**Intellitune**

**1. Problem Statement**

**1.1 Historical Introduction**

Ham radio history dates back to the discovery of electromagnetic waves. In 1894, just six years after electromagnetic waves were proven to exist by Heinrich Hertz, Guglielmo Marconi produced the first successful radio transmission, opening the door for the amateur radio operator. In the beginning, ham operators could communicate with as little as a bundle of chicken wire, but some crude methods like the spark-transistor lead to problems such as interference with commercial and government. This led to development of regulation by the federal government. Regulation stunted the growth of ham radios, but did not stop it. By 1912, ham radios were capable of reaching one hundred miles. As progress came, so did more regulation. In 1912, they also limited ham radio wavelength to 200 m and required a permit in an attempt to discourage use. The creation of the tube operated regenerative receiver in 1913 furthered developments, but was short lived as WWI started shortly after. Ham radio continued to endure, and in 1924, the first trans-Atlantic transmission was produced between England and New Zealand using a 110 m wavelength proving the benefits of a shorter wavelength. By the 1930’s, tube technology became more economical allowing greater growth.

As ham radio growth continued, so did the need for a way to tune out of the antenna interference caused by impedance and capacitance. This was traditionally done using a manual tuning unit which had variable capacitance and impedance to offset interference. Manual tuning became the standard until MFJ introduced an automatic tuning unit, which we will improve upon.

Even today, ham radios are still common, and have sparked interest for over one hundred years including two world wars, various moon landing, the dot com bubble, and through to the high tech world of today. MFJ has been at the forefront of the industry for over thirty years with many technological advances of their own. Our automatic tuning unit will bring a more economical and reliable product to ham radio operators as we hope to add our own contributions to the long history of ham radios.

**1.2 Market and Competitive Product Analysis**

In the United States alone, the amateur radio community is large and growing. The Federal Communications Commission’s (FCC) Universal Licensing System database reports 821,255 active ham radio licenses [1]. With this large of a community a market is present that the autotuner can satisfy. Palstar’s AT4K antenna tuner is a comparable product priced at $899 and is rated up to 2500 Watts. The Intellituner has the upper hand due to its microcontroller and lower price. Radio consumers can turn to the Intellituner for continuous automatic tuning versus manual tuning the AT4K and other tuners offer.

The Intellituner is based off of the MFJ-9982 manual tuner that employs a variable capacitor and inductor and the MFJ-998 autotuner that implements relays for impedance matching. The Intellituner takes pieces from both designs and optimizes them in a new and improved model. Saved impedance configurations for previously used frequencies will provide faster tuning speeds for autotuner users. This model will also attract radio operators that were satisfied with the previous 998 model but looking to automate the tuning process.

**1.3 Concise Problem Statement**

For years, ham radio users have been tasked with adjusting the antenna impedance manually in order to operate the radio at peak efficiency. Since this has been a manual process, it is time consuming and leaves room for human error. Our product aims to eliminate these concerns by letting technology complete the tuning process automatically.

In the past, antenna tuners have been manufactured to simplify the tuning process, but our product wishes to take this a step further. The Intellituner will read in the value of the Voltage Standing Wave Ratio (VSWR) and use stepper motors to adjust variable capacitors and inductors. Our product will also have the ability to save the locations of the motors for various frequencies for future uses. A huge advantage of this product is that it will require less maintenance on the hardware due to a more efficient design that implements fewer relays.

**1.4 Implications of Success**

Upon successful completion of our automatic tuner, it can be used as a more efficient, reliable, and effective alternative compared to what is already out there. Some ham users in the past might have been reluctant to buy an auto tuner because of the unreliability (did not want to service annually/biennially) and opt for the reliable manual one, but our product will be able to meet the needs of those looking for a product they can count on. Our product shares its base tuning components with that of the manual tuner which have proven to last. These parts also allow for a better “tune” because of the variability they have. Our design allows for more specific tuning control.

Our product will not necessarily bring any new consumers into the market, because it is not a product that has changed the landscape of ham radios. However, our product improves the function of the ham radio. By offering an all-around better product, it will be able to attract those ham users that are hesitant to spend money on a product unless it is guaranteed to last and simplify their tuning process. Some operators may not have bought an auto tuner at all due to the headache of the manual tuner and their uncertainty of the products abilities. These operators will see a new product with a competitive price which will hopefully give them confidence to make the leap to that next piece of equipment. We hope that the improvements implemented in our design will attract the consumer to purchase our product.

The Intellituner will be a positive advancement in the ham radio community. With the continuous rise in ham radio popularity, the Intellituner can be turned to by consumers looking to save their time and money. In emergency situations or natural disasters where no electricity or internet is available, amateur radios provide effective communication for the individuals involved. Our product can be utilized in these situations with its assured performance. For users with ham radios as their hobby, the Intellituner will ease operation and make the radio experience more enjoyable.

Reference:

[1] wireless2.fcc.gov. (2018). License Search - Amateur License Search. [online] Available at: http://wireless2.fcc.gov/UlsApp/UlsSearch/searchAmateur.jsp [Accessed 29 Aug. 2018].

J. Maxwell, “Amature Radio: 100 Years of Discovery,” ARRL: The National Association of Amateur radio, 01-Jan-2000. [Online]. Available: http://www.arrl.org/files/file/About ARRL/Ham\_Radio\_100\_Years.pdf. [Accessed: 27-Aug-2018].