USE OF ROBOTS FOR LIQUIDATION OF THE CONSEQUENCES OF THE ACCIDENT AT THE CHRONOBYL NPP

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Historical context

The 1986 Chornobyl nuclear power plant accident was not only a tragedy for Ukraine, but also for the whole world. It was a global event that changed the approach to crisis management in high radiation environments. Given the threat to the lives of the liquidators, robotic technology played a key role, although the technological capabilities at the time were very low. The example of the Chornobyl disaster response shows how extreme conditions stimulate the development of new technologies (Aguiar et al., 2024, pp. 1-28).

Several types of robotic systems were used during the Chornobyl accident response, differing in functionality and capabilities. «Lunokhod»: A lunar rover invented by the USSR and specially modified to collect radioactive waste, because before the modifications, it could not drive on the roof of the 4th rector due to

gravity. It had thick steel plates to protect it from radiation, and after 302 days of operation, the lunar rover covered 10.5 km at an average speed of 0.14 km/h. It was moving 18% of the time.

«Joker»: It was created in Germany at the request of the Soviet leadership to help in the aftermath of the Chernobyl disaster. It was designed as a high-tech robot capable of working in conditions of high radiation. The main task of Joker was to clear the roof of the fourth power unit from radioactive debris, where the radiation level exceeded the limits permissible for humans. Despite the seriousness of the approach, this robot did not work for long.

Mobile Robot Manipulator: This robot was one of the few machines that could be used effectively, thanks to its remote control. It cleaned the roof of the reactor, where radiation levels exceeded the capabilities of the human body.

But unfortunately, the use of robots was not so widespread at that time, so in the end they resorted to human power.

The main technical challenge for these robots was the resistance of electronic components to high levels of radiation. Most of them failed due to the inability of electronics to function in such conditions. For example, the Lunokhod system was capable of performing complex manoeuvres, but radiation quickly destroyed its main components (Aguiar et al., 2024, pp. 1-28). Another limitation was the level of autonomy of these robots, which required constant monitoring by operators, preventing full automation of work on the roof.

Impact on the development of robotics

Despite all the difficulties, the Chornobyl experience was a significant impetus for the development of robotics. First, it encouraged developers to create more radiation-resistant materials and electronic components that are now used in many industries. Secondly, the case demonstrated the importance of having robotic systems available for emergency response. This contributed to the development of robots that are now used not only in radiation contamination, but also in other extreme environments, such as space, deep-sea exploration, and man-made disaster sites.

Current achievements and prospects

The experience from the Chornobyl nuclear power plant has been used not only in the elimination of the consequences of severe disasters, but also in space technologies, which has helped to make new discoveries about our earth. Drones that can fly for long periods of time and collect accurate data are now used to monitor the radiation background in the Chornobyl zone. The latest robotic manipulators have powerful protective shells that allow them to work in high radiation conditions without the risk of failure. In addition, modern advances in artificial intelligence allow these robots to operate with minimal human intervention, which significantly increases their efficiency (Bankins & Formosa, 2023, pp. 1-16).

Conclusion.

The use of robots in the aftermath of the Chornobyl disaster was a landmark event that stimulated the development of the entire robotics industry. This experience not only demonstrated the capabilities of robots, but also highlighted the need for continuous improvement of technologies for work in extreme conditions. Today, robots working in hazardous areas are a direct result of technological progress initiated during the liquidation of the Chernobyl accident.

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