



**Neuric Technologies, LLC**

**The Neuric<sup>®</sup> Brain in Animation**

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## The Neuric<sup>®</sup> Brain in Animation

This white paper discusses Neuric<sup>®</sup> Technologies' alternative to conventional artificial intelligence, its benefit to the movie animation industry and why it can be an inflection point for the industry.

In its essence, a brain is attached to each animation character. With human-like thinking, emotion and feelings, the now-sentient characters read, absorb and play out the script themselves. This is in contrast to the animators who read the script and key-frame the outcome. In summary, the following benefits are brought to animation companies using the Neuric Brain:

Streamline the animation process

Reduction of animation time and cost

Continuity of animation characters for future use

Automatic and autonomous display of emotion, both facially and in body language

### Description and Application to Animation

Neuric Technologies, LLC, is implementing a human-like brain with emotion, temperament and expression. The subject of many patent filings, the brain model has been developed quietly over a period of about 15 years, but with implementation undertaken as a commercial effort since Q2, 2006.

It is an enabling technology with wide applications in:

- Entertainment - Animation movies, and video games (a brain behind the characters)
- Medicine . Diagnosis, triage and prosthetics
- Robotics . Traditional and hazardous material handling
- Education . Live interaction with historical figures (Churchill, Lincoln) about their experience
- Information Fusion . Merge data from multiple sources
- Expert Systems . Acquire knowledge from retiring personnel
- Dolls . Living conversational playmates that know their friend

The Neuric Brain is empowering and brings benefits that cross wide segments of industry. It is not programmed, but trained in the same manner as a human being. A key difference between a human (or a human-like brain) and a computer is that a computer must be programmed to deal with any situation it can be expected to encounter. A human and the Neuric Brain is given general training and then figures out what to do in the situation. A computer program always operates the same way. By contrast, the brain chooses the best manner for the moment, without constraints of scenarios that some programmer could contemplate.

Like its human role model, Neuric Brain has personal expectations and *learns* from its experience, sometimes adjusting those expectations for next time. Where appropriate, it *adapts* to real life. Its temperament and personality profile is previously established, and it behaves, reasons and acts in a manner consistent with that profile.

One especially suitable application is film animation and video games, where present capabilities parallel the needs of the industry. The brain affects the cost of labor, realism, time-to-market and ease of content re-use. With similar impact that key-framing brought to the industry, the Neuric Brain automates some highly manual processes. It still leaves the animator to impose his creative expression of a character onto the screen, both in the characters and in scene background content.

This translates into either a reduction in animator workload or an increase in the number of films an animator can implement in a given time frame.

Some example benefits of the Neuric<sup>®</sup> Brain in animation include:

- Reduction of time to market, by 30%
- Reduction of *per film* cost, by 30-50%
- Greater output per animator, 150-200%
- Improvement of cross-film character continuity
- Authentic emotional expression at lower time-\$ cost
- Estimated savings of 50% of live-animator's time
- Transport of character . and personality - to video games and mobile media

Implemented in animation properly, key-framing for brain-based characters is entirely eliminated. The animation artist still designs the expression to be used when a given emotion is displayed (and with multiple variants), but the brain morphs that expression automatically (and to the degree that emotion is felt by the character at the moment, or as directed by the animator). Animators always before could hand-draw emotion on a figure manually, but they could not render *spontaneous* feeling.

The characters can be told by the script what to do ó as if they were fully human ó and they carry out the actions in manners appropriate to their character, body and physical attributes. Each character is configured for temperament, as well as the psychological -anchorsø and -back-storiesø that shape outlook and emotional conduct. Each is then trained (in college-level English) with knowledge and historical background.

This represents both a technology change and paradigm shift in animation. It is revolutionary step change rather than evolutionary. The traditional animators are still used, but the work of animating the characters is off-loaded to the human-like brain behind each character, considerably reducing the work-load.

### **An Inflection Point in the Animation Industry**

What can be brought to animation? It is a matter of tremendous skill, time, study and money that transforms the raw capability of current 3D tools and scene-building systems into a movie. Realism and time/\$ cost are traded off, ultimately determining whether the finished film is a cartoon or living story. Even where the intent is to create an entertainment cartoon, trade-offs of detail, emotional accuracy and cost to convey the story line are still drivers. It is about *results*; what results do you want and what are you willing to pay to get them, in each film?

Adaptors of the Neuric Brain in the animation field will see a positive change in *results* and a reduction in the costs to achieve them. It will ultimately involve a methodology change for Neuric-based films, yet an overall simplification. It will change how the story script converts to film and will include development of a methodology ó process flow - that works for the specific studio culture. To some degree, one can expect a positive change in studio culture, increased enthusiasm for the processes and tools by the design team.

Application of the Neuric Brain to the animation industry will simplify the work-flow of adaptors, keeping the story line alive and active over a shorter development cycle. It has the potential to save 30% to 50% of the cost of a film. It brings higher degrees of realism to animation and transforms the viewer's idea that the character is -just plastic.ø Because the development of the psychological makeup of the character is a non-recurring expense, it is available -for freeø in subsequent films.

