receive panel	High: real-time
[U Spierling, 2002]	Setting the scene	Give the story requests	Limited
[David et al, 2009]	Learning to Influence Emotional Responses	Answering some given question to drive the narrative	Limited
[Yundong et al, 2010]	DIRACT	As a director virtual character (agent)	High: real-time
[Mariat et al, 2002]	Virtual story teller	Create characters and give priority	Medium
[Polbo et al, 2005]	Plot generation based on CBR	Query for a new story from old others	Medium

### 3.3 Tools Classification

The interactive storytelling approach can benefit user in many ways. The interactive storytelling used techniques can be classified as a tool of authoring, education, entertainment, and training. The classified techniques can be further classified into several story level influences, as shown in table. 3.

Table 3. Comparison between interactive storytelling approaches in term of technique used and how to benefit the user.

Author	The approach used	Used technique	Tool	Story level influence
[Y.- G Cheongh et al ,2008]	Framework for authoring interactive narrative	Branching graphs and AI planning	Authoring (Storyline)	Storyline (Script-based)
[Han YU et al, 2008]	Goal-oriented system	Multi agent system	Authoring(Character creation)	Presentation

[Edirlie et al, 2014]	Paper and pencil	Augmented reality, svm	Entertainment tool	Presentation
[Nuri et al, 2013]	RFID interactive panel	Mixed reality	Entertaining, educational and measuring tool	Presentation
[David et al, 2009]	Influence emotional responses	YouTube video And pre-authoring text	Tool to derive narrative by player (one time)	Narrative
[Yundong et al, 2010]	DIRACT	Multi agent system (inheritance)	Authoring (character creation)	Presentation
[Mariat et al, 2002]	Virtual story teller	Multi agent system (intelligent agent)	Authoring (automatic storyline)	Storyline (Character-based)
[M.O Raidle et al, 2007]	Believable agents	Combine narrative control, believable character agents and drama manager	Authoring and training tool	Storyline (Character-based)
[Polbo et al, 2005]	Plot generation based on CBR	Case-Based Reasoning CBR, Natural Language Generation NLG	Authoring tool	Storyline (Character-based)

As shown in table 3, the interactive storytelling techniques can be used as a very good authoring tool and can help the user with low experience in authoring to create their own stories such as those used in [Yundong et al, 2010], [M.O Raidle et al, 2007] and [Mariat et al, 2002]. From table 3, you can notice that most of interactive storytelling authoring tool approaches are using agent techniques; that is the behavioral and emotional agent designed to serve the storytelling attracting the users and giving them more chances and abilities to produce a good story. On the other hand, the approaches that used a simple way to interact at most real-time approaches are considered as a good entertainment tool.

### 3.4. Interactive storytelling approaches implementation and testing.

Some of the approaches used or suggested to make interactive storytelling are implemented and tested. Others were either implemented or just tested. As shown in table 4.

Table 4. Implemented and tested approaches.

Author	Approach title	Implemented	Tested
[Edirlie et al, 2014]	Paper and Pencil	Yes	Yes (for effectiveness and satisfaction)
[Han YU et al, 2008]	Goal-oriented system	Yes	Yes (usability)
[Polbo et al, 2005]	Plot generation based on CBR	No	No
[P.Y Perez, 2007]	MEXICA	Yes	Yes (interestingness, novelty, predictability)
[Yundong et al, 2010]	DIRACT	No	Technical test (usability)

[Edirlie et al, 2014] mentioned that their approach was implemented and tested by questionnaire contains 54 questions derived from the IRIS evaluation Toolkit, and the participants were high school students. Where [P.Y Perez, 2007], made a questionnaire using a story developed in MEXICA and MINSTREL in order to compare MEXICA and MINSTREL in terms of interestingness, novelty and predictability.[Yundong et al, 2010] made a case study to evaluate the approach usability.

### 3.5 Comparison of performance factors.

Table 5, summarized the surveyed approaches according to the performance factors: speed, accuracy, usability and reuse. Speed means the time needed to respond to user interaction. Accuracy is the ability to satisfy user purpose. Usability means the easiest to use the approach. Reuse is the ability of the use of elements from old stories to create a new story.

**Table 5:** comparison between approach in term of speed, accuracy and user interface

Author	Approach title	Speed	Accuracy	Usability	Reuse
[Edirlie et al, 2014]	Paper and pencil	Good (one interaction per minute)	83% because of some limitations in recognition algorithm	Satisfaction user interface because of the easy way to interact with the system	No

[P.Y Perez, 2004]	MEXICA	----	More than MINSTREL	-----	Yes
	MINSTREL	-----	Less than MEXICA	-----	Yes
[Han YU et al, 2008]	Goal-oriented	-----	Good	Friendly user interface saves development time and cost	No
[Polbo et al, 2005]	CBR plot generation	Not implemented	Not implemented	Not implemented	Yes
[Yundong et al, 2010]	DIRACT	Not implemented	Not implemented	Ease to use	Yes

[P.Y Perez, 2004], made a comparison between MEXICA and MINSTREL, where those two approaches were the most farmhouse at that time. He mentioned that the stories produced by MEXICA were more interesting, but some time they were poorly written. As we can see in the table, paper and pencil approach seems to be good in usability. However, for the accuracy, there were some limitations because of recognition algorithm, or some time in user sketches. Approaches in [Polbo et al, 2005] and [Yundong et al, 2010] was not implemented, but it was mentioned that these approaches allowing the reuse by their construction.

#### 4. CONCLUSION

Storytelling is the oldest way to communicate, learn, entertain and share experiences and thoughts among people. Furthermore, it is an effective way to reflect the feeling and people social background. Interactive Digital Storytelling (IDS) is the way to share stories over the world. There are many approaches used in IDS. They are classified into three basic groups: character-base, plot-based and hybrid approach, depending on the way that they follow to build the story. There are several approaches in terms of user interaction types and tools; where it is found that the most important are: low, medium, and high levels. Some of the approaches were implemented and tested, while others were not. The paper compares different approaches in terms of accuracy, speed, reuse, and user satisfaction.

As a conclusion, we can conclude that the real time approaches were the best for entertainment; because of the high interaction with it. Where the most appropriate approach for authoring and training are better to be implemented using agent technology. In terms of usability, the approaches with friendly user interface, had the better satisfaction.

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