

Technical Article Release

Will the Future Of Robotics Merge to Singularity?

A Futurist's Optimistic View on our Future Electronic Companions

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Humans have been using tools for a very long time; some estimates go back as far as 3.4 million years ago. Our tools have become more complex, but our reasons to invent tools remains consistent -- the desire to be more efficient, reduce risk to health and safety, and cut down on the drudgery of daily life. Enter now advanced robotics, a new category of tools that will change everything.

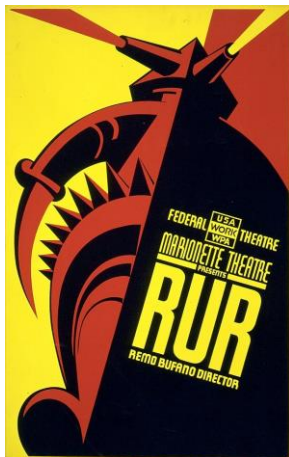


Image 1: The term 'robot' was first used in the 1920 play 'R.U.R.'

[Robots](#) are not new, yet their abilities and breadth of application will grow exponentially in the years ahead. Decades of academic and industrial research combined with increasingly cheaper components and facile manufacturing techniques are ushering in a robotic revolution. Leading Artificial Intelligence (AI) researcher Ray Kurzweil calls out robotics as one of the research areas that will lead to the “singularity,” a concept that argues the union of technology with human biology, and an era in which “our intelligence will become increasingly non-biological.” According to Kurzweil, the “singularity” will result from the next phase of human evolution that will emerge after the convergence of robotics with computers, genetics, nanotechnology, and artificial intelligence. As robots become more human-like both in appearance and cognitive ability, our fascination with them will undoubtedly grow. But will our acceptance and dependence on robots also grow?

There are three fields where advanced robotics is yielding promising results. While most of us are familiar with robots far removed from our daily lives, such as those that assemble goods in factories or scour distant planets, next generation robots are going to be more personal and autonomous -- think less “Mars Rover” and more “Star Wars droids.” It is worth noting that many consider the rise of robots that have equal, if not greater, computational power than the human brain to be a terrifying prospect. Technology giants Bill Gates and Elon Musk have spoken publicly about their concerns of robots and AI leading to potential apocalyptic scenarios. Mr. Musk has even gone so far as to donate \$10-million to ensure we build

safeguards into AI projects. While there is no doubt that certain risks will come to pass, such as robots replacing humans in certain jobs, we will come into a more optimistic future with our electronic counterparts.

Paging Dr. Robot to the Operating Room: Robots in Healthcare

There is a decent chance that some of us have already experienced robotic assisted surgery. In 2000 the U.S. Food and Drug Administration (FDA) approved the da Vinci Surgery System, the first robotic laparoscopic surgical tool. Robots, coupled with telepresence technology allow a surgeon to be in one location and the patient, along with the surgical robot in another. Advances in robotic technology will eventually remove the surgeon altogether, thus reducing risk of error and eliminating the spread of infection from surgeon to patient. Already there is work being done to completely automate tissue suturing and the application of anesthetics. Pharmacists may find assistance or replacement by robots. The UCSF Medical Center has a robotics-controlled pharmacy at two locations that pick, package, and dispense individual doses of pills.

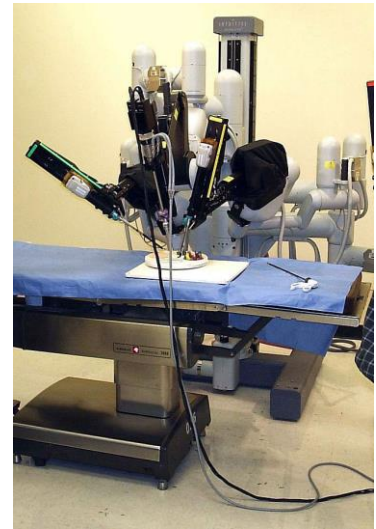


Image 2: Da Vinci Surgical Robot

Outside of the hospital, an aging population is presenting another issue for healthcare due to that fact that the number of healthcare professionals is not keeping pace with the number of people in need of care.

