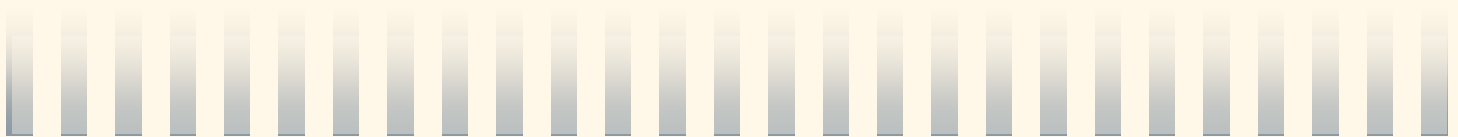




# Real World Robots



Nick Gigliotti & Tucker Martin





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# International Space Station

Traveling 230 miles above your head right now at an astonishing 70,000 mph is the International Space Station. Along with the crew of astronauts, the station also has a few robots on board. Long robotic arms are used to help the astronauts get around on the outside of the station. Whether it's to make repairs or to just get a good view, the astronauts tie their feet to the end of the arm and are



move themselves all the way around the station. In addition to carrying astronauts, the robot also holds tools and equipment needed for certain operations. The robotic arm manipulates new attachments into place while the crew members fasten them down. Even astronauts need a robotic helping hand.



# Mars Curiosity Rover

The Mars Curiosity Rover is one of the robots that NASA has sent to Mars to investigate the planet. On average, Mars is 140 million miles away from earth, so the journey for the Curiosity Rover to get from Earth to Mars took almost a year to complete. The goals of this rover are to collect data on the **habitability** and climate of mars, as well as essential data to determine if a manned aircraft could be sent to Mars. The most difficult part of



the mission was getting the rover to the “red planet” (Mars). The journey required a spacecraft that housed the rover during the flight which dropped of once it got close to Mars, where a decent rover slowly brought Curiosity to the surface of Mars like as pictured on the left. The successful landing of the rover required all of the parts used to transport the robot to stay in sync.

# Car Manufacturing Robots

One place people don't necessarily expect to find robots is in car manufacturing. If you, or one of your parents, drives a common car brand, then your car was most likely made by robots. They do the jobs of welding car chassis, holding parts in place for welding, painting, and much more. The precision

of robots along with the fact that they don't need to eat or sleep makes them great tools for car makers. They reduce the price of cars, increase consistency and reliability, and are also pretty awesome.



## Did You Know?

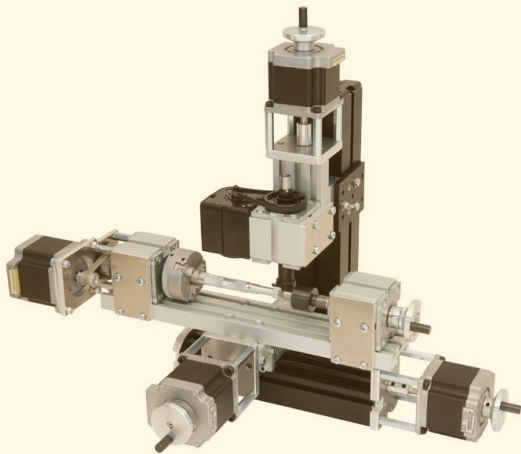
50% of robots in the world are used on assembly lines for automotive vehicles. Therefore car manufacturing robots are the most abundant form of robots in the world.

# CNC Machining Robots

Have you ever looked at a metal part on a car or computer and wondered how it was made? The answer is a CNC machine. **Computer Numerically Controlled Machines** are big robotic machines that have cutters and drills to make any and every kind of part imaginable. Before they were around, **Machinists** were needed to make specific parts for cars or industrial machines. However, now parts are designed on comput

