AUTONOMOUS ANIMATION IN EMBODIED AGENTS

TECHNICAL FIELD

[1] Embodiments of the invention relate to autonomous animation of Embodied Agents, such as virtual characters, digital entities, and/or robots. More particularly but not exclusively, embodiments of the invention relate to the automatic and real-time analysis of conversational content to dynamically animate Embodied Agents.

BACKGROUND ART

[2] Behaviour Mark-up Language, or BML, is an XML-based description language for controlling verbal and nonverbal behaviour for "Embodied Conversational Agents". Rule-based gesture generators, such as BEAT (SIGGRAPH '01) apply rules to generate gestures, paired with features of text, such as key words. This results in repetitive and robotic gesturing, which is difficult to customize on a granular level. Large databases of rules and gestures are required. Speech-driven gesture generators use neural networks to generate automatic movements from learnt gesture and speech combinations. However, these generators often work in a black-box manner, assume a general relationship between input speech and output motion, and have been of limited success.

[3] US9205557B2 discloses a method for generating contextual behaviours of a mobile robot. A module for automatically inserting command tags in front of key words is provided. US9721373B2 discloses programs for creating a set of behaviours for lip sync movements and nonverbal communication which may include analysing a character's speaking behaviour with acoustic, syntactic, semantic, pragmatic, and rhetorical analyses of the utterance.

[4] Efficient, automatic on-the-fly augmentation and/or modification of communicative utterances by embodied, autonomous agents remains an unsolved problem. Further, animating Embodied Agents in a manner that is realistic, non-repetitive and readily customizable remains an unsolved problem.

OBJECT OF INVENTION

[5] It is an object of the invention to improve autonomous animation in embodied agents, or to at least provide the public or industry with a useful choice.

SUMMARY

[5a] In a first aspect, the present disclosure provides method of animating a virtual character or digital entity, including the steps of: i. receiving Input Text specifying words to be spoken by the virtual character or digital entity; ii. for one or more body parts of the virtual character or digital entity, determining a Pose to be applied to Input Text; iii. determining an Action of the body parts to be applied to Input Text and iv. generating at least one motion of the virtual character or digital entity representing the Action being applied from the Pose.

[5b] In a second aspect, the present disclosure provides a system for animating a virtual character or digital entity, the system including: i. an input-module, the input module receiving input text; ii. a determination module, the determination module determining: i. a pose for one or more body parts of the virtual character or digital entity to be applied to Input Text; and ii. an Action of the body parts to be applied from the at least one Pose; and iii. an output module, the output module generating at least one motion of the virtual character or digital entity based on the Pose and the Action.

[5c] In a third aspect, the present disclosure provides a method of animating a virtual character or digital entity, including the steps of: i. determining an Input Pose of one or more body parts to be animated; ii. determining a Variation Pose of the one or more body parts, the Variation Pose configured to blend with the Input Pose; iii. determining a Blended Pose comprising a weighted interpolation between the Input Pose and the Variation Pose; and iv. animating the virtual character or digital entity using the Blended Pose.

[5d] In a fourth aspect, the present disclosure provides a system for animating a virtual character or digital entity, the system including i. a determination module, the determination module determining: i. an Input Pose to be animated; ii. a Variation Pose representative of a Gesture, the Variation Pose configured to blend with the Input Pose; iii. a Blended Pose comprising a weighted interpolation between the Input Pose and the Variation Pose; and ii. an animating module animating the virtual character or digital entity using the Blended Pose.

[5e] In a fifth aspect, the present disclosure provides a virtual character or digital entity, including the steps of: i. receiving Input Text specifying words to be spoken by the virtual character or digital

entity; ii. determining an emphasis score of each word in the Input Text; iii. determining a set of words with relatively higher emphasis score compared to the remaining words in the Input Text; and iv. animating a virtual character or digital entity to speak the Input Text and applying a gesture to each word from the set of words with relatively higher emphasis score.

