

# SceneMaker: Multimodal Visualisation of Natural Language Film Scripts

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**Abstract.** Producing plays, films or animations is a complex and expensive process involving various professionals and media. Our proposed software system, *SceneMaker*, aims to facilitate this creative process by automatically interpreting natural language film scripts and generating multimodal, animated scenes from them. During the generation of the story content, SceneMaker gives particular attention to emotional aspects and their reflection in fluency and manner of actions, body posture, facial expressions, speech, scene composition, timing, lighting, music and camera work. Related literature and software on Natural Language Processing, in particular textual affect sensing, affective embodied agents, visualisation of 3D scenes and digital cinematography are reviewed. In relation to other work, SceneMaker follows a genre-specific text-to-animation methodology which combines all relevant expressive modalities and is made accessible via web-based and mobile platforms. In conclusion, SceneMaker will enhance the communication of creative ideas providing quick pre-visualisations of scenes.

**Key words:** Natural Language Processing, Text Layout Analysis, Intelligent Multimodal Interfaces, Affective Agents, Genre Specification, Automatic 3D Visualisation, Affective Cinematography, SceneMaker

## 1 Introduction

The production of movies is an expensive process involving planning, rehearsal time, actors and technical equipment for lighting, sound and special effects. It is also a creative act which requires experimentation, visualisation of ideas and

their communication between everyone involved, e.g., playwrights, directors, actors, cameramen, orchestra, managers and costume and set designers. We are developing a software system, *SceneMaker*, which will assist in this production process. SceneMaker will provide a facility to pre-visualise scenes before putting them into action. Users input a natural language (NL) text scene and automatically receive multimodal 3D visualisations. The objective is to give directors or animators a reasonable idea of what a scene will look like. The user can refine the automatically created output through a script and 3D editing interface, accessible over the internet and on mobile devices. Such technology could be applied in the training of those involved in scene production without having to utilise expensive actors and studios. Additionally, SceneMaker could be used for rapid visualisation of ideas and concepts in advertising agencies. SceneMaker will extend an existing software prototype, CONFUCIUS [1], which provides automated conversion of single natural language sentences to multimodal 3D animation of characters' actions and camera placement. SceneMaker will focus on the precise representation of emotional expression in all modalities available for scene production and genre-sensitive art direction. To achieve this, SceneMaker will include new tools for text layout analysis of screenplays, commonsense and affective knowledge bases for context understanding, affective reasoning and automatic genre specification. This research focuses on three research questions: How can emotional information be computationally recognised in screenplays and structured for visualisation? How can emotional states be synchronised in presenting all relevant modalities? Can compelling, life-like and believable animations be achieved?

Section 2 gives an overview of current research on computational, multimodal and affective scene production. In section 3, the design of SceneMaker is discussed. SceneMaker is compared to related multimodal work in section 4 and Section 5 gives the conclusion and future work.

## 2 Background

Automatic and intelligent production of film/theatre scenes with characters expressing emotional states involves four development stages:

1. Detecting personality traits and emotions in the film script
2. Modelling affective 3D characters, their expressions and actions
3. Visualisation of scene environments according to emotional findings
4. Development of a multi-modal user interface and mobile application.

This section reviews state-of-the-art advances in these areas.

### 2.1 Detecting Personality and Emotions in Film Scripts

All modalities of human interaction express personality and emotional states namely voice, word choice, gestures, body posture and facial expression. In order to recognise emotions in text and to create life-like characters, psychological theories for emotion, mood, personality and social status are translated

into computable methods, e.g., Ekman’s 6 basic emotions [2], the Pleasure-Dominance-Arousal model (PAD) [3] with intensity values or the OCC model (Ortony-Clore-Collins) [4] with cognitive grounding and appraisal rules. Word choice is a useful indicator for the personality of a story character, their social situation, emotional state and attitude. Different approaches to textual affect sensing are able to recognise explicit affect words such as keyword spotting and lexical affinity [5], machine learning methods [6], hand-crafted rules and fuzzy logic systems [7] and statistical models [6]. Commonsense knowledge-based approaches [8,9] and a cognitive inspired model [10] include emotional context evaluation of non-affective words and concepts. Strict formatting of screenplays eases machine parsing of scripts and facilitates detection of semantic context information for visualisation. Through text layout analysis of capitalisation, indentation and parentheses, elements such as dialog, location, time, present actors, actions and sound cues can be visually recognised and directly mapped into XML-presentations [11].

