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# Extending video games by using machine learning

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ABSTRACT

Video game development requires significant design and coding effort to develop levels, characters, movements, animations, and other elements that are tied to the game engine. Once a game is completed and published, play by users is typically restricted to the actions and choices made possible by the developer of the video game, without customization or alteration. While user-developed modifications exist, developing such modifications requires significant effort. This disclosure describes the use of machine learning techniques to extend video games. A machine learning model is trained based on game play of a game and learns features of the game such as characters, levels, and experiences. The model can then be used to generate new game elements.

KEYWORDS

- video game
- game mods
- game customization
- machine learning
- transfer learning

## BACKGROUND

Video game development requires significant design and coding effort to develop levels, characters, movements, animations, and other elements that are tied to the game engine. Once a game is completed and published, play by users is typically restricted to the actions and choices made possible by the developer of the video game, without customization or alteration. While user-developed modifications exist, developing such modifications requires significant effort. Also, even with the ability to develop mods, users are still restricted by the game engine as to the level of customization that is possible.

DESCRIPTION

The techniques described herein enable game capabilities and designs to be extended without design or coding effort. The techniques enable non-technical users to generate new and customized game artifacts or personalized game content.

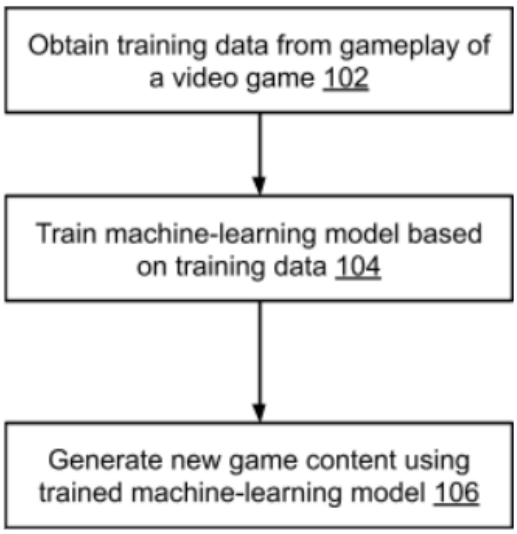


**Fig. 1: training and use of a machine learning model to generate game content**

Fig. 1 illustrates an example process to train and utilize a machine learning model to extend games. Training data from game play of a video game is obtained (102), e.g., by providing a video grab of the game or by playing the game. A machine-learning model is trained using the training data (104). During training, the model learns features of the game such as characters, levels, and experiences. The model can then be used to generate new game content (106). The model can generate content that can be utilized in the game directly or with minimal customization, thus allowing a game to be extended with new content without significant developer time.

During training, the machine learning model can capture not only the visual design of the game but also features such as voices and animations of a game character. The model can then generate other in-game characters and characters in other games. For example, dance moves of a character can be learned and transferred to another character. This enables the

generation of new experiences and game artifacts that can provide users with new types of personalized or customized content without the game developer having to explicitly design or write code. For example, a user can change the colors or clothes of characters in a game beyond what is supported by the game developer. New kinds of gaming mashups can be created by combining game scenes and characters from different games. The model can also be used to create new levels and characters that are styled on a particular game.

For example, a user can utilize the techniques to teach an in-game character some new moves or capabilities based on other favorite characters, even those in other games. In another example, the trained machine learning model can be used to create personalized video clips for each user, e.g., a game character that greets each user by name in a video clip that can be shared via social media.

Game developers can utilize the machine learning techniques described herein to create new characters or experiences. For example, the trained model can be used to generate new characters and scenes that the game developer didn't build. The model can be used across games and game objects without having to be customized for each game or scenario. Use of the techniques eliminates the need for game developers to create tools that support endless customizations. The machine learning model can be utilized to generate variations on the game without requiring the game developer to make any changes to the original game. For example, new levels and capabilities can be added to a game by the game rendering engine based purely based on the model.

Users can also customize their characters and the game scenes by applying the model to create their own custom versions of games. For example, the machine learning model can learn the behaviors and characteristics of 3D scenes and characters and generate new kinds of experiences in the 3D worlds that are used to generate video games. The model can also be added to game rendering engines to create games.

By having the machine learned model be responsible for the final rendered game, every aspect of the game can be customized by non-technical users. The machine learning techniques can be applied across different kinds of games and worlds without having to be coded for each game. The machine learning doesn't need to be embedded in the original game engine; however, game state and data can be used to augment the model. While the foregoing description refers to a single machine learning model, implementations can utilize multiple machine learning models, including models of different types, to enable game customizations. The machine learning model can be implemented on a user device or as part of a cloud-based gaming environment.

Training data used to train the model is obtained with user permission. Users are provided with options to control how their data, e.g., game play data, generated characters or other game elements, are utilized. Users and/or game developers are provided with options to control the elements of a game that can be utilized for training, and to restrict access to parts of a game. Personalized models, when utilized, are made available only to those users that provided game play data for model personalization. Custom game elements generated from such models are made available only to the specific user, and are shared with other users only upon permission from the user.

## CONCLUSION

This disclosure describes the use of machine learning techniques to extend video games. A machine learning model is trained based on game play of a game and learns features of the game such as characters, levels, and experiences. The model can then be used to generate new game elements.