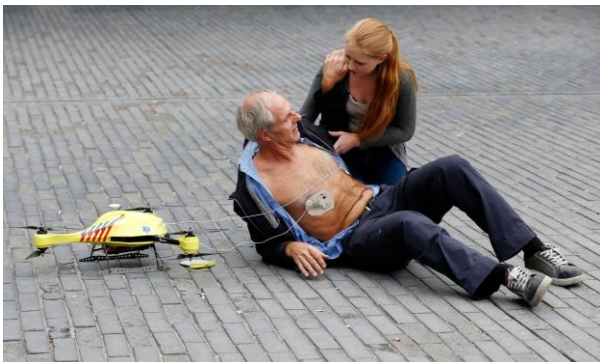


Image 3: Drone-based Defibrillator Delivery

In [medicine](#) there is a “golden hour” which refers to the one hour immediately following a traumatic injury that if medical care is received, chances of death are reduced dramatically. A heart attack is one such emergency that can be dealt with quickly using an [Automated External Defibrillator \(AED\)](#) to restart the heart. Unfortunately, an AED is not always readily available. What if an AED, and

potentially other lifesaving equipment, could come to you? A graduate student at Delft University of

Technology has invented an ambulance drone that can do precisely that. Being an aircraft it has the added benefit of being able to reach places a ground vehicle can't, such as the top of a mountain. It can help sustain life until emergency teams arrive.

There are many enabling technologies that are enabling the increased use of robotics in healthcare, not the least of which is IBM's Watson knowledge-mining technology. In fact Watson is already in use querying large sums of medical knowledge to give doctors the most current information on diagnosing and treating oncology diseases at Memorial Sloan Kettering.

For now this ability, still locked away in high-end servers, let's your doctor focus more on patient care and less time having to do doing research. But when this extraordinary computing capability is fused with the mechanical finesse of robotic technology, then it is not inconceivable that one day your doctor, surgeon, or paramedic will be a robot in a humanoid form factor. In fact, you may very well depend upon the precision with which micro-stitches or cuts are made in your limbs, organs, brain or eyes that are already mapped out with an MRI and carried out by a robot.

Old MacRobot had a Farm: Robots in Agriculture and the Environment

Human population continues to grow and is expected to reach 9 billion people by 2040. Agriculture and environmental concerns will become increasingly important in a world facing significant climate concerns with many more mouths to feed. According to the IEEE Robotics and Automation Society this means a 25% increase in agricultural efficiency. Farmers, environmentalists and governments are increasingly turning to robots to help monitor environmental factors such as soil quality, water availability, and temperature amongst many others. But robots will be doing much more than just monitoring the environment in the future.

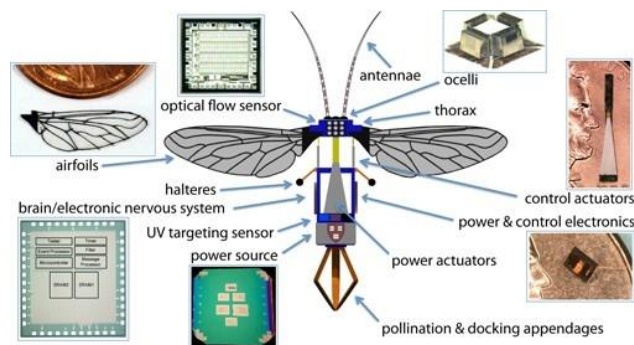


Image 4: BeeBot Concept

Harvard engineers are working on Bee Bots that will help mitigate the potential food chain disaster that could arise from the global declining bee population. Bee Bots will assist in the pollination of crops that we previously relied solely on biological bees to perform.

The romantic image of the lone cowboy herding his cattle could soon be replaced by robots roaming the range. Australian researchers are working on a robotic rover to assist in the herding duties thus allowing ranchers to focus on running other aspects of their operations. Out at sea, robots are increasingly being used to track algae blooms that threaten aquatic life, the spread of pollution in our oceans, and to monitor the impact that global warming is having on the shorelines of cities around the world. Robots will also be pivotal in environmental restoration after disasters such as cleaning up after oil spills.