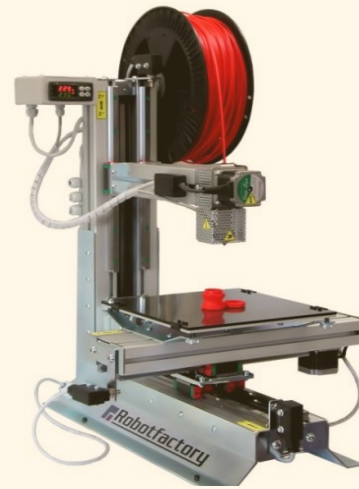
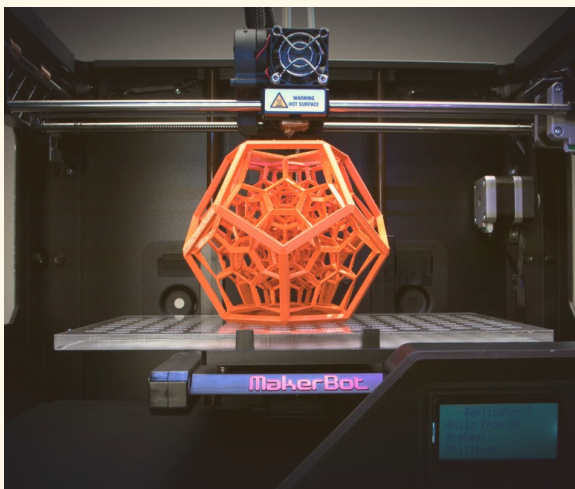


puters using **CAD** (computer aided design) **software**. Funky curves and intricate designs never before possible can now be made with ease. In addition to the versatility of CNC machines, another great thing is their accuracy. They can make a part almost identically over and over again. It may be possible to make replacement parts for the machine itself, making it self repairing.



# 3D Printing Robots

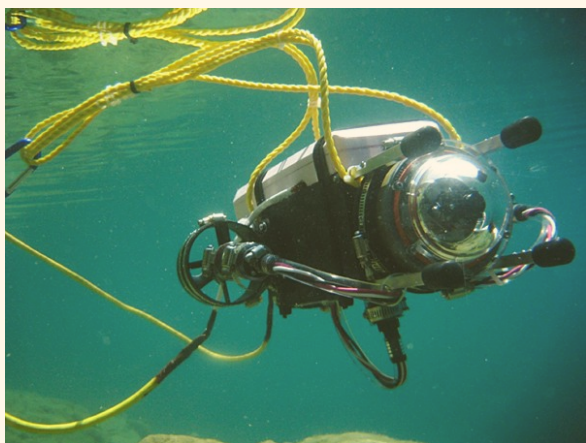
Three-dimensional printing has been around for decades, but now it is cheap enough for the average person to buy or build their own. A 3D printer is exactly what it sounds like, a printer that adds a third dimension: depth. The cheapest 3D printers use hot, molten plastic as the material. An extruder, which can move in all directions squirts out the plastic at a controlled rate as it moves around above a small table. To begin,



you make your model or creation on a computer using CAD (computer aided design) software. Then, connect your 3D printer and hit “print”. The plastic extruder moves around, laying out the first layer first and the moving up in layer sequentially. This process continues until the 3D model is completely finished. Now its possible for anyone to make whatever they want cheaply and quickly

# Deep Under Sea Robots

A new life-form is found lurking deep under the ocean's surface. Its discovery is only possible with the help of a robotic diver. Robots deep under the sea are being used every day to explore shipwrecks, find new life and search for geologic formations. These small, box-like machines are controlled by humans in ships on the surface.

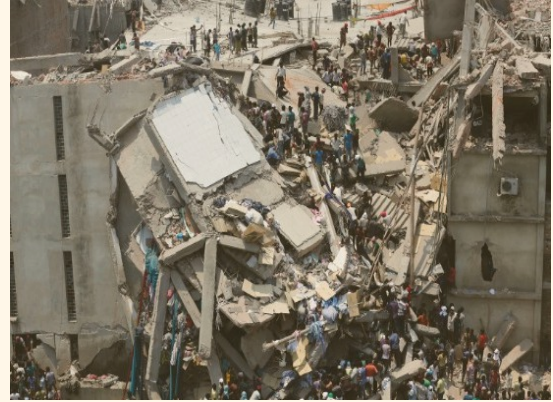


The researchers tell the robot where to go, and the robot uses propellers and jets of water to move around. If something interesting float past, the robot has containers and suction tubes to collect it. With their small design and long battery life, the robots allow scientists to explore shipwrecks and sea vents for hours.