[5f] In a sixth aspect, the present disclosure provides a system for animating a virtual character or digital entity, the system including: i. input-receiving means for receiving input text; ii. a plurality of gestures, wherein each gesture is associated with: i. an animation; ii. at least one configurable parameter for varying the animation; and iii. a configuration range of the configurable parameter; iii. an animation generator, wherein the animation generator is configured to: i. analyse input text to determine at least one gesture; ii. determine a configuration of the configurable parameter from the configuration range; and iii. animate the virtual character or digital entity with the animation as varied by the configurable parameter, wherein each gesture is associated with at least one modulatory variable for modulating the configuration range of the configuration parameter, and wherein the animation generator is configured to determine a configuration of the configurable parameter as modified by the modulatory variable.

[5g] In a seventh aspect, the present disclosure provides a method of animating a virtual character or digital entity including the steps of: configuring one or more parameters of a set of gestures, the parameters being configured such that the gestures reflect traits of the virtual character or digital entity; and animating the virtual character or digital entity with the gestures as configured by the one or more parameters.

CLAIMS

1. A method of animating a virtual character or digital entity, including the steps of:

    i. receiving Input Text specifying words to be spoken by the virtual character or digital entity;

    ii. for one or more body parts of the virtual character or digital entity, determining a Pose to be applied to Input Text;

    iii. determining an Action of the body parts to be applied to Input Text and

    iv. generating at least one motion of the virtual character or digital entity representing the Action being applied from the Pose.

2. The method of claim 1 wherein the pose is an arm pose and the method of determining a pose includes the step of determining a horizontal distance between arms.

3. The method of ~~claim 1 or~~ claim 2 wherein the pose is an arm pose and the method of determining a pose includes the step of determining a vertical height of one or more arms.

4. The method of ~~any one of~~ claim~~s 1 to~~ 3 wherein the at least one motion is a beat gesture.

5. A system for animating a virtual character or digital entity, the system including:

    i. an input-module, the input module receiving input text;

    ii. a determination module, the determination module determining:

        i. a pose for one or more body parts of the virtual character or digital entity to be applied to Input Text; and

        ii. an Action of the body parts to be applied from the at least one Pose; and

    iii. an output module, the output module generating at least one motion of the virtual character or digital entity based on the Pose and the Action.

6. A method of animating a virtual character or digital entity, including the steps of:

    i. determining an Input Pose of one or more body parts to be animated;

    ii. determining a Variation Pose of the one or more body parts, the Variation Pose configured to blend with the Input Pose;

    iii. determining a Blended Pose comprising a weighted interpolation between the Input Pose and the Variation Pose; and

    iv. animating the virtual character or digital entity using the Blended Pose.

7. The method of claim 1 wherein the step of determining a pose includes the steps of the method of claim 6.

8. A system for animating a virtual character or digital entity, the system including:

    i. a determination module, the determination module determining:

        i. an Input Pose to be animated;

        ii. a Variation Pose representative of a Gesture, the Variation Pose configured to blend with the Input Pose;

        iii. a Blended Pose comprising a weighted interpolation between the Input Pose and the Variation Pose; and

    ii. an animating module animating the virtual character or digital entity using the Blended Pose.

~~9. A method of animating a virtual character or digital entity, the virtual character of digital entity having at least one arm, wrist, and digit, the method including the steps of:~~

~~i. determining at least two of:~~

~~an arm pose selected from a range of arm poses;~~

~~a wrist pose selected from a range of wrist poses; and~~

~~a digit pose selected from a range of digit poses; and~~

~~ii. animating the virtual character or digital entity to display an overall pose including the arm pose, the wrist pose, and/or the digit pose.~~

~~10. The method of claim 9 wherein determining at least two of is determined randomly.~~

~~11. A method of animating a virtual character or digital entity, the virtual character of digital entity having at least one limb, the method including the steps of:~~

~~i. determining at least:~~

~~a limb pose selected from a range of limb poses; and~~

~~a pose of a sub part of the limb selected from a range of sub part poses; and~~

