1. PROBLEM

1.1 Historical Introduction

During WWI, “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. It could reach speeds of 100 mph but instead of using it offensively, it was used for aerial target practice [1]. “During WWII, [the] Nazis developed a UAV to be used against nonmilitary targets” named Revenge Weapon I [1]. It was an unmanned flying bomb that could reach speeds of almost 500 mph and carry 2,000 pounds of explosives.

“In the 1960's and 1970's, the United States flew more than 34,000 surveillance flights using the AQM-34 Ryan Firebee, a UAV launched from a host plane and controlled by operators within that plane” [1]. “The U.S. also employed UAV's called Lightning Bugs that were released from airborne C-130s for missions over China and Vietnam” [1]. In the late 1970's and 1980's, 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 spent more than $3 billion in UAV research in the 1990’s and now play a major role in the military [1].

Despite their military role and background, UAV's provide enjoyment for hobbyists and are also starting to be used in the workforce. The area of use of UAV's is diverse and can range from delivering a package to search and rescue missions. The use of an UAV would provide faster transportation for not only a package as simple as a letter or a toy, but would also provide faster transportation for medical supplies.

1.2 Market and Competitive Product Analysis

The market to develop and use UAV’s as a delivery service started back in 2011, when a company called Matternet released their design. Under current FAA regulations, commercial use of UAVs in the United States is illegal unless permit is granted. Revisions to these regulations are set to be announced in September 2015 [2]. Other countries have less restrictions and a number of business are already using them in daily operations.

Matternet and DHL are the only companies that have a delivery UAV in duty. They both are using a UAV with 4 motors (quadcopter) to deliver packages in rural areas with limited access and can travel as far as 15 miles [3]. Matternet is set to release their first commercially available UAV in early 2015 [3]. The price will range from $2,000 to $5,000 [3]. Currently, Matternet UAV's operate in New Guinea, Germany, and Bhutan, while DHL operates only in Germany [3]. Conversely, Google and Amazon are currently in the testing phase for their UAVs. Google’s UAV uses a fixed wing setup with 2 motors. Our UAV is called Air Mail. Amazon is the only company that resembles Air Mail by using a UAV with 6 motors (hexacopter).

While Amazon plans to create a large network of delivery UAV's to deliver their orders from their distribution centers, Air Mail is more of a small scale delivery solution for local businesses, local health care suppliers, or relief aid organizations that have a need to deliver small package's 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 transmitter. In comparison to Matternet, Air Mail will be available at a fraction of the cost.

1.3 Concise Problem Statement

With efficient implementation of a delivery UAV, it will greatly change how parcels and documents are delivered. Due to increases in population, roads are becoming more difficult to traverse, which is why easier and faster means of transportation are being sought after. Being able 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 can save lives. Having direct delivery routes will also reduce fossil fuel consumption by having less delivery vehicles in route, or provide shorter routes for the ones in route. Development of this design and it's utilization is a step forward in modern convenience and practicality.

Although a person can get delivery on most anything ordered in the modern day, there is still an inconvenience to this convenience! Ordering food still can take upwards of 30 minutes to reach the desired location, depending on traffic conditions or cooking length. If UAV's could fly a take out order to a customers door, or a business can deliver products directly to the customer, traffic would be less congested on roads for individuals commutes, and service would be provided much 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 of territory. Even if a UAV flies the same route a delivery vehicle would the difference in avoided stoplights would make a large difference in commute time, and might even provide warmer food.

Our Air Mail design will be able to solve these problems and provide an added layer of convince for small business than other competitors. Air Mail, instead of focusing on long large-scale flights like it's competitors, will be the cheap go-to accommodation for businesses looking to move merchandise around cities. Providing easy to program destinations and tracking capabilities, Air Mail will make for fierce desirability in increasing sale speeds.

1.4 Implications of Success

Since a product like this does not currently exist on the open market, 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, even local business trying to compete with there online counterparts could offer their customers deliveries directly from there business to the customers door.

Air Mail will be very user friendly so someone with a mild level of training could preform operations. This will be a great benefit for businesses not having to hire additional on-site staff. However, this could negatively impact the job market for businesses who currently employ people to run deliveries to their customers. 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 done on the UAV. The UAV will have mechanical parts that will need to be inspected an a regular basis to ensure the operations will remain be safe. This could lead to opportunities of new companies starting up for the maintenance of the UAV's and new jobs being created by those companies.

Autonomous delivery can also aid in times of disaster or areas of the world that may not be developed. Many times when a disaster happens it can be difficult to transport goods to the people affected. The UAV delivery system could be used to deliver things like first aid supplies difficult to reach area's affected by a disaster. According to isi-web.org 70% of countries in the world "137" are currently developing [4]. Most of these countries have very poor commuting infrastructures and could greatly benefit by using a product like Air Mail to deliver much needed supplies to area's that could otherwise be inaccessible.

[1] T. Scheve. (22, July 2008). *How the MQ-9 Reaper Works* [Online].
Available: http://science.howstuffworks.com/reaper1.html

[2] J. D'onFro, "Meet The Startup That's Using Drones To Change The World" Business Insider Accessed: January 25, 2015. Avaliable: http://www.businessinsider.com/matternet-uav-delivery-drones-2014-11#ixzz3Ptxon9Cv

[3] "FAA grants drone exemptions following report U.S. is lagging worldwide" *CBSNEWS* Accessed: February 3, 2015. Available at: http://www.cbsnews.com/news/faa-grants-drone-exemptions-following-report-u-s-is-lagging-worldwide/

[4] "Developing Countries" Retrieved: January, 2014 Avalable:
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