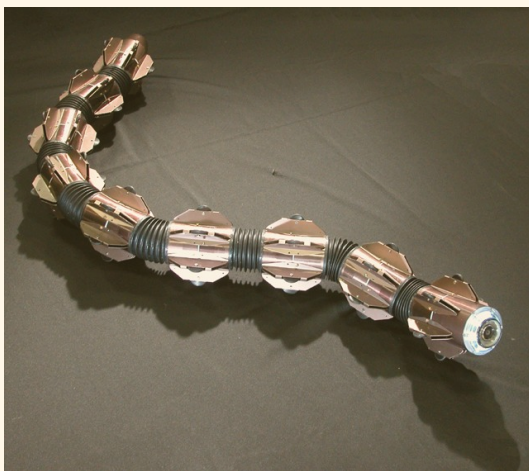


# Rescuing Robots

An accidental spark ignites a fuel tanker outside of tall office building. It collapses, trapping many citizens under piles of rubble. Firefighters work for hours trying to sift through all the debris, but they take too much time. There is another way, robots are being developed to help find people in a situation like this.

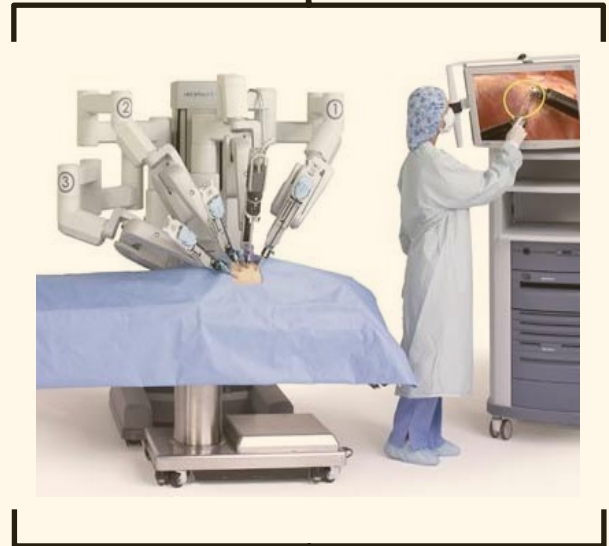


Long snake-like robots are being built to search through the rubble to help firefighters more quickly identify the best areas to clear out. The robots weave in and around slabs or concrete and support beams with ease, reducing search times. The slim design allows them to fit where no human can. Perhaps in the future, these robots will be able to save countless lives.

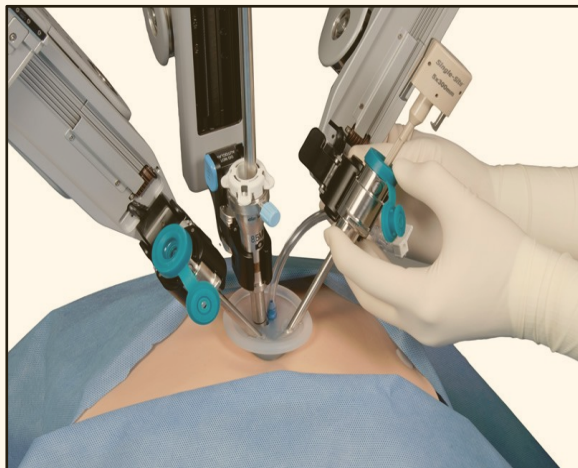


# Surgical Robots

A patient lies silently on an operating table, awaiting an operation. The surgeon, instead of pick up a scalpel, grabs a control stick and guides a robotic arm to make the first incision. This is the truth for hundreds of operations around the world. With just two or three small holes, the robot can often time perform the same operation while avoiding a large cut. Scaring is reduced, and because of the accurate control, patients feel less



pain and spend half the time in the hospital. These robots also have another distinct advantage. Because the robot is controlled but a surgeon through a computer, the surgeon can be anywhere in the world. This allows anyone around the world to receive the best care possible as they have a robot on hand. Robots allow people to recover quicker, and feel less pain with a higher level of care.