## 2.2 Modelling Affective Embodied Agents

Research aiming to automatically model and animate virtual humans with natural expressions faces challenges not only in automatic 3D character transformation, synchronisation of face expressions, e.g., lips and gestures with speech, path finding and collision detection, but furthermore in the refined sensitive execution of each action. The exact manner of an affective action depends on intensity, fluency, scale and timing and impacts on the viewer’s interpretation of the behaviour. Various scripting languages specifically cater for the modelling of the detected emotions and affective behaviour characteristics. Non-verbal behaviour of avatars is automatically modelled from conversational text with the Behaviour Expression Animation Toolkit (BEAT) [12]. Based on the analysis of linguistics and context of dialogue scripts appropriate Multimodal Presentation Mark-up Language (MPML) [13] annotations are automatically added to model speech synthesis, facial and body animations of 3D agents. SCREAM (Scripting Emotion-based Agent Minds) [14] is a web-based scripting tool for multiple characters which computes affective states based on the OCC-Model [4] of appraisal and intensity of emotions, as well as social context. ALMA (A Layered Model of Affect) [15] implements AffectML, an XML based modelling language which incorporates the concept of short-term emotions, medium-term moods and long-term personality profiles. In [7] the OCEAN (Openness, Conscientiousness, Extroversion, Agreeableness and Neuroticism) personality model [16], Ekman’s basic [2] emotions and a model of story character roles are combined through a fuzzy rule-based system to decode the meaning of scene descriptions and to control the affective state and body language of the characters. Su et al. [7] map personality and emotion output to graphics and animations. Postural values for four main body areas manipulate the shape, geometry and motion of the character model considering physical characteristics of space, timing, velocity, position, weight and portion of the body. Embodied Conversational Agents (ECA) are capable of real-time face-to-face conversations with human users or

other agents, generating and understanding NL and body movement. The virtual human, Max [17], engages museum visitors in small talk. Max listens while the users type their input, reasons about actions to take, has intention and goal plans, reacts emotionally and gives verbal and non-verbal feedback. Greta [18] is modelled as an expressive multimodal ECA. Affective Presentation Markup Language (APML) defines her facial expressions, hand and arm gestures for different communicational functions and with varying degrees of expressivity (manner). The behaviours are synchronised with the duration of phonemes in speech. Multimodal annotation coding of video or motion captured data specific to emotion collects data in publicly available facial expression or body gesture databases [19]. The captured animation data can be mapped to 3D models, which is useful for instructing characters precisely on how to perform desired actions.

### 2.3 Visualisation of 3D Scenes and Virtual Theatre

Visual and acoustic elements involved in composing a virtual story scene, the construction of the 3D environment or set, scene composition, automated cinematography and the effect of genre styles are addressed in complete text-to-visual systems and scene directing systems. Scene visualisation requires consideration of the positioning and interaction of actors and objects, the camera view, light sources and audio like background noises or music. SONAS [20] constructs a three-dimensional virtual town according to the verbal descriptions of a human user. WordsEye [21] depicts non-animated 3D scenes with characters, objects, actions and environments. A database of graphical objects holds 3D models, their attributes, poses, kinematics and spatial relations. In CONFUCIUS [1], multimodal 3D animations of single sentences are produced. 3D models perform actions, dialogues are synthesised and basic cinematic principles determine the camera placement. Another modality, cinematography, can assist in conveying themes and moods in animations. Film techniques are automatically applied to existing animations in [22]. Reasoning about plot, theme, character actions, motivations and emotions, cinematic rules are followed, which define appropriate placement and movement of camera, lighting, colour schemes and the pacing of shots. A high-level synchronised Expression Mark-up Language (EML) [23] integrates environmental expressions like cinematography, illumination and music as a new modality into the emotion synthesis of virtual humans. ScriptViz [24] renders 3D scenes from NL screenplays immediately during the writing process, extracting verbs and adverbs to interpret events and states in sentences.

The time and environment, the theme and the emotional tone of a film’s story classify different genres with distinguishable presentation styles. Commonly, genres are categorised into, e.g., action, comedy, drama, horror and romance. Genre is reflected in the detail of a production, exaggeration and fluency of movements, pace (shot length), lighting, colour and camerawork. These parameters are responsible for an appropriate affective viewer impression. Cinematic principles in different genres are investigated in [25]. Dramas and romantic movies are slower paced with longer dialogues, whereas action movies have rapidly changing, shorter shot length. Comedies tend to be presented in a large spectrum of bright

colours, whereas horror films adopt mostly darker hues. The automatic 3D animation production system, CAMEO [26], incorporates direction knowledge, like genre and cinematography, as computer algorithms and data to control camera, light, audio and character motions. A system which automatically recommends music based on emotion is proposed by [27]. Associations between emotions and music features in movies are discovered by extracting chords, rhythm and tempo of songs.