Robots will no doubt play a much larger role in monitoring and caring for our planet. Robots can be produced in greater quantities and be deployed to more locations than we could ever hope to reach using humans alone. Advances in mesh networking, advanced sensor technologies and AI will allow robots to work smarter and make their own decisions on how to accomplish tasks. The knowledge gained by their work will allow us to make informed environmental policy and economic decisions to support our ever-burgeoning population.

Danger, Will Robinson, Danger! Robots in Emergency Response

An individual's life is not replaceable. Fortunately, robots are. The military applications of unmanned systems are widely discussed, but there are other dangerous situations such as fires, nuclear disasters, and earthquakes where sending in a robot will become the preferred alternative.

Robin Murphy, director of the Center for Robot-Assisted Search and Rescue at Texas A&M, was recently quoted regarding her excitement for the future of robots in disaster recovery. Specifically she highlighted research into burrowing robots as a major point of interest. Mimicking behaviors of certain burrowing animals allows these robots to reach people trapped in the voids of a collapsed building much more quickly than we can do today.

For those lost in the wilderness, rescue will come a lot sooner since robots are able to operate for longer periods of time and under more difficult environmental and terrain conditions than their human counterparts. Robots can also "see" better using special optics, such as infrared cameras, which will give them an advantage in finding people in remote locations even in poor weather conditions. Moving forward, as data fusion technologies mature and improved algorithms are developed, groups of search robots will be able to adapt search tracks on their own, resulting in a greater likelihood of success and in less time.

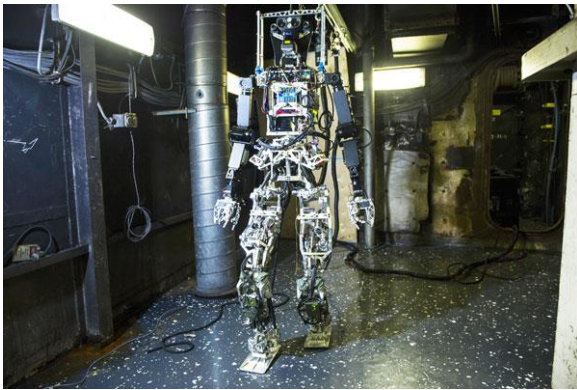


Image 5: SAFFiR Firefighting Robot

As robotic rescue technology becomes more affordable, local fire and rescue departments will augment their rescue equipment with robots. Instead of a human firefighter entering a burning building to rescue those trapped inside, it will be a robot that braves the flames. The U.S. Navy is already working on such a robot and recently unveiled their Shipboard Autonomous Firefighting Robot (SAFFiR), which will help to combat fires aboard ships. AI and advanced sensors will allow robots to become more than just our forward-

deployed eyes and ears, they will be given autonomy to make decisions. In certain crisis those few seconds gained by granting decision-making ability to a robot could mean the difference between life and death.

The Future of the Biological and Electronic Partnership

Robert Oppenheimer, after witnessing the first detonation of the atomic bomb remarked to himself "Now I am become Death, destroyer of worlds." Fears of a robotic apocalypse such as those raised by Elon Musk and Bill Gates are valid, but should be taken in context. It is no doubt that robots will replace people in certain jobs. However, this is a risk posed by all new technologies. As for the concern of AI giving rise to sentient beings that have the intelligence,

but not the ethics of humans, the risk comes down to engineering ethics. We as society and a profession need to hold creators of such machines accountable to build in the necessary safeguards to prevent such a scenario. As for achieving singularity with technology, robots are one manifestation that represents a large step that some might find scary. We've walked this line with nuclear technology, so it is not unreasonable to assume that we can learn from the past to expect the unexpected and will be able to integrate electronic companions into our lives without ushering in an apocalypse. But just in case we aren't successful, be ready to welcome our new robotic overlords."