Best Ball

Team C3: Christopher Hess, Seaver Dahlgren, Erik Feldmann
18-500 Capstone Design, Spring 2023
Electrical and Computer Engineering Department
Carnegie Mellon University

Product Pitch

Best ball is the solution golfers have been looking for to analyze their putting ability. Our system will help analyze your putting **stroke** and **accuracy** from various distances on the putting green.

To achieve this, we have required our system to be accurate within 3cm of true distance to the center of the hole, within **10 rpm of true ball spin**, and to classify putting strokes as accelerating, decelerating, or constant through the ball with **97% accuracy**.

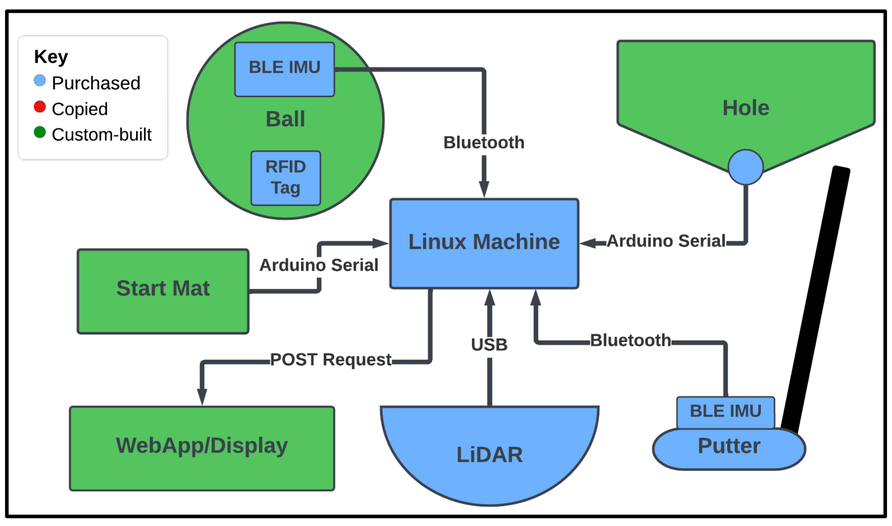
In testing we found putter stroke classification and ball speed to fall within our requirements, however, our system has up to a **4.2cm error** in distance measurement.

Overall, we found our system to be a **success** and hope you enjoy trying it out yourself!

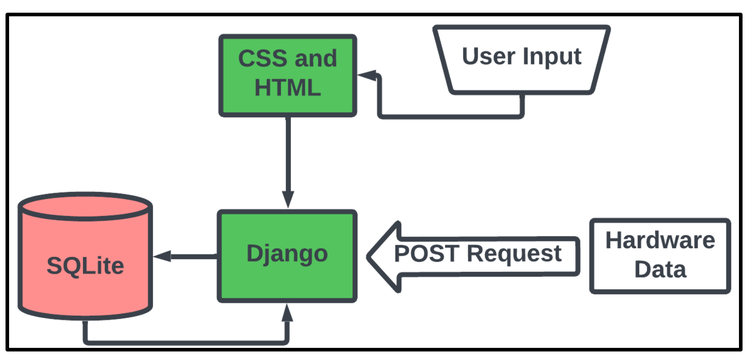
System Architecture

Our system is composed of 5 hardware components and 1 software component. For hardware, our ball consists of an IMU to measure ball spin and speed and an RFID tag. The IMU computes the spin rate of the ball and transmits it in real-time via Bluetooth to the Linux machine which forwards that data to the web app. The tag allows our software to uniquely identify each player and which ball they are using to track the score. The hole is a regulation-sized golf hole retrofitted with a pressure sensor to detect when a putt is made.

The LiDAR sensor is used to track the ball's location relaying the distance to hole measurement to the web app. Finally, the putter has a similar IMU to the ball mounted on the top of the club head. This IMU is used to track the acceleration of the putter through impact with the ball.



