Truck Parking and Management in Virginia
(Technical Paper)

The Ethics of Precision Autonomous Drones in Warfare
(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Fall, 2020

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

As technology has progressed throughout the last several decades, automation has creeped its way into almost every industry. From manufacturing to automobiles, autonomy delivers more precise and economic solutions to tasks at hand. This trend, however, is now progressing into more and more questionable territory. The threat of cyber warfare has grown increasingly worrisome with the adoption of computers for offensive tactics, but autonomy and artificial intelligence is advancing into physical warfare with the development of autonomous drones. Unarmed Aerial Vehicles (UAV), often known as drones, are commonplace on the battlefield. UAV's, however, still have direct human oversight and piloting. Autonomous drones, meaning drones programmed to act and react completely independent of human input are already in the works, however (Dyndal, Bernsten, 2017). Going forward drones as they are commonly known will be referred to as RPA's (remotely piloted vehicles) in order to avoid confusion when comparing them to autonomous drones. As Col Dyndal and LtCol Bernsten discuss throughout their joint article, autonomous drones are no longer science fiction. The two argue that though there are several challenged facing the development of these autonomous aircrafts, great strides have been taken by universities and private corporations alike, making the discussion ever more important. When a computer takes complete control of a drone, who is responsible for civilian casualties and unintended consequences of mistakes? Is the benefit of this new technology worth the risks? The first essay will address the ethics behind autonomous drones and the implications they have on the battlefield. Beyond the debate of performance and ethics, how would the enlistment of autonomous drones change the trajectory of artificial intelligence in warfare? The second essay investigates the development of tools and equipment to manage and track freight truck parking at rest stops on interstate highways and freight corridors. Poor parking

management leads to a higher rate of illegal parking, and fatigued freight truck drives, which increases roadway accidents and traffic. The approach to this problem involves an array of sensor and communication equipment to provide real-time parking availability measures to truckers for them to better plan their routes and rest stops. This information and user feedback would be disseminated via a mobile application to truck in search of parking vacancy during their scheduled commutes. This paper will explain the approach to this problem and its implications on trucking going forward.

Technical Topic

The poor management of freight truck parking has led to illegal parking and overcrowding, causing traffic and safety issues along major interstate highways in Virginia. Truckers must adhere to legal requirements regarding maximum vehicle operation time, and parking is expected to occur at waypoints and designated locations. However, as there is no centralized system to locate vacancies and relay that information to truckers effectively, parking stations often become overcrowded. This leads drowsy truckers to either illegally park on the highway or continue driving in search of an available space, endangering themselves and other vehicles on the road. The larger issue that has been identified is the lack of total parking spots, for which greater infrastructure changes must be made. For the purposes of this capstone project, the aim is to develop a space-based solution to conduct remote sensing of trucks and parking spots, and then construct a systems architecture to process the data and disseminate it to truckers in a non-intrusive way. We have partnered with the MITRE Corporation under the mentorship of Dr. Cj Rieser and Dr. Michael A. Balazs, as well as our technical advisor Professor Chris Goyne, to investigate and tackle the problem.

The team has reached out to the Eastern Transportation Coalition, I-81 Corridor Coalition, Owner-Operated Independent Drivers Association, and the American Transportation Research Institute. Interviews with the first three have already been conducted, and the common theme driving the truck parking problem is the lack of initiative from the government despite its importance to roadway safety. Thus, it falls into the hands of independent research groups to explore this problem. As this problem extends beyond the borders of Virginia, a comprehensive solution will take more cooperation and awareness of the issue to implement.

Despite limitations, past organizations have attempted to remedy the truck parking problem in localized areas using different data collection and management techniques. As part of the process, the team conducted research on state-of-the-art solutions and developments. Crowd-sourced tracking apps as well as "detectors installed in the ground, and video cameras for additional monitoring" with truck detecting algorithms (see Figure 1) are all solutions that are currently commercially available; however, all of these solutions have major inefficiencies (I-95 Corridor Coalition, 2009). Tracking apps require truckers to input and update current data, a method with obvious drawbacks as drivers without access to the app and unreliable users can lead to flawed data (Woodrooffe, 2016).

