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Abstract

An additional cost to human loss and property destruction during fire disaster is fire fighters injuries and death. The recent statistics of 63,350 fire fighters injuries that occurred during the year 2014 confirms that firefighting still presents great risks of personal injury to the fire fighters [1]. The lack of details on information about the victims trapped in fire and situation in the fire zone increase the risk to fire fighters [2, 3]. To reduce these fatalities fire fighting robots (FFRs) emerged as possible solutions therefore they are developed and researched on. The FFRs are designed for either prevention or emergency (same as intervention) tasks of fire and are applied indoor or outdoor. However, the prime movers of the majority of the FFRs are electrically powered [4] which made them to be suitable for preventive task alone and inappropriate for the emergency task. Their inappropriateness is due to the vulnerability in high temperature environment that characterised fire emergency. Thus, alternative propulsion systems for the mobility of fire fighting robots in emergency setting are evolving.

Furthermore, literature survey reveals that water powered hydraulic propulsion system has been the only alternative to the drawbacks of dc motors in the hot environment. The mechanism was implemented on snake fire fighting robot for tunnel fire application [5]. In the mechanism, hydraulic motor was used to actuate the snake joints for mobility while water provides power for the hydraulic motors. However, the snake robot was designed for outdoor application. Consequently, the need for an autonomous fire fighting robot with a novel propulsion system becomes imminent.

This paper therefore presents a novel concept of an autonomous firefighting robot capable of fighting an indoor using a carbon dioxide gas propulsion system. The carbon dioxide gas propelled autonomous fire fighting robot (CAFFR) will be deployed for indoor fire emergency and will have the task to autonomously locate a fire source, navigate to the source and extinguish the fire while in a high temperature environment. Furthermore, the CAFFR will be propelled by a

pneumatic motor which derives its pneumatic power from carbon dioxide gas instead of air. The carbon dioxide gas will be self-generated by the proposed robot (CAFFR) from dry ice.

The novel concept is based on the fact that dry ice (which is the solid form of carbon dioxide (CO_2) gas) can sublime directly to gaseous form without any deposit. Correspondingly when the CO_2 gas is produced in a closed container pressure will build up with time. So the pressure that develops can be used to power the pneumatic motor. Furthermore, manufacturer of pneumatic motor confirms that it can be powered by pressure ranging between 40psi – 110psi [6]. This concept was demonstrated in an air closed container with the set up as shown in figure 1. This experimental result demonstrates the viability of the proposed concept. This result represents a proof-of-concept.

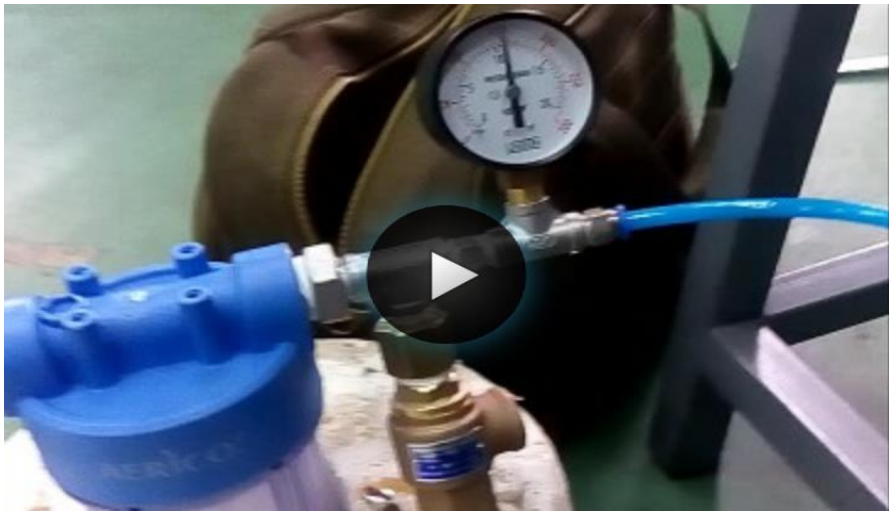

Figure 1. 100psi pressure generation from Dry Ice

Keywords: Autonomous, Carbon dioxide propulsion system, Emergency /Intervention task, Firefighting Robot, indoor fire,

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