FIRE FIGHTING ROBOTS IN CHEMICAL INDUSTRIES

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SITUATION

Fires in chemical factories are toxic in nature and pose a serious threat to firefighters. Extreme temperatures, poisonous chemicals, both liquid and gaseous, are factors that contribute to the severity of these fires. A suitably armored firefighting robot that is designed to survive harsh conditions can save the lives of firefighters and help reduce chemical fires.

PROBLEMS

Chemicals, melting metals, corrosive materials, falling objects and extreme heat can cause damage to the external and internal components of firefighting robots

Fire can damage the sensory components (e.g. cameras) and electric components inside the robot

Debris and rubble can block the movement of the robot

A system to douse the fire that fits the size restrictions of the 30x60x30 cm robot is required

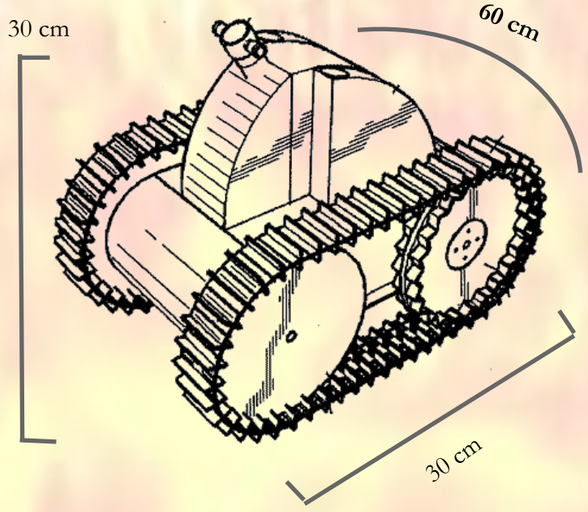

Figure 1: External body of the robot [4]

SOLUTIONS

Nano-coating will protect the robot's exterior and interior components from acids and corrosion

Titanium will create a well-protected exterior body

The motor, circuits, wiring, cables, sensors, and cameras will be protected in a flameproof cavity

The robot will have backup sensors embedded inside the body in case of damage to the main sensors

A passive adaptive double-track mechanism (e.g. used in ROBHAZ-DT3), made of a motor that drives two tracks independently will be used for moving on the rough terrain [1]

A externally attached fire hose will be used as fire extinguishing system

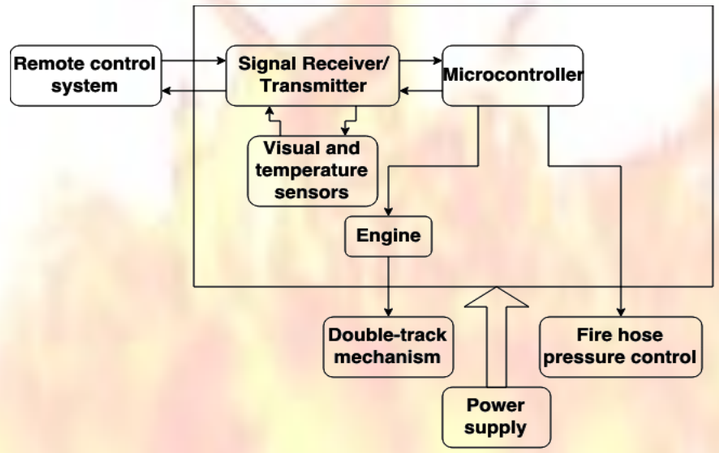

Figure 2: Flowchart of the robot components

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EVALUATION

A hydrophobic aluminide nano-coating applied on TK35 cast β-titanium alloy will protect the robot's body from corrosion and acids. This composition has a corrosion rate of 0.5 mg/cm², while the uncoated titanium's corrosion rate is 3.0 mg/cm² [2]

All the sensory components will be placed inside the robot, except for the sensory input parts (e.g. camera lens). Modern sensors are small in size and of good quality

The rotational passive adaptive mechanism equipped between the front and rear body will enable effective movement on uneven terrain. A South Korean explosives removal robot ROBHAZ-DT3 employs this type of mechanism. It was tested in field conditions by the South Korean police [3]

Lightweight Attack Fire hose can easily aim at distant targets. This type of hose is covered with nitrile (−C≡N) jacket which is resistant to heat, aggressive chemicals and mechanical damage

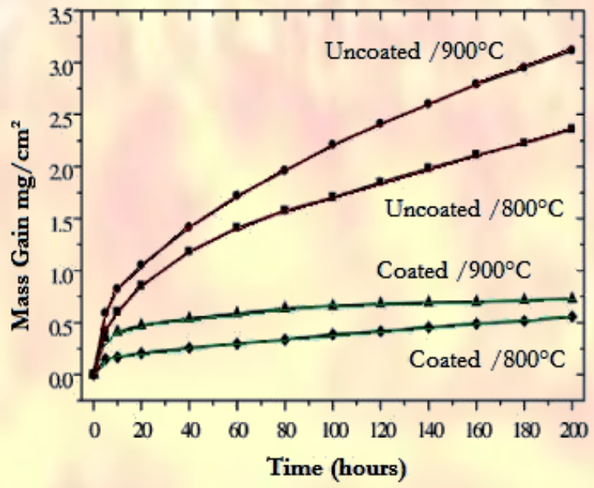

Figure 3: Corrosion rate of Titanium [2]