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SMART TENNIS RACQUET WITH TENNIS ELBOW INJURY PREVENTION

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Abstract:

This project will help beginning tennis players learn how to swing and hit a tennis ball in the right spot. This smart tennis racquet will provide tennis players feedback in a friendly, easy-to-understand way in order to allow them to improve on their swing. Ideally this training tool could also be added to any existing racquet during restringing. We will accomplish this by placing an embedded controller on a tennis racquet that measures that measures the pressure differential between strings during a hit in order to locate the hit and notify the player what part of the racquet was hit. Learning the proper swing to hit the sweet spot of the tennis racquet is very challenging. It is difficult to measure why a hit was good or bad. Our enhanced tennis racquet will make the learning process a little easier for all new tennis players. Wearables find in sports one of their main applications. In recent years, many wearable devices have been commercially released such as the Babolat Play or Sony Smart Tennis Sensor that detect and classify different types of tennis shots and provide a performance analysis to the player. In tennis the injury risk was fairly similar for males and females; the older age groups were affected more often and indoor tennis was related to a higher incidence of injuries in comparison to outdoor tennis.

Introduction:

The Learning the proper swing to hit the sweet spot of the tennis racquet is very challenging. It is difficult to measure why a hit was good or bad. Our enhanced tennis racquet will make the learning process a little easier for all new tennis players. Wearable find in sports one of their main applications. In recent years, many wearable devices have been commercially released such as the Babolat Play or Sony Smart Tennis Sensor that detect and classify different types of tennis shots and provide a performance analysis to the player.
Overrecentyearsdramaticevolutionoftennisracquetdesignhasleadtoanincrease in game speed that resulted in increased physical forces being imparted on the player. These increased forces are thought to have given rise to increases in the development and aggravation of injuries. The most common injuries are those that involve the player's upper extremities, and are believed to come primarily as a result of the forces transmitted to the player during racquet-ball impact.

The most common injury resulting from such impact forces is lateral epicondylitis (tennis elbow). Tennis elbow is not the only upper extremity injury encountered by players, but with tennis elbow affecting 40-50% of recreational players 7, the injury inhibit player performance on a large scale. Recent surveys have shown that 55.6% of recreational players occasionally suffer from symptom soft tennis elbow, and 42.2% of those injured said that tennis elbow reduced the amount of tennis they played (Sports Marketing Surveys 2003). The management of tennis elbow is therefore in high demand.

Although tennis elbow represent acute problem for Many Players the world, additional upper extremity injuries, such as wrist and shoulder strains, also affect the players. Upper extremity injuries are thought stem from the transfer of large impact forces in are positive manner, to the player via the racquet-hand interface known as the tennis grip. Injuries, such as tennis elbow, can be better managed only if the causes can be better understood. This in turn means that the transmission of racquet force to the player needs to be better understood. The impact forces transmitted to the player are in the form of impact shock and post- impact racquet vibrations. Specific stroke types, such as the backhand, allow for a greater degree of energy transfer to the player as they biomechanically isolate the susceptible forearm tendons during the stroke.

Backhand strokes require the use of wrist extensors that develop the symptoms of tennis elbow if they are over use do placed under great strain 3. The largest rain on the wrist extensor muscles and tendons arises from the transfer of energy generated by the impact. Correlations between racquet vibration levels and grip pressure characteristics need to be made before a comprehensive understanding of energy transfer to the player can be established. It is important that the transfer mechanics be described in detail in order to gain a greater insight. The Effect of racquet impact forces on the player. Racquet design can evolve based on the understanding of the racquet-hand interface mechanics, which affect the racquet's dynamic behaviour.

Optimisation of racquet design currently focuses on the in here structural properties such as mass distribution, stiffness and additional damping materials. However, the dynamic properties of the racquet (i.e. natural frequencies etc.) will not be the same under the hand-held conditions during a match. Extra mass is added in the hand-held racquet in the form of the hand as it becomes part of the system. This added mass will alter the dynamic response of the racquet, in terms of natural frequencies and vibration damping. Therefore optimisation of racquet design (in terms of vibration attenuation) can only be achieved by incorporating the effects of the hand, with respect to its damping mechanics

Methodology:

