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BIOMIMICS

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Abstract-Evolution has resolved many of nature's challenges leading to lasting solutions. Nature has always inspired human achievements and has led to effective materials, structures, tools ,mechanisms, methods, systems, and many other benefits. This field ,represents the studies and imitation of nature's methods is known as biomimetics, also offers enormous potential for inspiring new capabilities for exciting future technologies. Billions of years of evolution have produced extremely efficient natural materials, which are increasingly becoming a source of inspiration for engineers. Biomimetics is the science of imitating nature is now a growing multidisciplinary field. Substantial benefits of biomimetics include the development of prosthetics that closely mimic real limbs and sensory-enhancing microchips that are interfaced with the brain to assist in hearing, seeing and controlling instruments. A review is given of selected areas that were inspired by nature, and an outlook for potential development in biomimetics is presented.

I. INTRODUCTION

The term biomimetics, which was coined by Otto H.Schmitt in1969,represents the studies and imitation of nature'smethods. Biologically inspired design or adaptation orderivation from nature is referred to as 'biomimetics'[1]. It means mimickingbiology or nature. Biomimetics is derived from the Greek word biomimesis[2].Otto Schmitt, who did his doctoralresearch, developed a physical device that mimicked the electrical action of anerve. Other words used include bionics (coined in 1960 by Jack Steele of Wright-Patterson Air Force Base in Dayton, OH), biomimicry and biognosis.The field of biomimetics is highly interdisciplinary[3]. It involves the understandingof biological functions, structures and principles of various objectsfound in nature by biologists, physicists, chemists and material scientists, andthe design and fabrication of various materials and devices of commercialinterest by engineers, material scientists, chemists and others.

The cell-based structure,which makes up the majority of biological creatures, offersthe ability to grow with fault-tolerance and self-repair, whiledoing all of the things that are characteristic of biologicalsystems. If we are successful in making biomimetic structures that consist of multiple cells, we may be able to design devicesand mechanisms that are currently considered science fiction.Emerging nanotechnologies increasingly enhance the potentialof such capabilities. Humans have learned much from natureand the results have helped surviving generations and continueto secure a sustainable future. The process hasalso involved scaling from nano and micro to macro andmega.Biological materials have capabilitiesthat surpass those of man-made ones and these includesilk, leather and wool that are widely used to makeclothing.

Figure 1: First aircraft by Wright brothers was inspired by the fight of pigeon.

II. BIOMIMICRY: THE BRIDGEBETWEEN THE ECONOMY AND THE ENVIRONMENT

Biomimicry provides the means to achieve both environmental and economic goals. As policy leaders throughout the world begin to focus more on "sustainable growth", the clash between environmental and economic interests could potentially be greater than ever. As job growth following the "great recession" continues to be subpar, finding the proper balance between preservation of our natural resources and increasing employment poses great challenges.Biomimicry could provide a critical bridge between business and the environment.

Biomimicry is a rapidly growing field where solutions found in the natural world are applied to human problems. Man has taken inspiration from nature for centuries to find answers. For example, Leonardo da Vinci (1452-1519) attempted to design a flying machine based on a study of the anatomy and flight of birds. In the long-term, policymakers, business, and the public will only embrace efforts to protect the environment and safeguard our natural resources if it makes economic sense. Biomimicry provides that critical bridge. By increasing efficiency and reducing costs, solutions inspired by nature can allow us to both raise standards of living.

III. BIOINSPIRED STRUCTUREAND TOOLS

Biological creatures can build amazing shapes and structures using materials in theirsurroundings or materials that they produce. The produced structures are quite robustand support the required function over the duration the function is needed[6]. Plants offer engineering inspiration, where mimicking the concept of seeds that adhere to an animal's fur Velcro was invented and it has led to an enormous impactin many fields, including clothing and electric-wires strapping. Devices and instruments that are designed using biologically inspired rules are intuitive to operate by humans, which makes them user friendly and means they require minimal operation instructions.

These examples illustrate the diverse and incredible number of possibilities that have already been mimicked:

LOTUS EFFECT

Figure 2: The hydrophobic effect of water on lotus leaves which collects dust.

Lotus is one of two species of aquatic plant in the family Nelumbonaceae. This plant is an aquatic perennial. Under favorable circumstances its seeds may remain viable for many years. What is so special about this flower is,that it showssuper-hydrophobic power of self cleaning.

Although they live above muddy water and cannot actively groom themselves, lotus leaves remain pristine and dirt free. The self-cleaning ability of lotus leaves results from the tiny, wax-coated protuberances on their surface.[4] When water falls on a leaf, it does not spread out and wet the surface, as it would on the smooth leaves of most plants, but rather forms tiny beads atop and collects dust.

Hence this application of lotus is now used in many ways. A brand of paints is now available to clean your house whenever it rains.This concept is used in water proofing phones, protecting fabrics etc.

IV. TERMITE MOULDS

A small, pale soft-bodied insect(termites) that lives in large colonies with several different castes, typically within a mound of cemented earth.[5] Many kinds feed on wood and can be highly destructive to trees and timber.

