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Robotics

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Abstract

The history and use of robots is a Long one go back into the BC era and up to today and beyond. This is shown in the history portion. Robots have also been used in combat scenarios and standard robots or as unmanned drones. Robots such as Lego mindstorms have even been used to teach and promote the study of robotics in kids.

A robot is “a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer”. The earliest account of a robot was created by Archytas in 400BC and was a steam powered pigeon.A greek philosopher by the name of Aristotle wrote this famous quote around 320BC:

“If every tool, when ordered, or even of its own accord, could do the work that befits it... then there would be no need either of apprentices for the master workers or of slaves for the lords.”

Centuries later plans for a humanoid robot were drawn by Leonardo da Vinci and were highly detailed drawings for a mechanical knight that could move various parts of its body. The first ever humanoid robot was created by Friedrich Kauffman it was a soldier that played a trumpet. The word robot was first used in a 1921 play called R.U.R which stands for Rossum’s Universal Robots by Karel Capek it is about how robots are finished taking orders from humans and begin a revolution that leads to the extension of the human race. Metropolis by Fritz Lang had the first robot ever to be on film. Alan Herbert Reffell created a robot made of aluminum that looked like a knight. It had a motor, eleven electro magnets inside, and was shown at the annual exhibition of the Model Engineers Society. Elektro a seven foot tall robot was shown at the world fair in 1939. Elektro could walk, speak, move its head and arms, and numerous other things. In 1941 Isaac Asimov created the Three Laws of Robotics which are:

1 A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2 A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

3 A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws

The first electronic computer Colossus was built in Britain by a team of mathematicians and electrical engineers in 1943. Soon after that the first autonomous robots were created by William Walter in 1948 named Elmer and Elsie. They were propelled by three wheels and were capable of doing phototaxis so they could go to a recharging station when their batteries run low and managed to show lifelike behaviour with very simple circuitry. In 1950 Alan Turing proposes a test to see if a machine is self aware to pass the test the robot must be able to be indistinguishable from a human during a conversation this test has come to be known as the Turing Test. In 1954 the Unimate was created by George Devol, and it was a single arm for use in industry. The arm was later sold to General motors in 1960 and was used to lift hot metal from a die cast and stack them. The USSR launched the first artificial satellite named Sputnik into orbit in 1957 which was the first artificial satellite in orbit and began the space race. Four years later during 1961 Marvin Minsky created a tentacle arm and is the first computer controlled arm ever due to Unimate being controlled by a magnetic drum. IBM’s computer the IBM 360 becomes the first mass produced computer in history in 1964. With 8mb of memory and a storage of 512kb. The computer was also easy to upgrade and influenced the computers that followed it. Later in 1970 Shakey a robot

that could reason about its surroundings was created. Shakey had an antenna for radio, sonar range finders, a camera, processors, and collision sensors. It had a list of commands it could perform: moving from A to B, Turn lights on or off, opening and closing doors, and pushing around objects. Early in the 1970s Freddy and Freddy II were built, and could assemble wooden blocks across several hours. In 1979 the Stanford Cart managed to cross a hall filled with chairs using only stereo vision. Two years later in 1981 Takeo Kanade created a Direct Drive arm using electric motors these allowed faster movement, higher accuracy, less friction and backlash. In 1996 David Barrett built the robotuna to study fish in water and to allow better exploration of the ocean. The fish has a skeleton of aluminum and 49 ribs made of polyester. Later in 1994 the cyberknife a robot that delivers radiotherapy was created by Dr John Alder. These have been installed at over 150 locations and have treated over 40,000 patients. Also in this year a robot called Dante II was built by scientists from Carnegie Mellon moves around the inside of the Mount Spurr volcano in Alaska collecting volcanic gas samples. In 1996 Honda showed the P2 robot it was six feet tall and still smaller than its predecessors. The Deep Blue Computer created by IBM defeated Garry Kasparov the World Chess Champion in the may of 1997 the score was 3 ½ - 2 ½ . After the match Kasparov accused the computer of cheating and wanted a rematch but never faced Deep Blue again due to Deep Blue being scrapped after the match. Also in this year the robotic rover Sojourner lands on mars in early July. In the may of 1999 Sony revealed the ABIO a robotic dog that can interact with humans, and completely sold out in twenty minutes. Lego company released their first robot system in 1998 called Lego

mindstorm. In 2000 Honda unveiled ASIMO a humanoid robot standing 4ft 3in and is capable of walking also a upgrade on the previous P3. In october of 2000 the UN estimates that there are about 742,500 robots in work around the world and half of these are in japan. ASIMO had also been improved on over the years upgrading its abilities. Cornell University showed a robot capable of self replication which is the first of its kind in 2004. It consisted of cubes that could rotate and magnets so it could connect to more cubes allowing to self replicate. Also Cornell University in 2006 revealed a four legged “starfish” robot that could walk even after being damaged. In this year lego also made the newest version of their mindstorm system available for purchase. This is the version used in Pasadena’s robotics competition for middle schools. This mindstorm was later improved on as a new model in 2013 by the EV3 which has color sensors and updated parts.