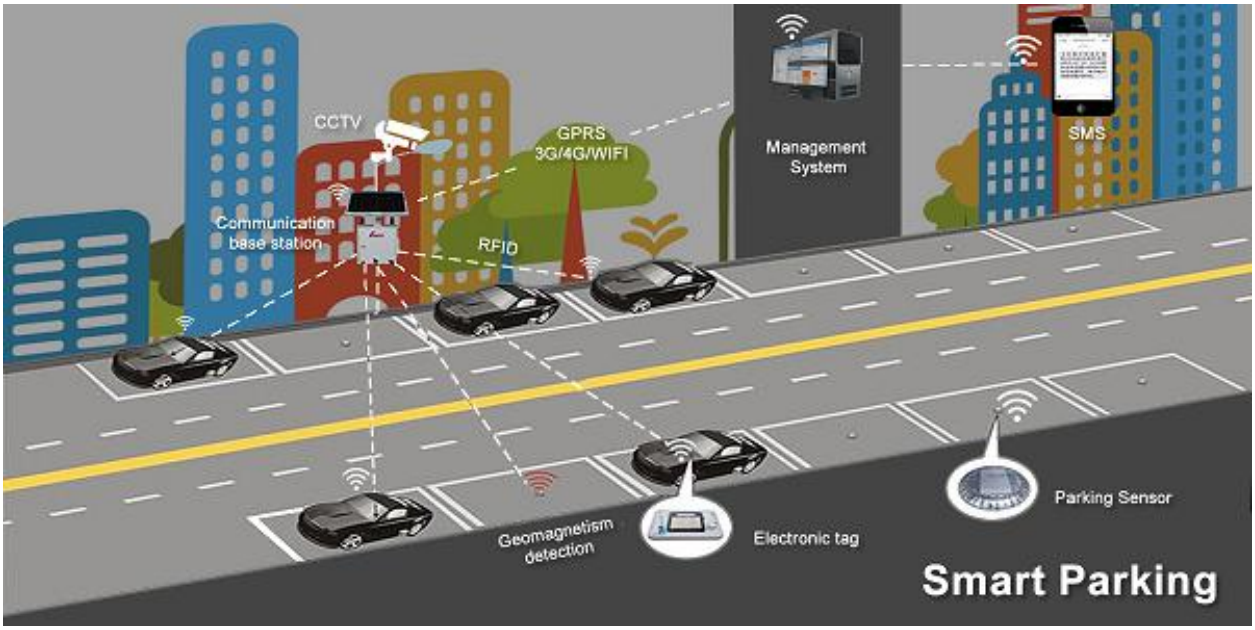

Figure 1: Example of a sensor based parking system with video cameras to demonstrate the inefficiency of this design. (Research N Reports, 2018)

In an interview with the I-81 Corridor Coalition, the use of in-ground sensors was discouraged due to the Virginia Department of Transportation's (VDOT) apprehension to damage the existing infrastructure - the pavement - to install the sensors. On-site cameras are currently the most favorable solution; however, this still requires the installation of a camera at every parking site and the establishment of a communications network between them (Morris, 2017). From interviews with the organizations listed, and research on current solutions, we have gathered that our solution needs to have a relatively high data collection frequency - as knowing there was a space available hours ago is not useful - and should be widely applicable, avoiding the installation of sensors or cameras at every parking location in the state.

Due to the research and design emphasis of this project, there are minimal initial resource requirements necessary to complete this semester's tasks successfully. One requirement would be ample access to the stakeholders previously mentioned, as they provide first-hand accounts about where the problem lies and what solutions have been implemented in the past.

