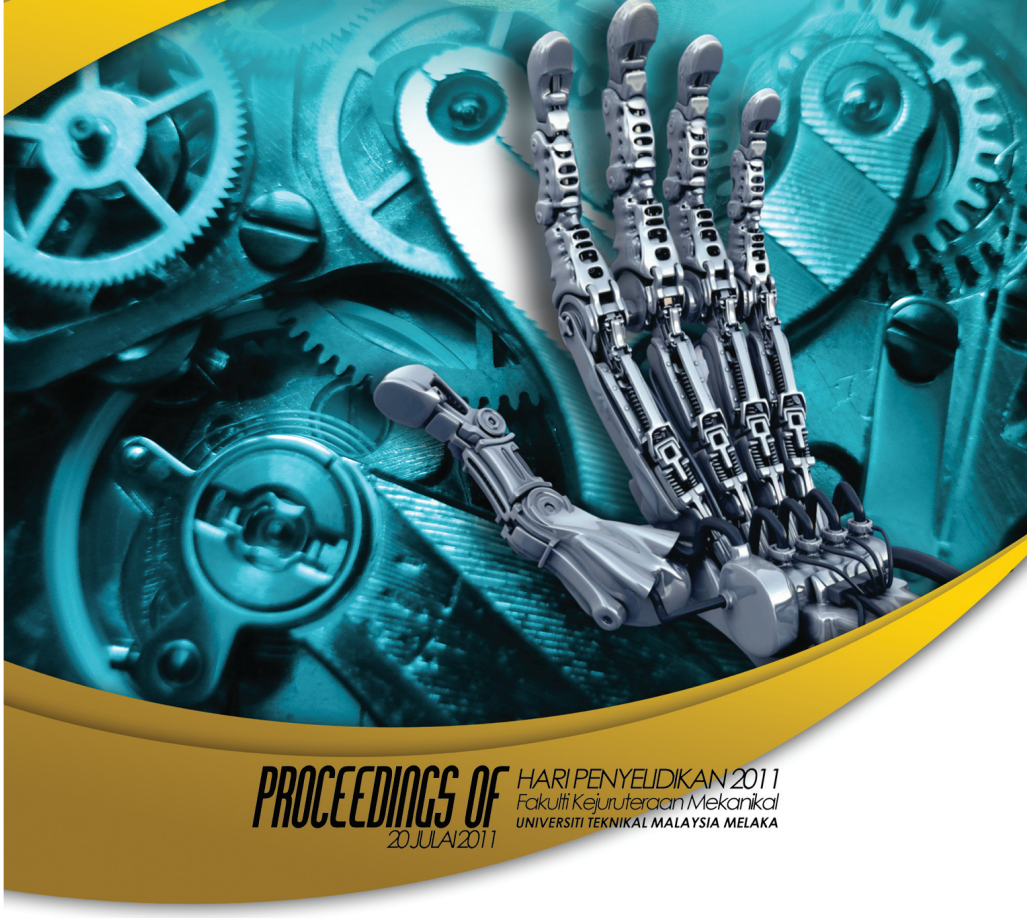

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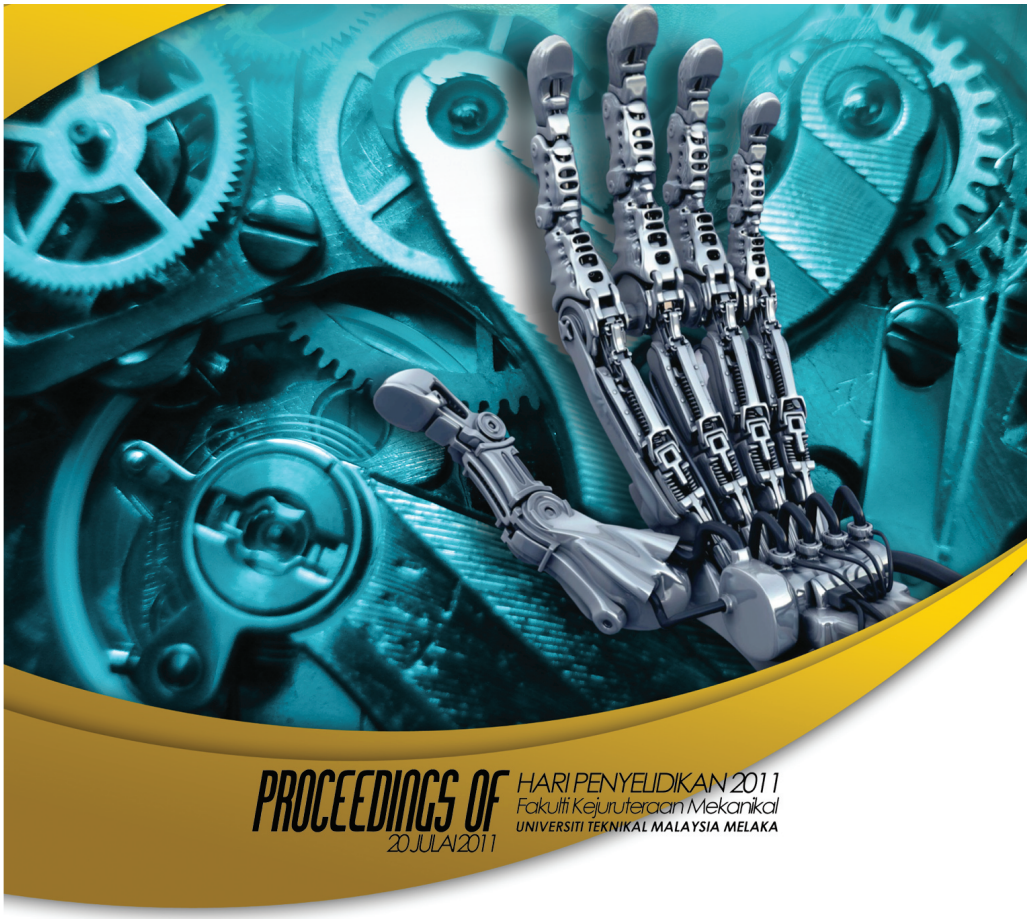

