# The Origin of Artificial Species: Creating Artificial Personalities

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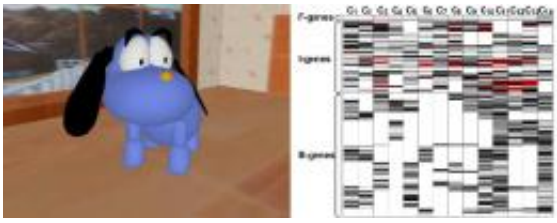

(Left) Rity was developed to test the world's first robot "chromosomes," which allow it to have an artificial genome-based personality. (Right) A representation of Rity's artificial genome. Darker shades represent higher gene values, and red represents negative values. Image credit: Jong-Hwan Kim, et al. ©2009 IEEE.

(PhysOrg.com) -- Does your robot seem to be acting a bit neurotic? Maybe it's just their personality. Recently, a team of researchers has designed computer-coded genomes for artificial creatures in which a specific personality is encoded. The ability to give artificial life forms their own individual personalities could not only improve the natural interactions between humans and artificial creatures, but also initiate the study of "The Origin of Artificial Species," the researchers suggest.

The first artificial creature to receive the genomic personality is Rity, a dog-like software character that lives in a virtual 3D world in a PC. Rity's genome is composed of 14 chromosomes, which together are composed of a total of 1,764 genes, each with its own value. Rather than manually assign the gene values, which would be difficult and time-

consuming, the researchers proposed an evolutionary process that generates a genome with a specific personality desired by a user. The process is described in a recent study by authors Jong-Hwan Kim of KAIST in Daejeon, Korea; Chi-Ho Lee of the Samsung Economic Research Institute in Seoul, Korea; and Kang-Hee Lee of Samsung Electronics Company, Ltd., in Suwon-si, Korea.

"This is the first time that an artificial creature like a robot or software agent has been given a genome with a personality," Kim told *PhysOrg.com*. "I proposed a new concept of an artificial chromosome as the essence to define the personality of an artificial creature and to pass on its traits to the next generation, like a genetic inheritance. It is critical to provide an impression that the robot is a living creature. With this respect, having emotions enhances natural human-robot interaction for human-robot symbiosis in the coming years."

As the researchers explain, an autonomous artificial creature - whether a physical robot or software agent - can behave, interact, and react to environmental stimuli. Rity, for example, can interact with humans in the physical world using information through a mouse, a camera, or a microphone, with 47 perceptions. For instance, a single click and double click on Rity are perceived as "patted" and "hit," respectively. Dragging Rity slowly and softly is perceived as "soothed," and dragging it quickly and wildly as "shocked."

To react to these stimuli in real time, Rity relies on its internal states which are composed of three units - motivation, homeostasis, and emotion - and controlled by its internal control architecture. The three units have a total of 14 states, which are the basis of the 14 chromosomes: the motivation unit includes six states (curiosity, intimacy, monotony, avoidance, greed, and the desire to control); the homeostasis unit includes three states (fatigue, hunger, and drowsiness); and the emotion unit has five states (happiness, sadness, anger, fear, and

neutral).

“In Rity, internal states such as motivation, homeostasis and emotion change according to the incoming perception,” Kim said. “If Rity sees its master, its emotion becomes happy and its motivation may be ‘greeting and approaching’ him or her. It means the change of internal states and the activated behavior accordingly is internal and external responses to the incoming stimulus.”

The internal control architecture processes incoming sensor information, calculates each value of internal states as its response, and sends the calculated values to the behavior selection module to generate a proper behavior. Finally, the behavior selection module probabilistically selects a behavior through a voting mechanism, where each reasonable behavior has its own voting value. Unreasonable behaviors are prevented with matrix masks, while a reflexive behavior module, which imitates an animal’s instinct, deals with urgent situations such as running into a wall and enables a more immediate response.

“Rity was developed to test the world's first robotic ‘chromosomes,’ which are a set of computerized DNA (Deoxyribonucleic acid) code for creating robots that can think, feel, reason, express desire or intention, and could ultimately reproduce their kind, and evolve as a distinct species in a virtual world,” Kim said. “Rity can express its feeling through facial expression and behavior just like a living creature.”

As the researchers explain, each of the 14 chromosomes in Rity’s genome is composed of three gene vectors: the fundamental gene vector, the internal-state-related gene vector, and the behavior-related gene vector. As each chromosome is represented by 2 F-genes, 47 I-genes, and 77 B-genes, Rity has 1,764 genes in total. Each gene can have a range of values represented by real numbers. While genes are inherited, mutations may also occur. The nature of the genetic coding is such that a

single gene can influence multiple behaviors, and also a single behavior can be influenced by multiple genes.

Depending on the values of the genes, the researchers specified five personalities ("the Big Five personality dimensions") and their opposites to classify an artificial creature's personality traits: extroverted/introverted, agreeable/antagonistic, conscientious/negligent, openness/closeness, and neurotic/emotionally stable.

To demonstrate an artificial genome, the researchers used their evolutionary algorithm to generate two contrasting personalities for Rity - agreeable and antagonistic - and compare Rity's behavior in the different cases. Running the algorithm through 3,000 generations took about 12 hours to generate a genome encoding a desired personality by a Pentium 4, 2 GHz processor. For comparison, the researchers also used manual and random processes to generate genomes with agreeable and antagonistic personalities, though neither outperformed the evolutionary algorithm in terms of personality consistency and similarity to desired personality. Finally, the researchers also verified the accuracy of the evolutionary genome encoding by observing how the artificial creature reacted to a series of stimuli.

"The genome is an essential one encoding a mechanism for growth, reproduction and evolution, which necessarily defines 'The Origin of Artificial Species,'" Kim said. "It means the origin stems from a computerized genetic code, which defines the mechanism for growing, multiplying and evolving along with its propensity to 'feel' happy, sad, angry, sleepy, hungry, afraid, etc."

As the researchers showed, a 2D representation of the genome can enable users to view the chromosomes of the three gene types and easily insert or delete certain chromosomes or genes related to an artificial creature's personality.

In the future, the researchers plan to combine the genome-based personality with the artificial creature's own experiences in order to influence the creature's behavioral responses. They also plan to classify and standardize the different behaviors in order to generalize the artificial genome structure.

More information:

Robot Intelligence Technology Lab:
rit.kaist.ac.kr/home/ArtificialCreatures

Jong-Hwan Kim, Chi-Ho Lee, and Kang-Hee Lee. "Evolutionary Generative Process for an Artificial Creature's Personality." *IEEE Transactions on Systems, Man, and Cybernetics - Part C: Applications and Reviews*, Vol. 39, No. 3, May 2009.