Future Logistic Convoy Operations: Recommendation for Autonomous Vehicles

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Abstract: The Allied Forces fighting against terrorism in Afghanistan and Iraq have experienced an increasing threat of improvised explosive devices over the past 15 years. Due to the inability to consistently detect these devices, the United States military has suffered casualties at a significant rate. In order to mitigate this threat, the United States military began transitioning its vehicles from utilizing human drivers to a leader follower method. Ultimately, the military aims to have completely autonomous vehicles by 2040. In coordination with the Tank Automotive Research and Development Engineering Center (TARDEC), this research proposes a System Modeling Language (SysML) diagram outlining a prospective conceptual design for an autonomous logistic vehicle convoy. Our conceptual design incorporated the use of an Unmanned Aerial System (UAS) to assist with route planning and threat identification in support of the autonomous convoy. Through use of the Systems Design Process, we determined the most informative conceptual diagram.

Keywords: Autonomous Vehicles, TARDEC, SysML, Systems Architecture, Leader Follower

1. Introduction

Currently, the United States’ standard vehicles in military operations are human operated. However, the United States Department of Defense (DoD) has increased its interest in autonomous technology on the battlefield (Carter, 2012). This goal of improving the current technology in vehicles is to effectively control the battlefield and to limit the exposure of soldiers in combatant environments in order to decrease risk exposed to U.S. military personnel during missions. Specifically, the purpose of technology revolves around preventing human casualties. Over the past decade, numerous government and nongovernment organizations have worked towards engineering autonomous vehicles to eventually replace the human presence of soldiers in convoys (Horning, 2016). TARDEC identified a quicker resolution to completely redesigning the Army fleet of wheeled vehicles by integrating computerized autonomous kits. Despite the current development in autonomous technology, TARDEC continues to seek solutions to eliminate gaps in existing systems, and hopes to employ a fully autonomous fleet between the years 2030-2040. The purpose of this report is to develop and broaden the depth of existing research, and to determine potential solutions to the DoD’s objective to autotomize today's military vehicles by the year 2040.

1.1 Problem Statement

The Department of Defense (DoD) in coordination with multiple government agencies including TARDEC aims to reduce the troop casualties in combat sustainment operations in Iraq and Afghanistan and possible future operations where improvised explosive devices threaten U.S. forces abroad. The goal of this study is to develop a system modeling language (SysML) diagram to graphically represent the overall system of military autonomous vehicles (logistic), specifically focusing on convoy operations. This will enable TARDEC engineers creating the autonomous vehicle design to understand how the systems will interact with each other and in the environment.