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Development of Ground Vehicle for Fire Fighting Purpose

CheeFai Tan[1], Mohd. Rizal Alkahari[1], Mohd. Nazim Abdul Rahman[1]

Abstract –*Fire fighting is risky profession. They are not only extinguishing fires in tall buildings but also must drag heavy hoses, climb high ladders and carry people from buildings and other situations. There are many fire fighters lost their lives in the line of duty each year throughout the world. The statistics of the fire fighter fatalities are still maintain at high level every year and it may continue to increase if there is no improvement in fire fighting techniques and technology. This paper describes the development of ground vehicle for fire fighting purpose.*

Keywords*: Ground Vehicle, Fire Fighting*

I. Introduction

Fire fighter need to work in a long and irregular hours and unfriendly working environment such as high temperature, dusty and low humidity, firefighters are also facing with potentially life threatening situation such as explosion, collapsed building and radioactive. The common equipment used by firefighters such as flat head axe, halligan bar, turnout jacket, fire retardant or bunker pants, boots, flashlight, helmet, face mask, and gloves do not significantly reduce risk on their lives when facing those life threatening situations.

In the USA, the traumatic death rate amongst firefighters shows that 1.9 firefighters are killed per year, per 100,000 structure fires which is the rate only slightly lower than that obtained in the early 1980s [1] . However, this rate was increasing to 3.0 per 100,000 structure fires across a thirty year period which is peaking in the 1990s [2]. There are many causes for Line of Duty Deaths (LODD) such as smoke inhalation, burns, crushing injuries and related trauma [3]. As a result of this, over the past few years, research and development on firefighting technology is extensively made around the world especially in US, Japan, and a number of European companies. There were many studies [4-8] had emphasized on machine development to replace fire fighter to fight fire in dangerous situations and to reduce the fire fighter risk. The machines help the fire fighter using extinguishing agent such as water, foam or others without fire fighter having to set up or operate directly in danger areas.

Amano [9] highlighted the weaknesses of existing machine design and suggest integration of all important elements in developing fire fighting machine so that a successful rescuing process can be achieved. These elements are size, weight, cost and performance. Therefore, this research was integrated required technical aspects to develop a ground vehicle based on the end user requirements which is fire fighting rescue team. The paper describes the development of fire fighting ground vehicle.

II. Comparison of Fire Fighting Machine

Existing fire fighting technology and machines design is still under extensive research around the world with a few of them start to be comercialized. The comparison of existing Firefighter machines in terms of the design weaknesses, special features of design and potential of design improvement that can be made on the remote firefighter machine is showed in Table 1. The table compares Washremote [10], Firemote [11], Luf60 [12], Jelka-4 [13], and Firefighting Robot [14] which have been developed by different research institution and organization.

Table 1: Comparison of different fire fighting machine.

Machine	Design Weaknesses	Special Features of Design	Potential of Design Improvement
Wash remote	• The size of machine is big. • Outdoor use only. • Specifically for washing only. • Can't clear away smoke.	• Washing and decontamination. • Remote control nozzles. • Waterproof design. • Wireless system variable through building wall.	• Make the design small. • Remotely operable hose release. • Minimum water usage. • Indoor and outdoor usage. • Ventilation fan. • Dozer blade.
Firemote	• Can't clear away smoke. • Can't move object.	• Remotely operable hose release. • Small design. • Monitor • Track articulation. • Indoor and outdoor usage.	• Minimum water usage. • Ventilation fan. • Dozer blade.
Luf60	• The size of machine is big • Outdoor use only. • Slow movement.	• Rugged machine • Ventilation fan • Minimum water usage. • The nozzle can adjust. • Clears away smoke. • Can move object.	• Make the design small. • Remotely operable hose release. • Indoor and outdoor usage. • Dozer blade. • Move faster.
Jelka-4	• The size of machine is big. • Outdoor use only. • Can't clears away smoke	• The nozzle angle can be adjusted. • Rugged machine • Hydraulic arms • Dozer blade.	• Make the design small. • Remotely operable hose release. • Minimum water usage. • Indoor usage. • Ventilation fan.
Firefighting Robot	• The size of machine is big. • Maximum water usage.	• Traction system • Charging system	• Make the design small. • Ventilation fan. • Remotely operable hose release. • Minimum water usage. • Indoor and outdoor usage. • Dozer blade.

