Advancements in Robotics Throughout The Years: Aiding in Disaster Management.

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***Abstract* — Throughout the years machines and technology have worked hand in hand in broadening the human aspect of safety and finding ways of supporting the betterment of society. Throughout the research paper the development of technology to help counter disasters is covered and how we, as humans, have made technology for disaster prevention and making life easier. Robots have certain capabilities that make them such successful mitigators, as proven by previous emergencies and the direction in which research is going.**

Keywords* —*natural disaster, robotics, computer science, engineering, sensors, emergency

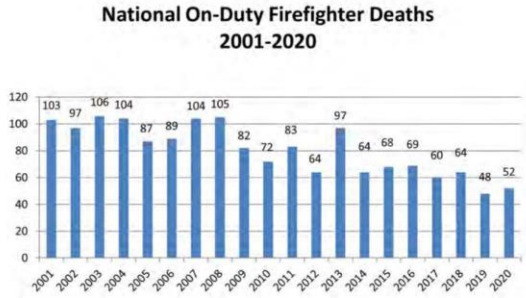

Fig. 1: The downward sloping graph of firefighter deaths throughout the years 2001 to 2020. Source [2]

I. INTRODUCTION

Throughout the years, machinery has aided humans in making life more simple or leisurely. From the invention of the wheel to space travel, technology has come a long way. Throughout that it has branched out to include methods of intervention that can be implemented in emergency circumstances, or times when we encounter difficult situations, i.e. connecting people worldwide to performing nano surgery technology. What implementations do robots have in emergency circumstances? During times when humans may be unavailable, or when it's too risky for a person to get help, a robot may prove to be very useful. They can be used to light up hallways towards safety, or automatically distinguish fires when no one else is around. Previously these jobs would have to be done by humans and may increase the potential risk or reduce efficiency. [1] Endangering human lives to save other human lives is something that some a lot of people disagree with and believe that it is morally wrong to risk one human life to save another, let alone multiple lives to save one human life. Robots remove the risk of human lives

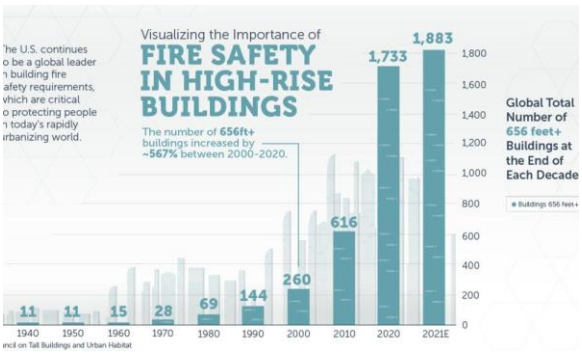

Fig. 2: The increase in fire safety technology in buildings throughout the United States. Source: [3]

One such example could be the deaths of firefighters throughout the years. They are people who risk their own lives to save other lives and often lose their life in the process, while the risk of disasters has been increasing. Due to this the use of technology to save lives becomes more and more persistent. By implementing this switch towards more robots countless human lives can be saved.

II. HISTORY OF TECHNOLOGY

Technology started developing a lot time ago dating back to the discovery of fire, and since worked on building things from other things that they discover. Like using fire to cook food and make tools then using tools to build houses and civilization. This paved the way for technology as we know it and led us to where we are today.

A. 6000 – 1200 BC

[4] Throughout these years humans figured out irrigation systems and developed basic ideas of what civilization should look like. Then we figured out that the wind can be used to push ships through the waters, and that helped build the first sails. Then worldwide use of iron to make tools and build stuff that couldn't be built before.

B. 800 – 1100

In China people were aiming to find ways of extending their life span and in the way invented gunpowder Using that they were able to develop methods of propelling arrows and other flying objects further than ever before. Then harnessing the power of the wind, the Persian people developed a windmill to ease human efforts. The Chinese people again figured out how to make a compass and use it to navigate themselves when there was no visibility in the sky.

C. 1200 – 1800

The hourglass was there for a long time prior to this, and then the invention of a mechanical clock happened in Europe that was then used to mark times of worship in churches. The first printing was also achieved during this time, where a bible was successfully printed by Gutenberg. Which led to a rise in the information people held throughout the area. After this people were able to make engines powered by coal and water: the Steam Engine. This kickstarted the industrial revolution to a whole new level by revolutionizing how energy can be used. With the new invention of the steam engine, railways were created to transport goods and people from place to place. Travelling no longer required pure human work and could be powered by a locomotive. Then Alexander Graham Bell figured that if it was possible for people to send information like morse code through wires, then why couldn't sound waves like voices be sent too. After this they discovered that they could keep fuel inside an engine and created the internal combustion engine that would later be used to power cars and such automobiles. Thomas Edison also invented the electric light bulb using a carbon filament and was able to burn it for 13.5 hours and subsequently created the first power plant.

D. 1900s

After people were able to send audio through telephones, Marconi wanted to be able to broadcast that to everyone worldwide to long distances. The first flight of the world took flight during this time too, with the wright brother flying a plane for 120 feet. Then Goddard figured that he could try propelling a rocket upwards and maybe achieve space travel one day. He flew a rocket for the first time to a height of 12.5 meters. Once people were able to transmit radio, they figured the next logical step would be to transmit video, which led to the invention of a television that was still black and white. In the years following the first computer was also created using the binary numbers 1 and 0. Then using the discovery of Atomic bomb and radiation, the first nuclear power plant was created where a self-sustaining chain reaction was created. In the same year the first personal computer, and a way of sending and receiving information throughout the world was created called the internet. These inventions were all part of making the world as we know it today what it is. Without this nothing we have achieved so far would be possible. These are all huge advances in technology.

