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# Future Electronic Devices with Nano-Technological Advancement

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*Abstract-Electronics is the field that has affected the life of common man to a great deal. With the technological development, the size of electronic components is decreasing and has reached the size range of few micros to nanometers. These nanometer electronic devices have shown multiple functionalities like programmable matter, which has used c-atoms. This technology can design and manufacture anything in a matter of seconds. Apart from these applications, these devices are supported on the medical basis too. The nanometer based catheter can be implanted near heart to improve cardiac ablation simpler.*

**Index Terms:** Stretchable capacitor, Claytronics, 3D Fax Machine, NEMS.

## I. INTRODUCTION

In this paper we are going to concentrate on some of the revolutionary devices or we can say that those concepts that can change the life of man on earth. With the emerging advancements in science, day by day man has not been untouched from its effects. Considering the positive side of advancement, in this paper we are going to discuss the devices such as, 3D Fax Machine, stretchable supercapacitor, NEMS Non-volatile memory, etc. Everything being discussed here is a major leap in its classical version in each and every aspect. A 3D Fax machine is a machine which comprises of a myriad of tiny modules capable of inter-module communication and computation. These modules can measure the shape of an object by its reflection and generate its digital representation which can be further stored, manipulated, annotated and transmitted. Programmable matter can be defined as a technology that will allow one to control and manipulate three-dimensional physical artifacts (similar to how we already control and manipulate two-dimensional images with computer graphics). Programmable matter will take us beyond virtual reality, to synthetic reality, an environment in which all the objects in a user's environment (including the ones inserted by the computer) will be physically realized [1].

## II. 3D FAX MACHINE

A fax machine, as we all are aware of being a machine that is used to send the image and get it imprinted at the desired address. The address of the machine is obtained using telephone lines which are connected both to sending as well as receiving ends. A fax machine is used where urgency is the main issue i.e. it is required that document should reach within a specified interval of time. On the other hand, 3D fax machine, as the name suggests is a machine consisting of tiny modules which are capable of doing the same job as that of a simple fax machine but here the objects are different. The objects associated with this machine are three-dimensional in nature but the operations that can be performed on them are same as that of a simple fax machine as shown in Figure 1, the 3-D model of dinosaur made by zipping of polygon meshes. This is possible only because of the tiny modules which form clay like material capable of inter-module communication and computation [2]. Any 3D object will be stored in the material by its reflection and then its image can be texted, shared or manipulated. The creation of this clay like material or what we call it as programmable matter is the major concern of the day as it is the basic step for various other areas such as Pario [3] and Modular robotic system [4]. Larger quantity of data range measured either in the number of scans or number of range points was assembled to form a model of a dinosaur [5].

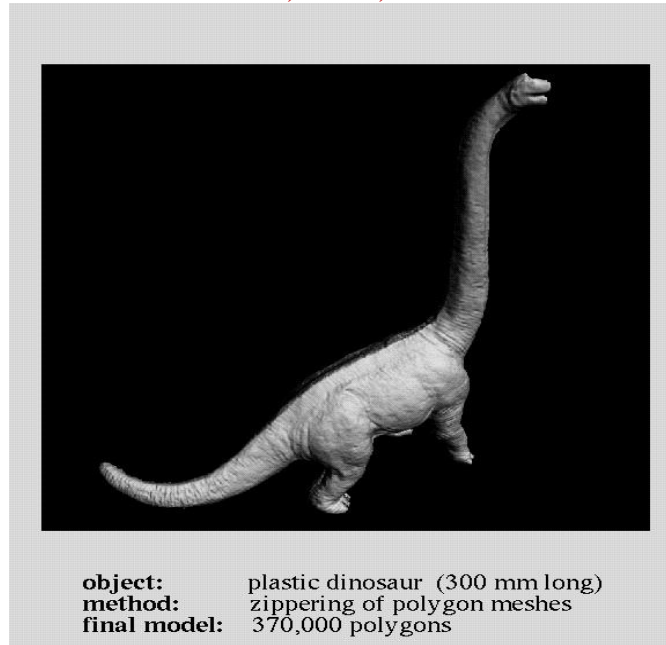


Fig1. 3-D Model of a Dinosaur developed using 3D Fax machine [5]

### III. NEMS NONVOLATILE MEMORY

Non Volatile memory devices are designed on the basis of storage layers, p-n junctions and transistors. These memory devices consist of loose and movable parts for performance enhancement. The loose part or shuttle is a tiny metal disk which is about 300 nm thick and 2 micrometers long residing inside a cylindrical metal cage. The position of metal cage is determined by the force of adhesion between metal and shuttle. Current flows between two electrodes when the shuttle gets to the top of the cage and the shuttle completes an electric circuit. At the bottom of the cage, the circuit is broken and no current flows. The shuttle is moved from top to bottom by applying a voltage to a third electrode which is known as gate [6]. Below is the Figure 2 showing an example of NEMS Technology, silicon on insulator (SOI) substrate which can be used to fabricate CMOS-NEMS that possesses highly-tunable nonlinear frequency response characteristics and also ease congestion over the airwaves to improve the performance of cell phones and other portable devices [7].