III. Control

The developed prototype is a fire fighting ground vehicle (F2GV) that can be controlled wirelessly via mobile computer. Therefore, special dedicated software is developed in order to interface the machine and the computer. Additional control mechanism is added by integrating the system with a joystick in order to ensure the mobility control can be improved. Fig. 1 shows the control system of F2GV. Visual Basic Programming language is used in the development of the program that interfaces the machine with computer. Two way communication also possible between the victim in the fire ground and the machine operator as there is internal microphone integrated with the system. Fig. 2 shows the machine and its controller which is a mobile computer and a joystick attached to the computer.

The developed F2GV as shown in Fig. 3 and the general specification as shown in Table 2.

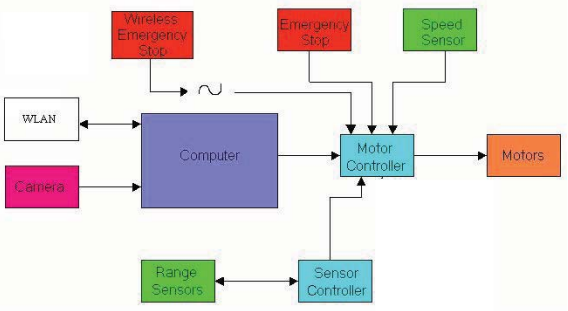

Fig. 1: The control system.

Fig. 2: Controller and F2GV.

Fig. 3: The F2GV prototype.

Table 2: General specification of F2GV.

Item	Description
Track System	Heavy duty rubber track belt
Electrical	22V
Engine	Electric DC Motor by Sanpo Electric Co. LTD.
Engine Power	750 W
Engine Current	46 A
Engine Speed	1900 rpm or 198.97 rad/s
Torque	3.77 Nm
Transmission	2 speed. Manually changed.
Curb weight	910 kg
Maximum Speed	2.36 Km/h

IV. Conclusion

In this paper, we have describe the development of fire fighting ground vehicle. The developed F2GV may used by Fire and Rescue Department, Malaysia to fight fire in a hazardous environment. Currently, the developed F2GV is further up-scaling for better mobility and fire fighting function.

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References

[1] International Association of Fire Fighters (IAFF), Death and Injury Survey, Washington, Available from: http://www.iaff.org/HS/PDF/ 2000%20D&I.pdf. Accessed on 5th September 2008.

[2] S.N. Kyle, NFPA Releases Firefighter Death Study, U.S.A," Available from: http://cms.firehouse.com/content/section/news. Accessed on 5th September 2008.

[3] N. Rosmuller and B.J.M., Ale, Classification of fatal firefighter accidents in the Netherlands: Time pressure and aim of the suppression activity, *Journal of Safety Science*, n. 46, page 282 – 290, 2008.

[4] Shanghai Qiangshi Fire-fighting Equipment Co. Ltd., Qiangshi Fire Fighting Robot, China, Available from: www.qs119.com/en/showpro.asp?id=530. Accessed on 5th September 2008.

[5] E. Sofge, First Firefighting Robots Deployed, Could Spark Autonomous Dept. Las Vegas, Available from: http://www.popularmechanics.com/science/roboticsl. Accessed on 5th September 2008.

[6] A. Konda, The Fire Fighting Snake Robot. Europe, Available from: http://www.sintef.com. Accessed on 4th September 2008.

[7] HKFSD, Mobile Fire Fighting Supporting Machine LUF 60R. China, Available from: http://www.hkfsd.gov.hk/home/images/equipment/fire/e_luf60.html. Accessed on 13th September 2008.

[8] NEVA, Mobile Fire Fighting Robot. Russia, Available from: http://www.neva.ru/CNII-RTC/Firemen/html. Accessed on 13th September 2008.

[9] H. Amano, Present Status and Problems of Fire Fighting Robots," SICE 2002. *Proceedings of the 41st SICE Annual Conference*, Vol. 2, page 880- 885, 2002.

[10] Ryland Research Limited. Washremote. http://www.securobot.co.uk/Washremote%20data%20sheet.pdf. Accessed on 5th September 2008.

[11] Ryland Research Limited. Fireremote. http://www.securobot.co.uk/ Firemote Version rochure.pdf. Accessed on 5th September 2008.

[12] Rechner's GES.M.B.H. Fire fighting technology- LUF60. http://www.rechners.com/rechnersenglish/index.php?option=com_content&view=article&id=58&Itemid=64. Accessed on 5th September 2008.

[13] All on Robots. DOK-ING JELKA firefighting robots. http://www.allonrobots.com/firefighting-robots.html. Accessed on 5th September 2008.

[14] All on Robots. Firefighting robots. http://www.allonrobots.com/firefighting-robots.html. Accessed on 5th September 2008.

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