Currently there is extensive research on packing drugs in nano particles. While there has been some progress, delivery still remains a major challenge. In the case of the swimmer, the cells and the structures together evolve into a functional machine that has the capability to deliver drugs to a specific disease area– cancer tumor, for example. "If intelligent biobots can do that autonomously, then we can imagine use of medicine with minimal side effects, since the drugs will be applied where it is needed and not spread all over the body. Since the swimmers have the muscle actuators, they might be able to perform microscopic surgeries as well."

They may also be employed in non-medical sectors like environmental cleaning and detoxification. Just like bacteria, biobots have the abilities to consume materials from their environment and chemically break them. "One of the applications of the biobots can be such degradation of unwanted materials in our environment, particularly in water."

He is envisioning a time, possibly just a couple of decades from now, when technology will effortlessly and elegantly meet the exquisite power of life.

It took more than three years for Dr Saif and his team–two PhD students– Brian Williams, Sandeep Anand and a post doctoral associate–Jagannathan Rajagopalan to achieve the desired results. Professor Saif's role was to envision the project, derive the necessary equations to predict what to expect from the biobot, and guide the students. And the graduate students played critical roles by implementing the ideas, solving the necessary equations, and carrying out the experiments to turn the concept of the swimmer into reality.

It wasn't, however, smooth sailing all along. "The main challenge was to find a way to make the living cells stick to the swimmer filament, as we were implanting heart cells from a live rat to a totally different environment. Once we found the right biochemistry, which took us the most time in the project, the rest fell into place."

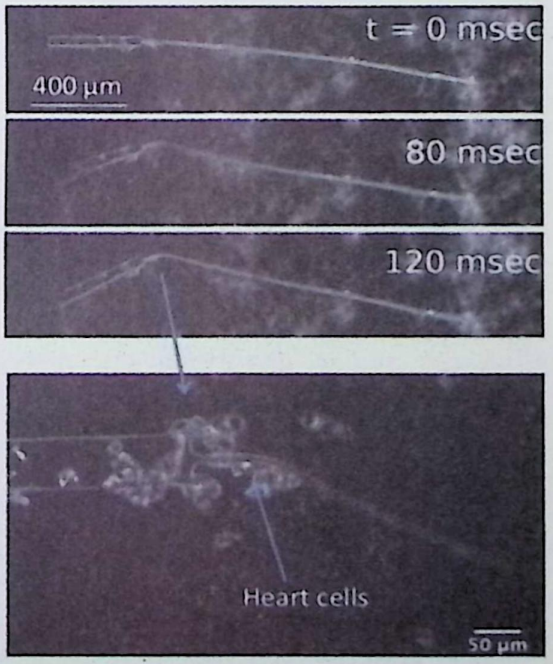
The swimmer is not yet ready for practical use. It may take 5-10 years to implement some of the initial biological machines with intelligence. "We are at the very early stages of this field. It took decades to implement commercial airlines from the early invention of Wright brothers."

A graduate in civil engineering from BUET, Bangladesh, Professor Taher went to the US in 1986 to pursue MS in Washington State University. In 1993, he completed his PhD in Theoretical and Applied Mechanics from Cornell University.

During a long distinguished academic career, he has taught and worked at top universities among them Cornell University and Max Planck Institute, Stuttgart, Germany. He was a Fellow of the American Society of Mechanical Engineers in 2011 and a Member of the Scientific Advisory Board, Singapore-MIT Alliance for Research and Technology, 2010-12.

An ace student since childhood, Dr Saif was inspired to nurture a scientific worldview by his parents and uncles who bought him a lot books. He grew up close to the villages–in smaller towns, which helped him develop a deep connection with his country.

Biobot swimmer in a petri dish powered by cardiac cells



Williams et al., *Nature Communications*, Jan 17, 2014.

Dr Saif believes that biological machines will impact societies all around the world, including that of Bangladesh. "This new technology is not expensive. In fact, the research on the biobot swimmer can be carried out in Bangladesh now. It needs very little advanced instruments."

The visionary professor isn't just talking with techno-utopian bravado–he is envisioning a time, possibly just a couple of decades from now, when technology will effortlessly and elegantly meet the exquisite power of life, and life will take on an altered form which we can't predict or comprehend in our current, limited state. "The research is fundamental in nature at this stage. When developed, the drug industries may use these bio hybrid swimmers to treat cancer patients all over the world."