The main objective of the modal analysis was to as certain the mode shapes, natural frequencies and damping coefficient soft he two racquets in the frequency range is 0. In addition to identifying these key modes of oscillation, the influence of the tennis strings on the dynamic response of the racquet was included in the modal analysis. The test racquets used (A & B) were analysed both with and without strings to identify mode which were inherent to the racquet frame and those that area cause of string effects. The testing factors regarding the choice of both them ethodof excitation and the use of transducer shave been taken into consideration in the design of the test procedure for determining the inherent dynamic properties of the tennis racquet an impact hammer be used with a uniaxial lightweight accelerometer in conjunction with a freely suspended racquet to determine the inherent dynamic properties of the tennis racquet. The laser scanning vibrometer could not be utilised for measuring the response because rigid body motion of a freely suspended racquet (i.e. the racquet does not remain in a stationary enough position for the laser to measure the response). Impact tests reduce the magnitude of mass loading associated with the attachment of excitation shakers to the structure. A roving impact hammer excitation/fixed response logic was also used in the modal analysis to avoid changes in mass distribution. Over the structure brought about by relocating the accelerometer for each measurement[4].

Result:

Final images of smart tennis racquet and waveform of each sensors.force sensors are placed in three dimension. Bluetooth model is fixed in the handle of the racquet to transfer the output waveforms to the mobile app and vibration sensor is fixed in the griping handle to sens the vibration of the racquet

Table 1: Final image of smart tennis racquet

- ✓ String Force Sensor Waveform
- ✓ Vibration Sensor Waveform
- ✓ Handle Force Sensor Waveform

Professional players has been indulged in the testing mode get the desired output and waveforms.Some players had played in the middling format in hiogh profession and some intermediate players plays in some rough and non middled spots .itys shows the risk of tennis elbow injury but professional players practicing hard to middle the ball in sweatspot to avoid tennis elbow injuries. Waveforms will clearly shows the sweatspot and injuries risk.