~~ii. animating the virtual character or digital entity to display an overall pose including the limb pose and the pose of a sub part of the limb.~~

~~12. The method of claim 11 wherein determining at least is determined randomly.~~

~~13.~~9. A method of animating a virtual character or digital entity, including the steps of:

i. receiving Input Text specifying words to be spoken by the virtual character or digital entity;

ii. determining an emphasis score of each word in the Input Text;

iii. determining a set of words with relatively higher emphasis score compared to the remaining words in the Input Text; and

iv. animating a virtual character or digital entity to speak the Input Text and applying a gesture to each word from the set of words with relatively higher emphasis score.

~~14.~~10. The method of claim ~~13~~ 9 wherein the gesture is applied to a stressed syllable of each word from the set of words with relatively higher emphasis score.

~~15.~~11. The method of claim ~~13~~ 9 ~~or claim 14~~ wherein the gesture is a beat gesture.

~~16.~~12. The method of ~~any one of~~ claim~~s~~ ~~13 to 15~~9 wherein the emphasis score is based on word rarity, wherein words with higher rarity have a higher emphasis score.

~~17.~~13. The method of ~~any one of~~ claim~~s~~ 9~~13 to 16~~ wherein the set of words with relatively higher emphasis score comprises words from the Input Text with an emphasis score within a predefined top percentile of all words in the Input Text.

~~18.~~14. The method of ~~any one of~~ claim~~s~~ 9~~13 to 16~~ wherein the gesture applied to each word from the set of words has a gesture amplitude proportional or substantially proportional to the emphasis score of the word.

~~19.~~15. The method of ~~any one of~~ claim~~s~~ 9~~13 to 16~~ wherein the emphasis score is calculated by applying a set of criteria to determine the emphasis score of each word, wherein the contribution of each criterion to the emphasis score is weighted using a weighting.

~~20.~~16. The method of claim ~~19~~15, wherein the set of criteria are selected from the group consisting of: word sentiment, part of speech, capitalization, negation and rarity.

~~21. The method of claim 20 wherein the weighting is optimized to emphasize words in the same manner as a human annotator.~~

~~22. The method of claim 21 wherein the weighting is optimised using machine learning.~~

~~23.~~17. A system for animating a virtual character or digital entity, the system including:

i. input-receiving means for receiving input text;

ii. a plurality of gestures, wherein each gesture is associated with:

i. an animation;

ii. at least one configurable parameter for varying the animation; and

iii. a configuration range of the configurable parameter;

iii. an animation generator, wherein the animation generator is configured to:

i. analyse input text to determine at least one gesture;

ii. determine a configuration of the configurable parameter from the

configuration range; and

iii. animate the virtual character or digital entity with the animation as varied by the configurable parameter,

wherein each gesture is associated with at least one modulatory variable for modulating the configuration range of the configuration parameter, and wherein the animation generator is configured to determine a configuration of the configurable parameter as modified by the modulatory variable.

~~24.~~18. The system of claim ~~23~~ 17 wherein determining a configuration of the configurable parameter from the configuration range is randomly determined.

~~25.~~19. The system of claim ~~24~~ 18 wherein configurable parameters are selected from the group consisting of: gesture speed, gesture amplitude and gesture pose.

~~26.~~20. A method of animating a virtual character or digital entity including the steps of:

i. ~~receiving Input Text specifying words to be spoken by the virtual character or digital entity~~configuring one or more parameters of a set of gestures, the parameters being configured such that the gestures reflect traits of the virtual character or digital entity; and

~~ii. analysing the Input Text to determine at least one gesture type, wherein each gesture type includes a plurality of gestures available for selection and an associated frequency value;~~

~~iii. selecting gestures to be applied to Input Text using gesture frequency values; and~~

~~iv.~~ii. animating the virtual character or digital entity with the gestures as configured by the one or more parameters~~using the selected gestures~~.