# Window Cleaning Robots

The job of window cleaning on a sky scrapper can seem intimidating and scary. Instead of suspending staging down from the roof and risking lives, we could use robots. Similar to the vacuuming robot, the window washing robots move around along the sides of the building all on their own. Using suction to keep from falling,

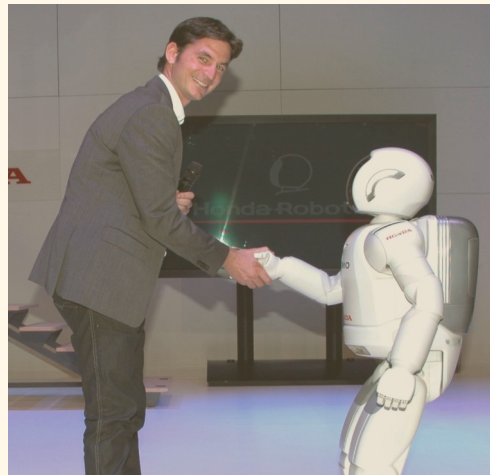


the robots drag cleaning fluid and wipers along the surface in regular patterns. They work their way up and down cleaning the whole windows at a time. This method is not only safer but also more efficient because the robots don't need to stop for lunch or to adjust the height of staging.



# Humanoids

With new robotic technologies arising daily, it has become practical to engineer robots that function very similar to a human, known as **humanoids**. A humanoid not only requires replicating one body part like an arm, but the whole body and making sure all of the components work together well. One of these humanoids is Asimo, (pictured at right) designed by the car manufacturing company, Honda.



This humanoid can accomplish many human tasks such as walking, running, recognizing other humans, understanding voice commands, stepping up stairs, and many more cool functions. The development of this humanoid began in 1980 and improvements are still being made today.



# Humanoids

Another well known humanoid is Topoi, which is a Ping-Pong playing humanoid designed by Tosy. This humanoid has strictly been designed to play Ping-Pong and therefore cannot perform the wide variety of human-like tasks that Asimo is able to demonstrate. This humanoid features a couple high-speed cameras which detect that Ping-Pong ball's movement



and then with its “brain” or **processor** it can analyze the best return based on the current path of the ball. This robot has been initially designed to play Ping-Pong to demonstrate its capabilities, but the goal of Topio is to become a household assistive robot for use in all houses around the world.



# V GO Assistive Robot

Many illnesses and disabilities can keep intelligent students out of school for long periods of time. However, recently a robot known as the V Go (pictured at left), designed by the well-known cell phone company Verizon, has allowed many of these students to participate in school from a household setting. The V Go has a webcam and screen built in which allows the



student to see the class from home as well as the class see him at school. One specific boy, Lyndon Baty, a high school student in Texas who has a physical disability prohibiting him from the high school environment uses the V Go robot to participate in his high school classes.



# Big Dog Military Robot

It is apparent that robots have uses everywhere including the military where robotics is used to ease the work of soldiers. One of these robots is Big Dog (pictured at right) designed by Boston Dynamics which is a rough-terrain walking robot that can carry very large loads. This robot can climb steep inclines, walk through snow, walk on slippery ice, trudge through mud, and even walk through piles of trash without falling over.



Big Dog uses a **gyroscope** as well as a group load sensor and shock-absorbing legs to keep balance. In addition, this military grade robot has an arm which can manipulate very large loads which has the intended use to transport wounded soldiers during battle. The strength of this appendage has been tested by throwing cinder blocks many yards.

# Drone Military Robots

Another military use for robotics is drones, also known as Unmanned Aerial Vehicles (UAV's). These flying robots are either flown autonomously or are controlled by a human operator on the ground. These UAV's allow for a smaller plane which does not put a human operator in harm's way when on very dangerous military missions.



Although the main use for drones is military, hobbyists often engage in building and flying drones. In the future, larger airplanes that transports items, for example a FedEx plane, may become UAV's to eliminate potential accidents to people in the plane.