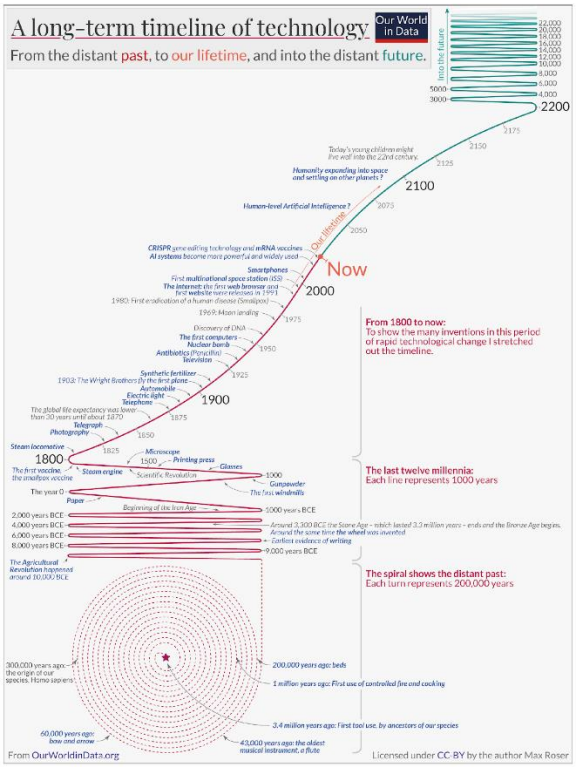

Fig. 3: A display of the technological advancements throughout the years. Source: [5]

III. ADVANCEMENTS IN DISASTER RELIEF

Technology started developing a lot time ago dating back to the discovery of fire, and since worked on building things from other things that they discover. Like using fire to cook food and make tools then using tools to build houses and civilization. This paved the way for technology as we know it and led us to where we are today. Specifically, robotics has improved disaster relief, whether that has been saving the lives of human beings or treating the disaster more effectively and efficiently. From saving people to putting out forest fires, the efforts of robotics to advance our efforts in disaster management and relief have been tremendously helpful.

IV. Examples of Robotics

A. Fighting Forest Fires from the Air

Drones have been incredibly helpful in fighting forest fires. Equipped with thermal cameras, the drones can efficiently provide real time information of a large fire so scientists and firefighters can control the situation effectively. The Predator Drone [6], in contrast to a manned plane, doesn't pose risk to the pilot's life and can stay at the scene longer, thus giving more data vital to firefighting. The aerial view drones provide also help locate important infrastructure and survey the landscape [6], which can allow scientists to predict how the fire will spread. Then, they can protect important infrastructure and predict and control the fire's spread.


Fig. 4: A drone surveying a forest fire. Source: [11]

B. Hazards on the Ground

Another example of the benefits of robots is disaster relief on the ground, in events of earthquakes and tsunamis, where infrastructure could be damaged and dangerous to enter. UGVs, or unmanned ground vehicles [7], can enter potentially dangerous areas without the need to endanger any person's life. Then, they can provide vital information or important supplies to trapped people [10] and assist in their rescue. Using advanced sensors and cameras, as well as tracks and an arm [7], robots can effectively navigate and manipulate surrounds to detect survivors, going into areas possibly dangerous or impossible for people to enter. An example is the TrackReitar Rescue robot [7], designed to aid injured people and help them evacuate during disasters.

C. Cleaning and Saving the Ocean

Robots help in cleaning debris and plastic from the ocean, as well as monitor ocean conditions and biodiversity for scientists to track the ocean's overall health. Plastic and garbage in the ocean have been a big problem, and the advancement of robotics could help us fix this. Robots are more efficient than humans in cleaning up trash, they can access more areas of the ocean, and they can also work longer than humans [10]. With so much trash, such as the Pacific Garbage Patch, in our oceans, robots can clean much more efficiently and effectively, making them incredibly beneficial in solving this massive problem. Clearbot [8] can spot pieces of trash with its vision system and is collected in a bin in the middle. The robot can hold up to 200 liters of waste and can operate for 48 hours before needing a charge.

Fig. 5: Clearbot in action. Source: [8]

In addition to trash collection, robots can also monitor marine life, as well as ocean water health and conditions. One example is monitoring biodiversity, or the diversity of different species. Ocean Census, using underwater robots, seeks to discover more species in the ocean [9]: there is estimated to be around 2.2 million marine species, but only 10% has been found. The underwater drone Hydrus [9] is used to monitor the health of coral reefs in addition to finding new species. Coral reefs are an important part of the marine ecosystem, providing food and shelter for many organisms and are able to show the health of the ecosystem as a whole. [10] Robots help monitor the health of the ocean as well as clean up its garbage and plastic in ways more efficient and effective than people, due to their ability to work more as well as work in places difficult for human beings.

V. CONCLUSION

Throughout the years, robots have become more advanced: they have grown to be used in many aspects of our lives. Their importance in aiding disaster recovery and management has only increased over time. Without the need for humans to risk their lives, as well as providing an efficient and effective approach, robots significantly improve how we respond to disasters and crises in our world. As technology steadily improves, there is no doubt that robotics will continue to play a leading role in our world in the continuing years.

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