Our software stack consists of a custom Python Django backend connected to an SQLite database along with a custom frontend designed in HTML and CSS. Users are prompted to enter their names when beginning a round and that data is stored in the database. Any incoming data from the hardware is sent through either a USB, serial, or Bluetooth channel to our Linux machine. The Linux machine then generates POST requests to specific endpoints configured within the web app to allow for seamless data transfer.

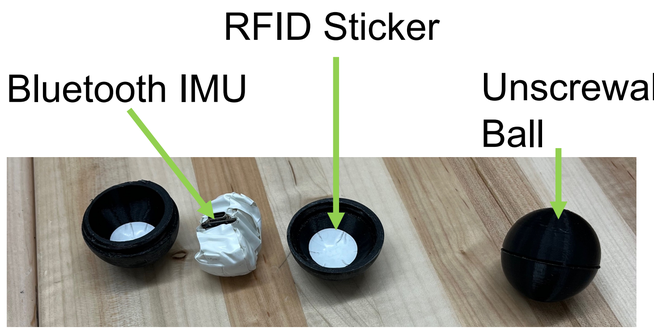


System Description

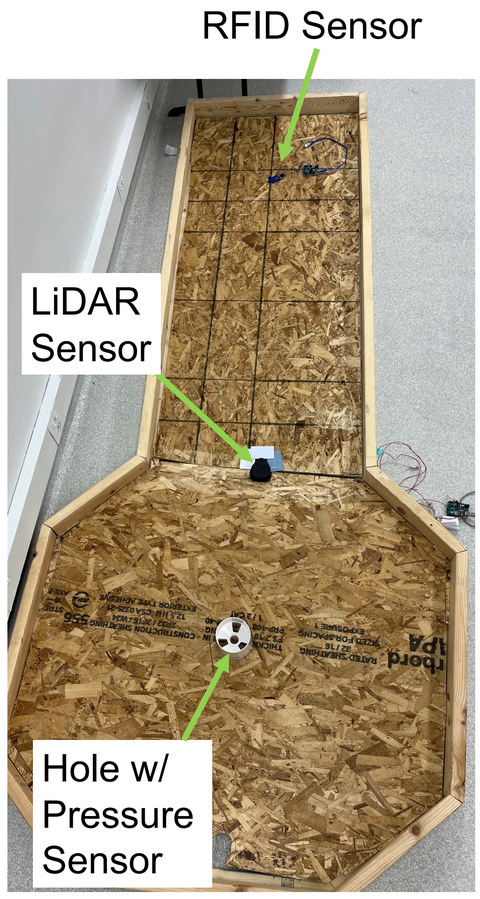
Our system has three main divisions: the custom balls, the putters, and the custom course. For each ball, we printed a 3D ball that can be unscrewed. In each ball, we have two RFID sticker tags, and our Bluetooth-connected IMU. The RFID tags are used at the start of the game to uniquely identify each ball. The IMU tracks the acceleration and speed of the ball and sends it via Bluetooth to the Linux Machine. We have also fastened the chip with a battery and padding to ensure that the ball remains durable.

We designed and built the course ourselves. The start of the course contains an RFID sensor which identifies, which ball is being hit. In the center of the course, we stationed our LiDAR sensor to track the real-time locations of all the balls on the course. Lastly, we added a pressure sensor to the golf cup to indicate when the ball has been sunk in the hole.

Lastly, each club is also fastened with an IMU to track club angle and acceleration throughout a player's swing.



3D Printed Ball



Custom Hole

System Evaluation

Metric	Test	Specification
Distance from Ball to Hole	Ball placed randomly 20 times. Compare distance measurements.	Within 3 centimeters of true distance
Club Acceleration Test	Swing club at constant, accelerating, and decelerating through the ball.	Correctly states accelerating, decelerating, or constant
Club Angle Test	Calibrate club at angle 0 degrees and rotate club	Correctly calculate change within 10 degrees
Ball Metrics Test	Roll ball on path while filming to verify speed and spin metrics.	Within 15 RPM of true spin
Durability + Battery Test	Drop ball with components from hip height to floor 50 times.	Ball tests still pass 100% of time and battery lasts 1 hr

Additional Information

VISIT WEBAPP

http://sman101.pythonanywhere.com/