# Vacuuming Robot

For many people, vacuuming the house can be a hassle, which is why a company known as IRobot has built a robotic vacuum which makes its way through a given room of any shape or size to clean the floors. This robot, known as the Roomba, was first introduced around 2000 where it offered basic vacuuming functionality with just a few sensors that prohibited it from falling off ledges and crashing into walls,



but now in 2013 the robot has improved vacuuming functionality as well as improved mobility with its new IAdapt technology. This new design feature allows the Roomba to most efficiently manipulate a room and clean each area thoroughly. The Roomba can travel through clutter, escape small areas, detect excess dirt and follow a wall to ensure that a room is cleaned to its fullest potential.

# Lawn Mowing Robot

Similar to the Roomba is a robotic lawn mower. This robot also has many onboard sensors so it can avoid crashing into obstacles that in encounters. Also, this device is able to select the most efficient path to mow and then make its way back to its charging base after it is done. Onboard this unique lawn mower is a solar panel as well to harvest energy and

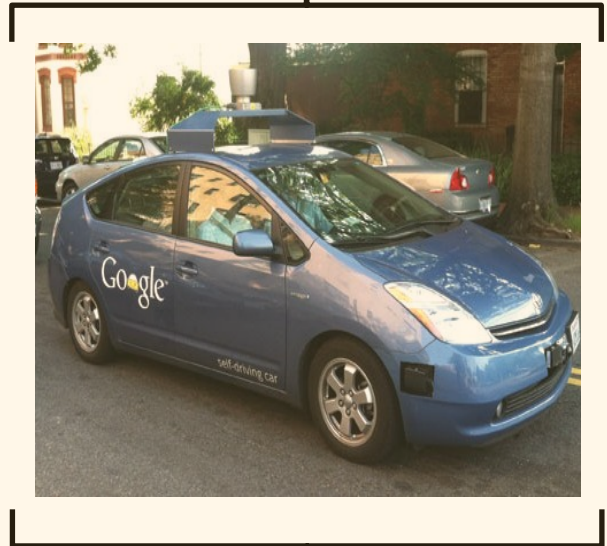


last longer on a given battery charge. Right now, these robots are not entirely practical for a typical consumer use since they cost about 3,000 dollars, but as they are improved the price will drop and therefore will become more abundant for consumer use.



# Autonomous Cars

Currently, restrictions on junior drivers are very strict, but we may need to forego these restrictions as we make way for driverless cars. Currently many car companies as well as the well-known Google are in testing phases of **autonomously** driving cars. Specifically Google's driverless car is being tested in Nevada, California, and Florida where it has completed several hundred thousand hours of Autonomous testing on the roads



all without an accident. To perform its driverless functions, the control system of the car calls upon many sensors with capabilities ranging from **ultrasonic** to imaging. Even though this car has proven to be safe on the roads, it will have to demonstrate many more road tests in order for it to be legalized around the nation and be brought into the consumer market.





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# Glossary

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## Term

## Definition

Habitability

How easy it is to live in a certain place.

Humanoids

Robots that perform similar function and look similar to humans.

Processor

The part of a robot that controls all of the robots actions.

Gyroscope

A device used to improve stability.

Autonomously

Operating without a human operate; using pre-programmed instructions.

Computer Numerically Controlled Machine

A machine that is controlled by pre-programmed instructions

Machinist

A person who's job it is to operate a regular non-computer controlled machine.

CAD Software

A computer program that allows the user to make 3D parts virtually.

# About the Authors

**Nick Gigliotti** is a senior at Mass Academy and is attending WPI. He is currently studying the field of robotic engineering and wishes to pursue a career in this field. He is the captain of FRC team 1100 and has been active participant for four years now. Nick enjoys spending countless hours designing and building robots in his spare time. Outside of the world of robotics, Nick plays golf and baseball and enjoys playing various field games with his friends.



**Tucker Martin** is a Senior at Mass Academy and is attending WPI. He is currently studying robotics at WPI and is very interested in turning his passion into a career. His junior year of high school he worked on developing an assistive cargo robot, a robot to help disable people by carrying their book and supplies. A member of FRC Team 190 for two years now, he enjoys spending his free time working on a few robotic projects with friends and fellow classmates.



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# Image Credits

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