1. PROBLEM

1.1 Historical Introduction

"World War I saw the development and testing of radio-controlled, unmanned aircraft began but none emerged from the testing phase in time to be used before the war ended" [1]. In the 1930's, the British Royal Navy developed a radio-controlled Unmanned Aerial Vehicle (UAV) dubbed the Queen Bee [1]. It could reach speeds of 100 mph but instead of using it offensively, it was used for aerial target practice [1]. "During World War II, [the] Nazis developed an UAV to be used against nonmilitary targets" named Revenge Weapon I (also known as the V-1) [1]. It was an unmanned flying bomb that could reach speeds of almost 500 mph and carry 2,000 pounds of explosives [1].

In the 1960s and 1970s, the United States used UAVs for surveillance in military missions [1]. In the late 1970s and 1980s, Israel developed the Scout and the Pioneer. The U.S. acquired the Pioneer and used it in the Gulf War [1]. These two UAVs used lighter materials and were smaller in size, which made them inexpensive to make [1]. The Department of Defense (DOD) spent more than $3 billion in UAV research in the 1990's, and the UAV now plays a major role in the military [1].

1.2 Market and Competitive Product Analysis

The market to develop and use UAVs as a delivery service started in 2011, when a company called Matternet released a design capable of inexpensively delivering one kilogram payloads [2]. Under current FAA regulations, commercial use of UAVs in the United States is illegal unless a permit is granted; revisions to these regulations are set to be announced in September 2015 [3]. Other countries have fewer restrictions and a number of businesses are already using them in daily operations.

Matternet and DHL are the only companies that have a delivery UAV in service. Both use an UAV with four motors (quadcopter) to deliver packages to rural areas with limited access and can travel as far as 15 miles [4]. Matternet is set to release their first commercially available UAV in early 2015, price will range from $2,000 to $5,000 [4]. Currently, Matternet UAVs operate in New Guinea, Germany, and Bhutan, while DHL operates only in Germany [2]. Google and Amazon also have delivery UAVs, but they are only in the testing phase. Google's UAV uses a fixed wing setup that has two motors and Amazon's UAV uses a six motor setup (hexacopter). All of these companies' UAVs use autonomous flight guided by GPS.

The name of the UAV for this project is Air Mail. It uses a six motor setup similar to Amazon. While Amazon plans to create a large network of delivery UAVs to deliver their orders from their distribution centers, Air Mail is a delivery solution for local businesses, local health care suppliers, or relief aid organizations that have a need to deliver small packages up to one mile. In regards to safety, Air Mail has a built in manual override system, where a pilot on the ground can take control of the UAV via a computer based control station. In comparison to Matternet, Air Mail will be available at a fraction of the cost.

1.3 Concise Problem Statement

An efficient implementation of a delivery UAV will greatly change how parcels are delivered. Due to increases in population, roads are becoming more crowded, which is why more concise means of transportation are being sought. The ability to deliver a payload via the air even over short distances could greatly impact many aspects of modern day life. For instance, being able to directly transport critical medical supplies faster to a specific location can save lives. The development and utilization of this design is a step forward in modern convenience and business standards.

Despite many businesses having the availability of delivery options, the convenience of a purchase can still be improved by faster delivery times. If Air Mail can deliver products directly to the customer, service could be provided faster. With our UAV implementation, businesses will be able to transport up to a 450 gram payload over the distance of a mile, thus covering 3.14 square miles. Even if a UAV flies over the same route a delivery vehicle would, the reduction in transit time would make a large difference in delivery time. Having the availability of quick deliveries provides extra incentive for a customer to order through local businesses rather than a cheaper major chain.

Air Mail will be able to quickly make deliveries and provide an added layer of convenience for small businesses. Air Mail, instead of focusing on long large-scale flights like its competitors, will be the cheap solution for businesses looking to move merchandise around cities. Since it will provides easy-to-program destinations and tracking capabilities, Air Mail will offer its customers the satisfaction of quicker deliveries.

1.4 Implications of Success

The Air Mail prototype will be capable of delivering a 450 gram payload up to one mile from the takeoff location. However, the instrumentation used to control the vehicle could be implemented on a larger UAV to allow for a heavier payload and a longer flight distance. A number of companies could benefit from having this type of delivery system. Businesses such as restaurants delivering food orders, pharmacies delivering a patient's monthly medication, and local businesses trying to compete with their online counterparts could offer their customers deliveries directly from their business to the customer's door.

Air Mail will be easy to use, and anyone with a mild level of training could perform operations. This will be a great benefit for businesses by not requiring them to hire additional on-site staff. However, this could negatively impact the job market for businesses that currently employ people to run deliveries. While the company that operates the UAV on a daily basis will not need to hire an on-site technician for maintenance, a certain level of maintenance will have to be performed on the UAV. The UAV will have mechanical parts that will need to be inspected on a regular basis to ensure the operations will continue to run smoothly. This could lead to new start-up companies to build and perform maintenance on the UAVs, which would create new job opportunities.

Autonomous delivery can also aid in times of disaster or areas of the world that are not

developed. Many times, when a disaster happens, it can be difficult to transport goods to the people affected. Air Mail could be used to deliver items such as first aid supplies to areas with limited access. According to isi-web.org, there are 137 developing countries in the world [4]. Most of these countries have a poor commuting infrastructure and could benefit by using Air Mail to deliver much needed supplies to areas that could otherwise be inaccessible.

7. REFERENCES

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