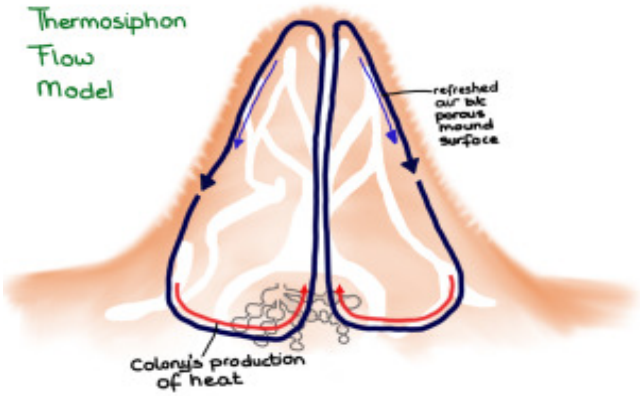

Figure 3: The principle of flow of heat in termite moulds(Thermosiphon Effect)

Few years ago, scientists observed that big termite mounds in Africa stay remarkably cool inside, even in blistering heat. The insects accomplish this with a clever system of air pockets, which drive natural ventilation through convection.

Architect Mick Pearce and engineering firm Arup borrowed that idea to build East gate Centre, a large office and shopping center in Zimbabwe that is cooled with the outside air. The system uses only 10 percent as much energy as conventional air-conditioning to drive fans that keep the air circulating.The building has an extensive tube system within the walls and floors that move air trough the building. Heat generated within the building, along with stored heat within the structure, creates a thermosiphon-effect that draws air up and down through the rooftops wherelarge chimney stacks is located. These tall stacks are essential for creating an induced flow.

V. BIONIC CAR INSPIRED BY BOX FISH

Ostracioncubicus is a species of boxfish.It can be found in reefs throughout the Pacific and Indian Ocean as well as the south eastern Atlantic Ocean. It reaches a maximum length of 45 centimetersequal to 18 inches.

The Mercedes-Benz Bionic was a concept car created by Daimler Chrysler AG under the Mercedes Group. It was first introduced in 2005. The exterior design was modeled after the yellow boxfish. Mercedes-Benz decided to model the Bionic after this fish due to the supposed low coefficient of drag of its body shape and the rigidity of its exoskeleton.

The boxfish conserves its strength by moving while consuming the least possible amount of energy. The Boxfish car includes many traits of the boxfish including;

1.The overall appearance
2. The rigid yet light material of car frame.
3.A complex engine and overall design that allows it to be extremely fuel efficient.20 percent lower fuel consumption and up to 80 percent lower nitrogen oxide emissions.

Its skin consists of numerous hexagonal, bony plates which provide maximum strength with minimal weight and effectively protect the animal from injury in exhaust emissions

Figure 4: Appearance of Bionic car inspired by boxfish

VI. SWIM SUIT INSPIRED BYSHARK SKIN

When seen under an electron microscope, sharkskin is made up of countless overlapping scales called dermal denticles. The denticles have grooves running down their length in alignment with water flow. These grooves disrupt the formation of eddies, or turbulent swirls of slower water, making the water pass by faster. The rough shape also discourages parasitic growth such as algae and barnacles.

Scientists have been able to replicate dermal denticles in swimsuits. Which are now banned in major competition but still used in the bottom of boats. When cargo ships can squeeze out even a single percent in efficiency, they burn less bunker oil and don't require cleaning chemicals for their hulls. Scientists are applying the technique to create surfaces in hospitals that resist bacteria growth the bacteria can't catch hold on the rough surface.

Figure 5: Swim suit made from imitation of shark skin .

VII. FUTURE OF BIOMIMICS

As we have seen nature and technology both are inter-related and nature has enabled us to think in a different way. There are many more applications than the few discussed above.

The Era of biomimics will not end right here, but follow a path which never ends.The next decade should be exciting for the field of *Bionics.* Justas biologists are discovering the structural and physiological mechanisms that underlie the functional properties of plants and animals, engineers are beginning to develop a fabrication tool kit that is sophisticated enough to capture their salient features. As the performance gap between biological structures and our mechanical analogs shortens, engineers may feel increasingly encouraged to seek and adopt design concepts from Nature.

Although the devices they construct may at first appear alien, their origins in the organic world may endow them with an odd familiarity. Also Artificial skin, heart, liver have also been biomimicked to solve human healthcare problems.Hence we as individuals should conserve nature and let it grow rather than destroying it for our own benefits.

VIII. CONCLUSION

From the discussion on the above study, it can be concluded that, the nature also can give an impact to the world. From the nature to the world of biomimics, in this article we discussed more on the application ofbiomimicry in the entire phenomenon and nature in this world. Furthermore, the ability of the nature to adapting the environment itself is enough for the human to take some knowledge of it. Sustainable thinking to find solutions using the nature can be harmonized through biomimics. As the result, designers, biologists, artist started to use nature. Each step taken will help the man kind to save the Earth from time to time. The important thing is to get people ready with the ideology of biomimicry. Using nature as model, mentor and measure the concept of inspired by nature can be seen right now. The inspiration from nature is expected to continue leading to technology improvements and the impact is expected to be felt in every aspect of our lives. Some of the solutions may be considered science fiction in today'scapability, but as we improve our understanding of nature and develop better capabilities this may become a reality that is closer than we think. Hence, let's make this world a better place to live in and let's imbibe knowledge from nature and convert this to technology.

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