Table 2: Grip vibration sensor waveform of professional player

Middling the ball in sweatspot

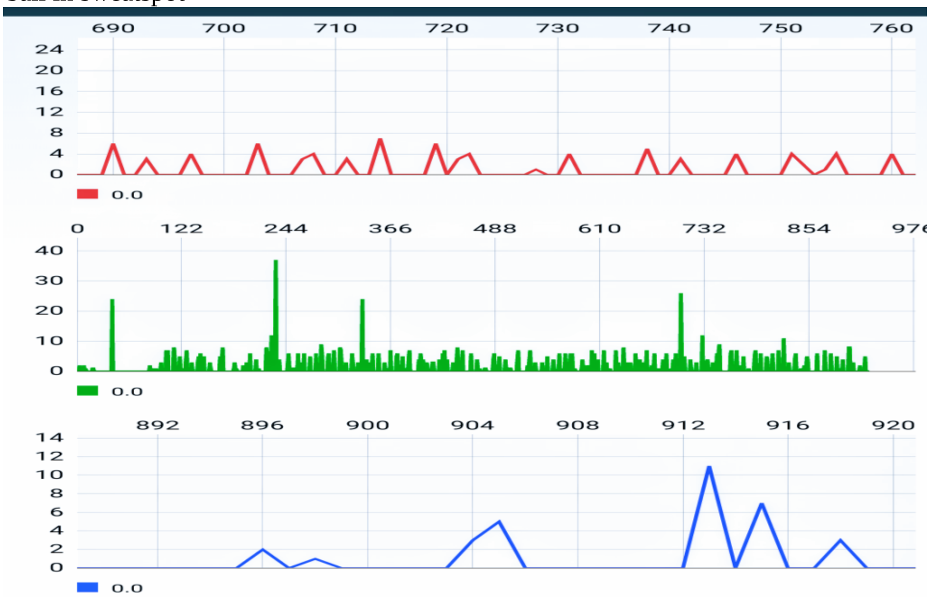

Table 3: handle force sensor waveform of professional player middling the ball

Table 4: String force sensor waveform of professional player

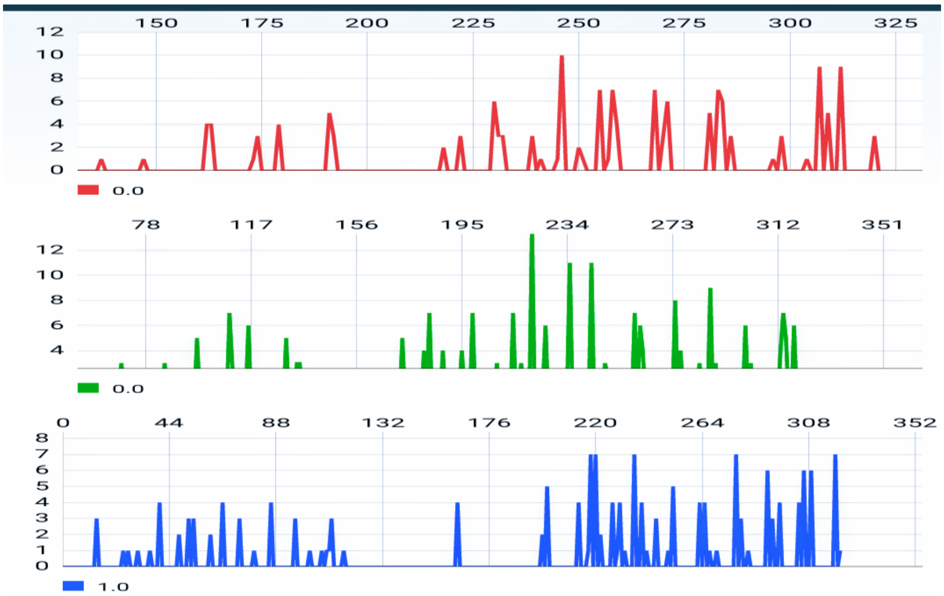

Figure 5: Grip vibration sensor waveform of intermediate player

Non-Middling the ball in sweatspot

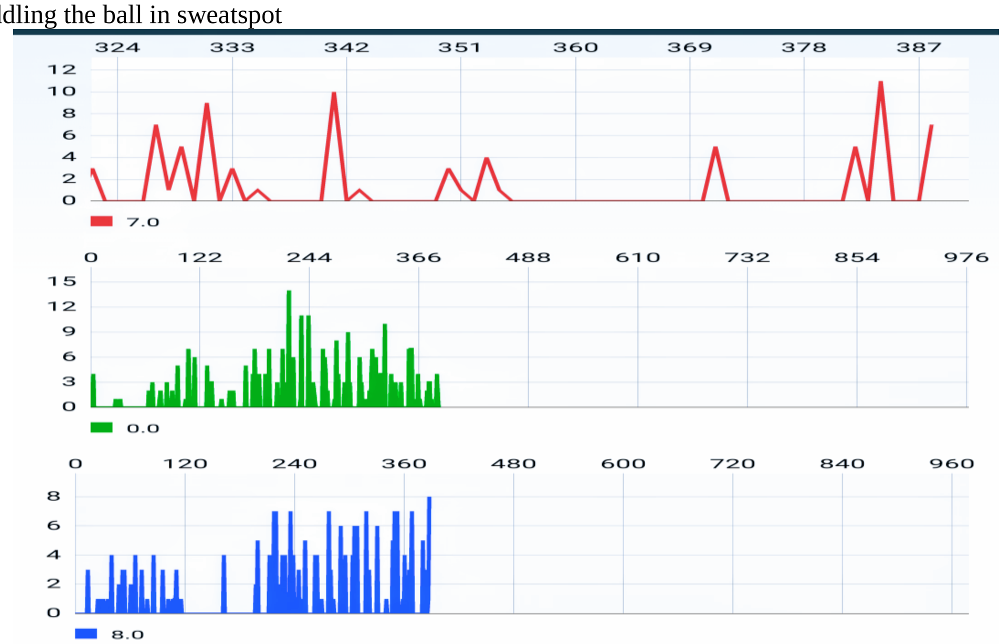

Figure 6: String force sensor waveform of intermiediate players non-middling the ball