## 2.4 Multimodal Interfaces and Mobile Applications

Multimodal human-computer interaction exists on mobile devices, such as SmartKom Mobile [28]. Script writing tools assist the writing process of screenplays, like ScriptRight [29] for mobile devices. The Virtual Theatre Interface project [30] offers a web-based user interface to manipulate actors' positions on stage, lighting and audience view points. Editing and manipulating virtual characters on mobile devices is tested on the 'mobile animator' interface [31]. 3D objects and camera are directly controllable on the handheld display by selecting and dragging body parts using virtual manipulators with a stylus. To maintain the level of detail of the 3D characters for display on bigger screens, handheld users are provided with a simplified representation. Bounding boxes roughly section the 3D model. The user can zoom into the simplified sections to access the full set of joints.

This wide range of approaches to modelling emotions, moods and personality aspects in virtual humans and scene environments along with first attempts to bring multi-modal agents onto mobile devices provide a sound basis for SceneMaker.

## 3 Design of SceneMaker

Going beyond the animation of explicit events, SceneMaker will apply Natural Language Processing (NLP) methods to screenplays to automatically extract and visualise emotions, moods and film genre. SceneMaker will be tested by augmenting short 3D scenes with affective influences on the body language of actors and environmental expression, like illumination, timing, camera work, music and sound automatically directed according to the genre style.

### 3.1 SceneMaker Architecture

SceneMaker's architecture is shown in Fig. 1. The key component is the *scene production module* including modules for understanding, reasoning and multimodal visualisation situated on a server. The *understanding module* performs natural language processing and text layout analysis of the input text. The *reasoning module* interprets the context based on common, affective and cinematic knowledge bases, updates emotional states and creates plans for actions, their

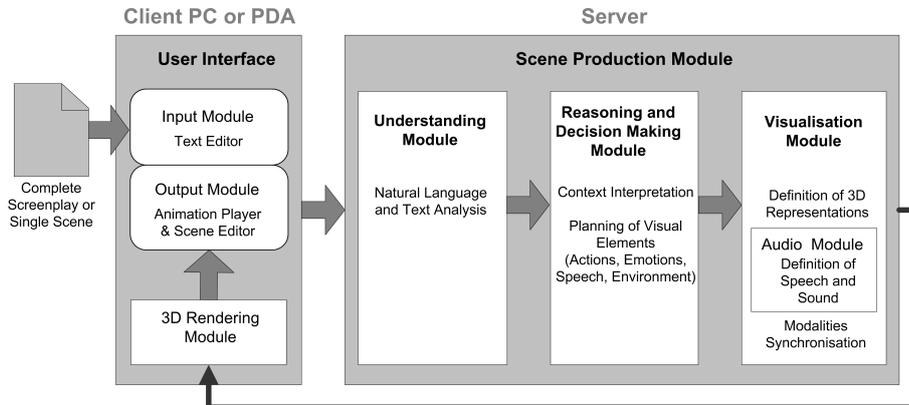


Fig. 1. SceneMaker architecture

manners and the representation of the set environment. The *visualisation module* maps these plans to 3D animation data, selects appropriate 3D models from the graphics database, defines their body motion transitions, instructs speech synthesis, selects sound and music files from the audio database and assigns values to camera and lighting parameters. The visualisation module synchronises all modalities into an animation script. The online user interface, available via computers and mobile devices, consists of two parts. The input module provides assistance for film script writing and editing and the output module renders the 3D scene according to the manuscript and allows manual scene editing to fine-tune the automatically created animations.

### 3.2 Implementation of SceneMaker

Multimodal systems automatically mapping text to visuals face challenges in interpreting human language which is variable, ambiguous, imprecise and relies on common knowledge between the communicators. Enabling a machine to understand a natural language text involves feeding the machine with grammatical structures, semantic relations and visual descriptions to be able to match suitable graphics. Existing software tools fulfilling sub-tasks will be modified, combined and extended for the implementation of SceneMaker. For the interpretation of the input scripts, SceneMaker will build upon the NLP module of CONFUCIUS [1], but a pre-processing tool will first decompose the layout structure of the input screenplay script. In the NLP module of CONFUCIUS the syntactic knowledge base parses the input text and identifies grammatical word types, e.g., noun, verb, adjective or other, with the Connexor Part of Speech Tagger [32] and determines their relation in a sentence, e.g., subject, verb and object with Functional Dependency Grammars [33]. The Semantic knowledge base (WordNet [34] and LCS database [35]) and temporal language relations will be extended by an emotional knowledge base, e.g., WordNet-Affect [36],

and context reasoning with ConceptNet [9] to enable an understanding of the deeper meaning of the context and emotions. In order to automatically recognise genre, SceneMaker will identify keyword co-occurrences and term frequencies and determine the length of dialogues, sentences and scenes/shots. Cinematic knowledge will then adjust the cinematic settings according to the determined genre. For instance, the light will be brighter in scenes of a comedy movie as compared to the scenes of a horror movie.

