

## **1. Problem Statement**

### **1.1 Historical Introduction**

The game of golf can be traced back to the middle ages. It began with simple wooden clubs and leather balls in Scotland, and spread internationally through Great Britain's colonial conquests [5]. Through the 1900s, golf became a household sport and its players began wielding advanced equipment because of the increasing interest and subsequent innovation. In addition, the thirst for improvement was pervasive, evidenced by some of the earliest film showcasing golf experts and their swings. Clearly, players have an innate drive to improve their performance and are even willing to invest money for an advantage on the course.

Analysis of the golf swing has improved dramatically over the past few decades. As early as 1985, kinesiologists were able to analyze their subjects' swings using a combination of phase-locked cameras and digital algorithms to determine the torque on the golfer's joints [1]. Much more recently, the explosion of small, inexpensive, solid-state electronics has brought swing analysis technology out of the research lab and into the average user's hands.

Modern data analytics and smartphone technology continue to revolutionize golf. Today's golfers can receive personalized on-course training and information through smartphone apps. Bluetooth sensors measure acceleration and position data during a swing, relaying the position data of a swing wirelessly to the app. The golf glove aims to increase the accuracy of recorded swing data by including additional sensors to measure hand movement, providing an even higher resolution dataset to provide feedback on.

### **1.2 Market and Competitive Product Analysis**

The golf glove is marketed towards tech-savvy golfers that may not always have enough money to afford a coach and is designed to be a cost effective alternative to gathering information on one's golf technique. On average, golfers spend \$2,776 annually on golfing related expenses [2]. The golf glove is specifically marketed at enthusiasts that want to improve their swing. Comparatively, driving ranges such as Top Golf service millions of new members every year and have become one of the largest driving range chains in the country. With an average customer spending rate of \$35 per visit, the golf glove could be integrated with a system such as Top Golf's to give visitors "on-the-fly" tips and techniques on their swing [3]. Patrons could rent the glove for a small fee and use it during their visit.

There exists on the market several other systems that can track a player's hand and club movement, but none that track wrist movement and grip pressure. The Garmin TruSwing and Skypro both cost \$150, clip onto a golfer's club and track club movement through the use of accelerometers and gyroscopes. Other systems involve screwing in sensors to the top of a golfer's club, and cost around \$16 per sensor [4]. These systems only focus on a golfer's club movement using a club-mounted gyroscope and accelerometer; they ignore important biomechanical data. The golf glove is designed to offer more useful data at or below the price point of these inferior systems on the market. Rather than solely tracking the golf club, the golf glove integrates flexible sensors that track biomechanical data of wrist inflection, rotation, and grip pressure. Additionally, the golf glove is designed to reduce the risk of wrist and elbow

injuries by encouraging proper swing technique through data feedback.

### **1.3 Concise Problem Statement**

The golf swing training tools that are currently on the market are either prohibitively expensive or only focus on club movement. Meanwhile, a professional coaching session may look at club movement, but these sessions are similarly expensive and also temporary.

The golf glove is designed to be an affordable and lasting solution to these issues. Utilizing an array of sensors including an accelerometer, a gyroscope, a pressure sensor, and resistive stretch fabrics, the glove will track the hand and arm biomechanics that control the golf swing. The data that these sensors collect will be analyzed and used to give training feedback to the user. Essentially, instead of showing the user their symptom that is poor club movement, our product will show the user the root cause of their swing problems: poor biomechanics. The golf glove is a wireless system that can be paired to any smart device or computer using a downloadable application.

### **1.4 Implications of Success**

The golf glove provides golfers with a training tool to track and analyze their swing at an affordable price. It unlocks the benefits of data-driven training for a significant population. The data captured and analyzed by the device provides feedback to the user, helping them to understand the flaws in their swing. Correcting these flaws will improve the user's golf swing and bring consistency to their overall golf game.

Additionally, the golf glove has applications in the professional market where it can assist swing coaches in their craft. Specifically, the golf glove makes benchmarking and tracking player improvement a breeze by attaching raw data to a swing. The precision of the device will also help swing coaches locate small inconsistencies in a player's swing that otherwise might be overlooked.

The functionality that the golf glove provides has the ability to revolutionize golf swing training. By collecting swing data and evaluating it for form correctness, the golf glove can suggest improvements to the golfer. Taking this training feedback into account, a golfer is able to take steps to improve their swing mechanics. By consistently strike the ball with proper mechanics, they will also be able to consistently record respectable, and thus enjoyable, rounds of golf. More enjoyable golf rounds results in both more golf being played and a greater chance that the player introduces the sport or our product to a non-golfer. As a result, the sport and market will grow.

## References

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