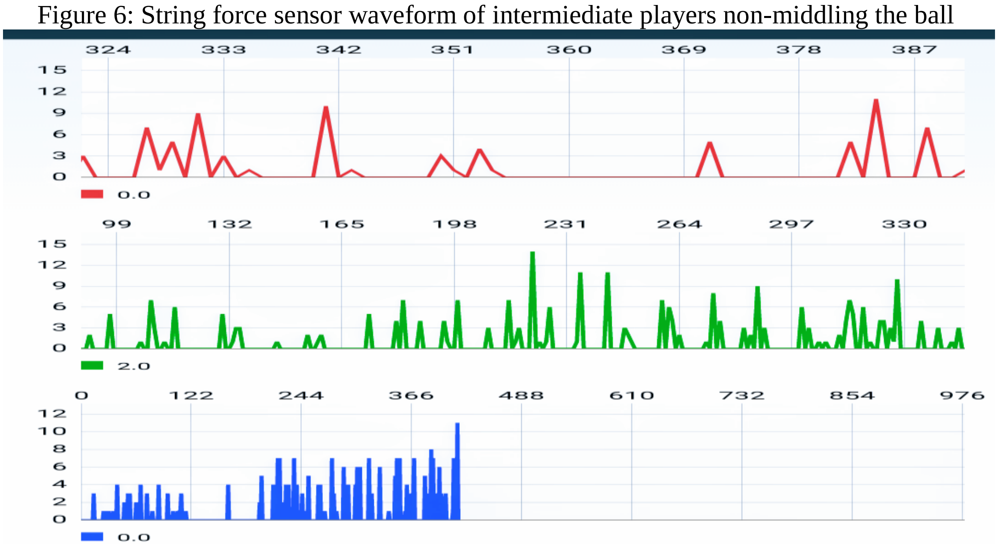

Figure 7: Handle force sensor waveform of intermediate players non-middling the ball

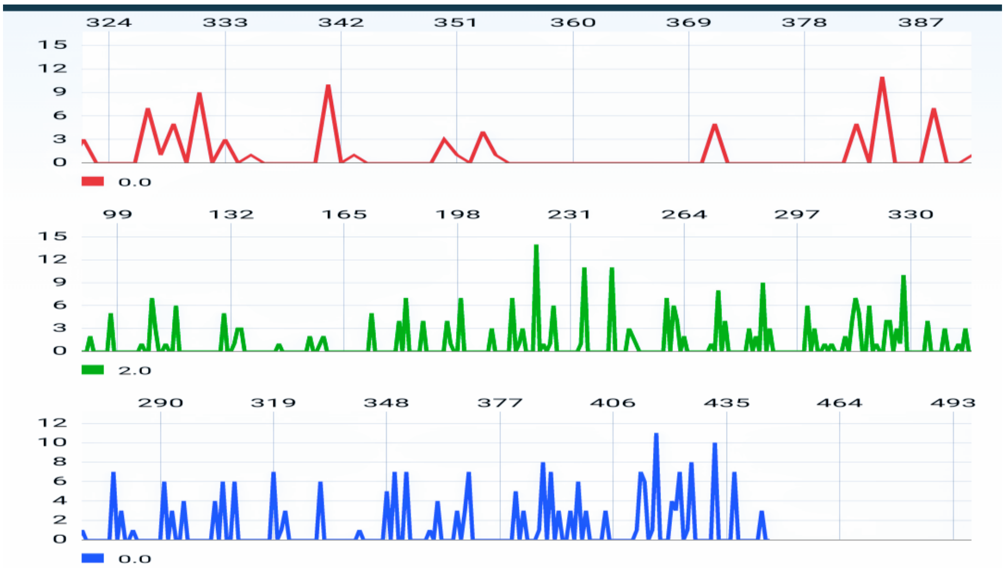

Figure 8: Tennis elbow injury risk happens to intermediate player because of handle and grip pressure and force

Conclusion:

This project will help beginning tennis players learn how to swing and hit a tennis ball in the right spot. This smart tennis racquet will provide tennis players feedback in a friendly, easy-to-understand way in order to allow them to improve on their swing. Ideally this training tool could also be added to any existing racquet during restringing. We will accomplish this by placing an embedded controller on a tennis racquet that measures that measures the pressure differential between strings during a hit in order to locate the hit and notify the player what part of the racquet was hit. Research into the biomechanics of the player's arm, hand and wrist during impact to gather with muscle behaviour is essential if contributing factors to tennis elbow injuries are to be reduced. The racquet-hand system with respect to racquet vibrations has been investigated in this research; however the biomechanics of the lower arm needs to be considered as well in order to determine the effects of shock and vibration transfer on the player.

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