In SceneMaker, the visual knowledge of CONFUCIUS, such as object models and event models, will be related to emotional cues. CONFUCIUS' basic cinematic principles will be extended and classified into expressive and genre-specific categories. EML [23] appears to be a comprehensive XML-based scripting language to model expressive modalities including body language as well as cinematic annotations. Resources for 3D models are H-Anim models [37] which include geometric or physical, functional and spatial properties. As in the Mobile Animator [31], the animation editor will provide virtual manipulators to modify the automatically animated H-Anim models manually. The user will be able to choose characters, objects, light sources and camera for the manipulation of geometry and animation in a selected time frame. Further fine tuning can be achieved through re-editing the input script. For the speech generation from dialogue text, the speech synthesis module used in CONFUCIUS, FreeTTS [38], will be tested for its suitability in SceneMaker with regard to mobile applications and the effectiveness of emotional prosody. An automatic audio selection tool, as in [27], will be added for intelligent, affective selection of sound and music according to the theme and mood of a scene. Test scenarios will be developed based on screenplays of different genres and animation styles, e.g., drama films, which include precise descriptions of set layout and props versus comedy, which employs techniques of exaggeration for expression. The effectiveness and appeal of the scenes created in SceneMaker will be evaluated against hand-animated scenes and existing feature film scenes. The functionality and usability of SceneMaker's components and the GUI will be tested in cooperation with professional film directors, comparing the process of directing a scene traditionally with actors or with SceneMaker.

## 4 Relation to Other Work

Research implementing various aspects of modelling affective virtual actors, narrative systems and film-making applications relates to SceneMaker. CONFUCIUS [1] and ScriptViz [24] realise text-to-animation systems from natural language text input, but they do not enhance the visualisation through affective aspects, the agent's personality, emotional cognition or genre specific styling. Their animation is built from well-formed single sentences and does not consider the wider context. SceneMaker will facilitate animation modelling of sentences, scenes or whole scripts. Single sentences require more reasoning about default settings and more precision will be achieved from collecting context information from longer passages of text. SceneMaker will introduce text layout analysis

to derive semantic content from the particular format of screenplays scripts. Emotion cognition and display will be related to commonsense knowledge. No previous storytelling system controls agent behaviour through integrating all of personality, social status, narrative roles and emotions. Only EML [23] combines multimodal character animation with film making practices based on an emotional model, but it does not consider personality types or genre. CAMEO [26] is the only system relating specific cinematic direction, for character animation, lighting and camera work, to the genre of a given story, but genre types are explicitly selected by the user. SceneMaker will introduce a new approach to automatically recognise genre from script text with keyword co-occurrence, term frequency and calculation of dialogue and scene length. SceneMaker will bring all relevant techniques together to form a software system for believable affective computational animation production from NL scene scripts. SceneMaker will present a web/mobile based user interface for directors or animators to directly edit scenes.

## 5 Conclusion and Future Work

The software system, SceneMaker, which automatically visualises affective expressions of screenplays, aims to advance knowledge in the areas of affective computing, digital storytelling and expressive multimodal systems. SceneMaker, contributes to believability and artistic quality of automatically produced animated, multimedia scenes. Existing systems solve partial aspects of NLP, emotion modelling and multimodal storytelling. SceneMaker focuses on semantic interpretation of screenplays scripts, the computational processing of emotions, virtual agents with affective behaviour and expressive scene composition including emotion-based audio selection. In relation to other work, SceneMaker will incorporate an expressive model for multiple modalities, including prosody, body language, acoustics, illumination, staging and camera work. Emotions will be inferred from context. Genre types will be automatically derived from the scene scripts and influence the design style of the output animation. SceneMaker's 3D output will be available to users for edit. SceneMaker's mobile, web-based user interface will assist directors, drama students, writers and animators in the testing of their ideas. Accuracy of animation content, believability and effectiveness of expression and usability of the interface will be evaluated in empirical tests comparing manual animation, feature film scenes and real-life directing with SceneMaker. In conclusion, this research intends to automatically produce multimodal animations with heightened expressivity and visual quality from screenplay script input.

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