Because the Neuric Brains can speak, the means of putting down the sound track can be simplified too. The voices can still be those of recognized talent, but recreated by the Brain behind the character. The talent's voice is digitized to extract speech characteristics ó a non-recurring expense. That voice can then be used in subsequent films (and video games) to sound precisely like the original actor or vocal talent.

Finally, subsequent post-release transfer of the brain to animation gaming companies is simplified because the brain is unlikely to do something in the games that was out of character in the movies (or can be trained not to do so!). This simplifies the monitoring of character continuity during transfer to video games.

## How the Neuric<sup>®</sup> Brain Works

The Neuric<sup>®</sup> Brain is an alternative to traditional Artificial Intelligence and is a general form of *sentient intelligence*. It is based on a form of neural network and is primarily based on *concepts* rather than words. It communicates in conversational English text, although it is presently being extended to fully inflected speech.

In use, a specific brain (≠agent∅) is configured for temperament that sets his/her predispositions. It is next trained using ≠back-stories∅ that shape its emotional makeup and the tendencies in how it interprets what it is told. The brain is then educated to the desired level, again using ordinary English text.

As an optional step, the agent can then be trained in methods of acting - including taking direction - much like a human actor is trained.

The brain is a ≠black box∅ but can be configured to interact with the outside world ∅ and animation engine systems ∅ in a manner appropriate to the industry partner. For example, internally we have a 3D modeling engine connected to the brain through a TCP/IP connection. Movement, emotional and environmental data flow bi-directionally between brain and the 3D modeling system. This includes time sync and other appropriate control records.

In an animation application, an industry partner and Neuric will determine out what the interface will look like and the preferred method(s) of interacting with (English) animation scripts. The partnership may also choose whether a particular project application is to be script-driven or experience-driven. (For example, in a gaming environment, the brain must interact with the world around it, and in an unscripted manner. It responds to events that occur within its environment and then drives the connected 3D modeling system appropriately.)

There are many alternative ways to apply the brain, either as a ≠generic∅ actor or as the final character itself. The training and approaches are quite dependent upon partner choices of how the brain is applied.

## IP History

The original provisional patents on the Neuric Brain model were filed in 2004, and the first of these has already issued as patent No. 7,089,218 last year. About 10 provisional patents have been filed to date, as well as additional full patents, and usage patents with coverage in many industries.

## Development Status<sup>1</sup>

Implementation of the Neuric Brain model has been rather like early child development, with increasing capability as time passes. Most early work focused on the parsing and ≠conceptualization∅ of English text, permitting the brain to capture the intent and information of sentences. With this came the ability to read and understand basic grammar, and then being asked about its content to demonstrate learning. Some minimal emotional connections and capability were incorporated by the time of the first demo release on 9-15-06.

The next effort was directed towards the capture and anticipation of *experiences*, with their attendant feelings and emotion. The facility to emotionally interact with the outside world was created, along with means to remember past feelings and set emotional expectations for the future. A 3D model of a human face and head was created for the purpose of displaying feelings, demonstrating them graphically. These capabilities were incorporated into a demo released December, 2006. A stream-of-consciousness back panel illustrates the fluidity of emotions with time.

Past achievements include:

- Parsing and ≠conceptualizing∅ of basic English and the ability to learn from it
- Demo of English-based learning (a geography lesson) released 9-15-2006.
- Capture of the emotional interaction in *experiences* and setting of future expectations.
- Demo of animated emotional interaction with the environment released 12-15-2006.

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<sup>1</sup> This paper was published in 2007.

- Current core-development activity includes:
- Enhancement of memory of experience and information
- Provision for self-generated *how-to* processes for repeated tasks such as mathematics and some forms of motor control (e.g., walking), habitual but alterable tasks done without conscious thought
- Simplification of English parsing and broadening handling of English style
- Addition of analytical skills and conjecture
- Interactive dialog, both with humans and other Neuric Brains.
- The addition of spoken speech output
- The recognition and interpretation of speech input, in the context of current conversation

Significant here was the extension of the brain core to strengthen the interpretation of English for a wider variety of writing styles. It augments the brain with capabilities to handle *processes*, such as the learning of a recipe, formula or the methods to do things.

**Speech** – Speech output uses a commercially digitized voice with real-time inflection added, both male and female. Speech input is an area of currently focused development.

Commercial speech recognition systems are presently far from perfect, and we do not for now intend to develop a better system internally. An existing speech recognition system supplied by Microsoft (in Windows XP and later) is currently used, augmented it with the Neuric Brain's interpretive capabilities. These are facilities of the brain for corrective *sense-making* to compensate for any mistakes.

That is, Neuric is working towards speech recognition based on untrained commercial technology, but whose mistakes are processed and corrected for intent almost instantaneously, through the brain's knowledge of conversational flow content.

**Summary** - The Neuric Brain model is predicated on *concepts* rather than on words and grammar alone. This permits learning based upon past experience. The emotionally capable brain can be configured for temperament, and given background training to shape its personality and then be applied in myriad fields, one of which is movie animation. In the latter, it brings human-like realism and emotion to the screen at low developmental cost.