Robots have also been widely used in the military in across the years such as drones and armed robots. A few models of autonomous tanks were built during World War II in the form of teletanks and automatic tank mines. A more recent robot used by the United States government starting in 2001 and used by other countries later is the Talon robot. The robot is built modularly and is 86.4cm long, 57.2cm wide, and 27.9cm tall and comes with a manipulator arm used to interact with the environment around it. The talon has a max speed of 8.37km/h and can even climb stairs. It is controlled by a waterproof control unit that works up to 800m away. It can also be controlled by a custom controller or from a laptop. SWORD versions can also be equipped with various different types of weapons such as rifles and LMGs and are the first ever robot to take arms into battle. HAZMAT versions use various sensors to detect chemicals, gas, temperature, and radiation. IED/EOD versions have sensors and a robotic arm to disarm explosives. STOAL variants have color cameras but do not have a robotic arm and are lighter than typical units because they are meant to be used for reconnaissance missions.

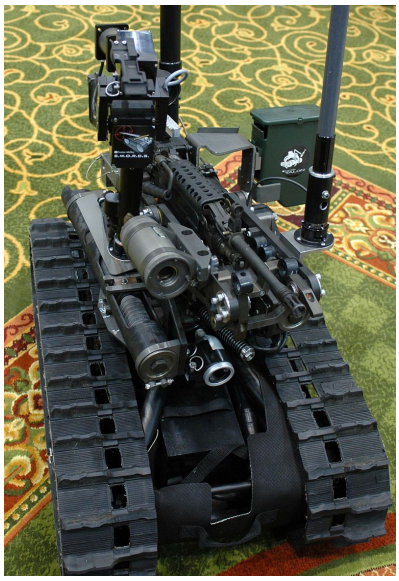

Fig 1 : a Talon SWORDS unit equipped with a weapon

The samsung SGR-A1 is an automated defense robot that guards the Korean demilitarized zone. Originally announced in 2006 as an $200,000 ,all weather, 5.56mm robotic machine gun with optional grenade launcher. It can track multiple moving targets using infrared and light cameras while being under control of a human operator. The robot can shoot up to two miles away and has a microphone and speakers to exchange passwords.

fig 2: the SGR-A1 turret

Unmanned Aerial Vehicles or UAVs have also been used by various governments. The first unmanned drones were created in the 1970s and used in the vietnam war. One of these is the General Atomics MQ-1 initially made for reconnaissance it carries various cameras and other sensors some have been modified for offensive roles and given missiles. Its first flight was on June 3rd 1994 over the mojave desert. The drone is controlled remotely by a nearby controller for take off and is then transferred to a control network. In 2007 and 2008 they fired 244 missiles and lost 70 drones. Four were shot down, fifty-five were lost due to weather or other issues, and another eleven were lost in mid air accidents.

The teletanks were unmanned remote controlled tanks created by the Soviet Union in the 1940s. They are controlled from radio at a distance of about 1 mile away. They were equipped with machine guns, flamethrowers, and sometimes a time bomb to destroy enemy bunkers. Teleplanes and teleboats were also made and were similar to the teletanks.

The lego mindstorm series which was mentioned earlier is used by various school districts to teach kids about robotics.

Fig 3: all of the lego mindstorms' main bricks

They can be coded in various languages such as C# , G, or C++. The original mindstorm released in 1998 came with two touch sensors, two motors and a light sensor. The NXT which was a upgraded model of the previous could use three motors, light sensors, sound sensors, touch sensors, and a distance sensor. The official software issued by lego are the RCX Code and the ROBOLAB. Other third party softwares exist such as ROBOTC and pbLua offering more languages to program the robots in. The robots can of course be built with legos and come with their own custom

parts. The building will be based around the the main brick unit which houses the controller. Various machines can be built from the mindstorm such as cars, scanners, crossbows, or even mini games that utilize the main brick.

The mindstorms have also allowed robot competitions between schools easier due to the low experience of coding needed. Pasadena's middle schools have a yearly competition using the NXTs with varying challenges every year. 2014's challenge was a race to the end of a board while following black tape using the color sensor. There were various lines that went off the board so the robot had to be programed to deal with them. 2015's challenge was another race to the center of a board while again a line was followed this time there was a gap where there was no line and various walls preventing cheating or a quick finish. The main winners of both years were Eliot and Sierra Madre.

Robots have been used in a wide variety of fields such as the cyberknife in medical, the unimate for automation, and lego mindstorms for recreation, along with military and reconnaissance. Robotics has allowed further research in hostile environments such as mars or volcanoes and defense of military zones. From ancient beginnings to now robotics has only advanced further in recent years and will continue to march on.

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