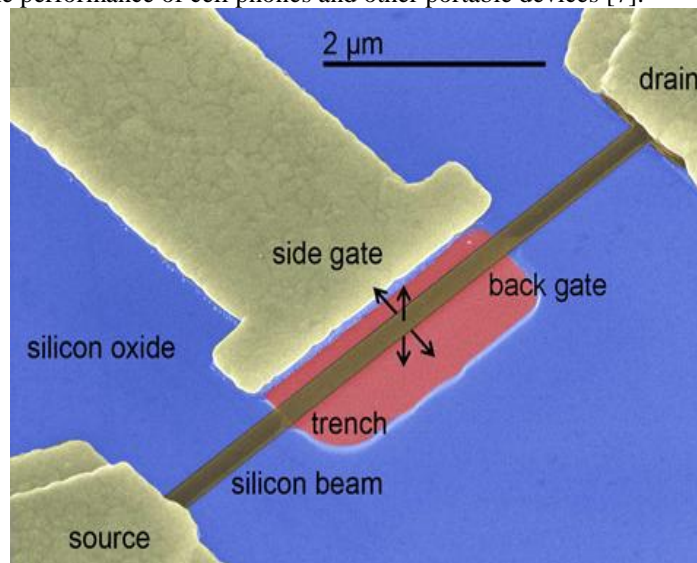


Fig2. A scanning electron microscope is showing a tiny mechanical device, which is an electrostatically actuated nanoresonator, that might ease congestion over the airwaves to improve the performance of cell phones and other portable devices.(Purdue University image) [7]



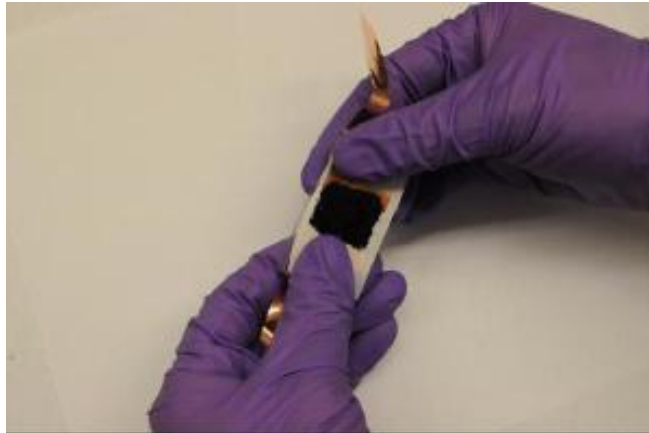
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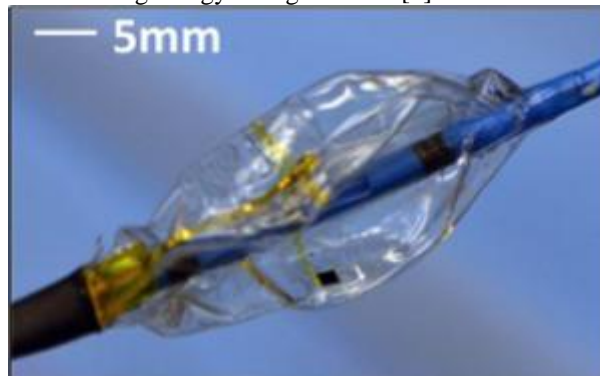
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#### IV. STRETCHABLE ELECTRONICS



**Fig3. Fully stretchable supercapacitor composed of carbon nanotube macrofilms, a polyurethane membrane separator and organic electrolytes. (Credit: Image courtesy of University of Delaware)[8].**

Flexible electronics, in which advancement has been done in recent past, rechargeable and stretchable energy storage devices which are also known as supercapacitors as shown in figure 3. Significant progress is being made in developing scalable, stretchable power sources for this type of application using carbon nanotube macrofilms, polyurethane membranes and organic electrolytes. Stretchable supercapacitor's performance is revealed by examining the system's electrochemical behavior using buckled single wall nano-tube (SWNT) electrode and an elastomeric separator. The supercapacitor developed has excellent stability and is very important for future design of the leading energy storage device. [8]



**Fig4. Researchers utilized stretchable electronics to create a catheter to make cardiac ablation simpler. (Credit: Image courtesy of Northwestern University)[8].**

Researchers at university of Mc Cormack designed a multipurpose medical catheter that monitors heart functions and make corrections on heart tissue during surgery as shown figure 4. The catheter is printed with a thin layer of stretchable electronics. The exterior of the catheter is protected by the electronics during its presence in the bloodstream; once inside the heart, the catheter is inflated like a balloon, exposing the electronics to a larger surface area in the heart. Catheter when in its specific position allows the individual devices to perform their particular tasks. Pressure on the heart is determined by an EKG sensor, and a temperature sensor controls the temperature so as not to damage surrounding tissue. High quality information can be retrieved from these devices -- such as temperature, mechanical force, and blood flow -- to the surgeon in real time, and the system is designed to operate reliably without any changes in properties as the balloon inflates and deflates [8].

#### V. CONCLUSION

Claytronics, 3-D Fax machine, Stretchable electronics, Non-volatile NEMS Memory is few upcoming breakthrough electronic devices with an innovation. This review paper focuses on Nanoelectronics devices that are demonstrated by researchers successfully and has shown results. These devices will prove helpful to mankind and change the whole scenario of life.



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