FUTURISTIC DEVELOPMENTS IN THE NANOWORLD:

QUANTUM COMPUTERS AND CLAYTRONICS

Part Two: Claytronics

This is truly a bold and amazing technology initiative conceived by Seth Copen Goldstein of Carnegie Mellon University and Todd Mowry of Intel Research Pittsburgh which brings one into the world of programmable matter, a world of dynamic physical rendering aptly termed 'synthetic reality'.

What is programmable matter? This is material that can be manipulated electronically in three dimensions and is composed of nano-robots, called claytronic atoms or "catoms". By analogy with actual atoms, catoms represent the smallest indivisible units of programmable matter. Each catom is a self-contained structure that has a receiver or antenna, a central processing unit (CPU), a power supply, one or more sensors, a video display, a means of locomotion, and a mechanism for adhering to other catoms. The idea is not to recreate an object's chemical composition, but rather to create a physical artefact that will mimic the shape, movement, visual appearance, sound, and tactile qualities of the original object. One needs simply to work with the model without going anywhere near a computer. As one manipulates the model, it would be modified at every other location where the same model is being handled by multi-users. The objects created from programmable matter will be scalable to life size or larger or even reducible in scale. Such objects will be capable of continuous, 3-D motion.

A highly readable account of the subject is given by Rajat Sharma [*Ref: claytronicatom. blog spot. com/2011/10/claytronics-ppt.html*] in his blog where he discusses some exciting potential applications. Quoted below are some examples that he has given:

- Human replicas could serve as stand-ins for medical personnel, firefighters, or disaster relief workers. Objects made of programmable matter could be used to perform hazardous work and could morph into different shapes to serve multiple purposes. A fire hose could become a shovel, a ladder could be transformed into a stretcher.
- A football game or other sporting event could be replicated in miniature on your coffee table. A movie could be recreated in your living room, and you could insert yourself into the role of one of the actors.
- Physical models to replace 3D computer models, which can only be viewed in two dimensions and must be accessed through a keyboard and mouse. Thus, using claytronics, you could reshape or resize a model car or home with your hands, as if you were working with modelling clay.

Dick Pelletier [*Ref: http://ieet.org/index.php/IEET/more/pelletier20120714*] gives even more exotic futuristic applications:

- programmable clothing which if you are at risk would become stronger than steel, while still maintaining its light weight, being impermeable to bullets and knives, and affording cushion-like protective cover in the event of auto accidents.
- walls in our homes that light up with a radiant glow upon command, and likewise doors and windows being commanded to shift to different walls.
- copying people on both ends of a phone call – mimicking the exact looks and movements of the person being replicated. At each end of the line, a real person is interacting with a replica. A step beyond *Skype*- instead of merely viewing each other on a screen, you can touch, kiss, or hug, as if you are physically together. This realistic sense to communication (aural, visual and physical) over long distance is called pario.

As can be appreciated, the creation of such technology that will represent information in dynamic, life-like 3-D forms is extremely challenging and complex. The Carnegie Mellon Intel Claytronics Research Project has set its sights on two principal pathways to advance this technology, namely:

- Engineering design and testing of modular robotic catom prototypes that will be suitable for manufacturing in mass quantities
- Creation of programming languages and software algorithms to control ensembles of millions of catoms

As of 2006 researchers have already created a prototype catom that is 44 mm in diameter. The goal is to eventually produce catoms that are one or two mm in diameter-small enough to produce convincing replicas.

For further information on the subject, the reader is referred to the article by Goldstein and Mowry entitled "*Claytronics: An Instance of Programmable Matter*" [*Ref: http://www.cs.utexas.edu/~skeckler/wild04/Paper12.pdf*] and to videos on Claytronics produced by Carnegie Melon University [*Ref: www.cs.cmu.edu/~claytronics/ movies/index.html*].

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