Additionally, the mentorship of Dr. Cj Rieser and Dr. Michael A. Balazs provides valuable input on gaps in our team's knowledge and on possible shortcomings of proposed space-based solutions. This capstone project is broken down into 12 tasks, the first three of which have been completed. The next three will be completed this fall semester, and the final six will be completed in the spring semester. The 11-member team has already presented its initial progress to MITRE and will present again at the end of the semester.

STS Topic

Warfare has been a driving force of society since the dawn of humankind. Nowadays, however, civilians are less accepting of the unintended consequences of war, such as civilian casualties, mission failure and collateral damage. According to James Walsh, Professor of political science at the University of North Carolina, the use of RPA's in warfare has accentuated this disproval as expectations for the precision of attacks increases when human error is less of a factor in combative operations. Walsh's opinion is consistent with findings showing that 53% of respondents were "very concerned" about the civilian casualties during precision drone strikes (Walsh, 2015). Without public support of the military, the country is less flexible in the methods in which it can protect itself and may not be as effective in neutralizing threats and keeping up with global superpowers. Drone warfare is a misleading term, however. Drone's refer to unmanned aerial vehicles, or remotely piloted vehicles, which have pilots actively piloting them remotely. This term has garnered a negative connotation in the public's eye throughout the past decade or so. Critics of drones argue that they encourage the use of force because of the lack of accountability for such actions (Shima, 2015). This problem will become much more pervasive with the deployment of autonomous drones. Dr Shima Keene, Director of Conflict Studies Research Centre in Oxford, discusses the common belief that the use of drones signals a

"dangerous decline" in the morals and accountability of the military. Though their physical capabilities will be superior to human pilots and RPA's (Roblin, 2020), it is increasingly important to discuss the ethics of autonomous drone use and what standards should be used to judge their actions in order to establish a moral precedent for such technology and to garner public approval.

An effective framework for the tackling of this discussion is Risk Society (Beck, 2000). Risk society, as defined by Beck, is "the manner in which modern society organizes in response to risk". This framework is useful in understanding and analyzing the perception of autonomous drones. The main risk that the public directly faces in regard to autonomous drones is the shared sense of accountability for any unintended consequences of the use of force. This is because there is no pilot that can be reprimanded or take the responsibility, rather the system that enabled such a mistake is at fault. Civilians are quicker to disapprove of RPA's for this same reason. The risk of a mistake in the autonomous technology is present, and thus affects the perception and support.

Research Question and Methods

Research Question: Will the benefits of autonomous drones be worth the risks involved in operating them?

In order to address this research question, Ulrich Beck's Risk society framework will be applied to characterize the risks involved with a battlefield of autonomous drones. Current data on current operating UAV performance and accuracy will be used to predict the efficacy of autonomous drones. Evidence will be gathered from publications regarding the use of autonomous weapons and data published directly from the Pentagon. The ethical discussion will entail existing literature and international statutes regarding the legality of autonomous weapons.

This methodology will be adequate in tackling the research question because it will consider both the advantages and drawbacks of autonomous drones, while considering important topics such as public approval, efficacy, and legality.

Conclusion

In conclusion, the goal of the technical project is to develop and implement a solution to illegal truck parking on exit ramps and rest stops on fre ight corridors. This solution must be unintrusive, in order to abide by state regulations, and must disseminate information efficiently to freight truck drivers. The deliverables of this project will include a detailed report on the problem and the team's planned solution and will be presented to the representatives at MITRE. If implemented well, the team's solution to the truck parking problem will reduce the amount of illegal freight truck parking and roadway incidents involving freight trucks due to poor parking or exhausted drivers. The research paper is anticipated to provide the reader a new perspective on the use of autonomous drones on the battlefield. It is not intended to inspire any new regulations on the use of autonomous drones, rather educate on the statistics regarding current UAV operation and the potential benefits and drawbacks of autonomous drones moving forward.

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