



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Grant J. Gallagher	Project Number J0408
Project Title Modification of a Ball Machine to Better Approximate a Human Tennis Swing by Providing a Visual Cue	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this study is to determine if visual cues help the interaction between humans and machines.</p> <p>Methods/Materials Solar cell, headlamp, microcontroller (Arduino), circuit breadboard, laptop computer, light emitting diodes (LEDs), resistor, speaker, wires, potentiometer, Legos, ball machine, tennis balls, plastic cones, and tennis player. Built a system composed of an optical system having a light source and a detector that detects when balls are shot out of the machine. Programmed the system to detect a ball being shot out of the machine, to predict when the next ball will be shot out of the machine, and to activate the LEDs just prior to the next ball being shot out. Tested tennis player to compare shot accuracy with and without LEDs being activated.</p> <p>Results I returned tennis balls shot from the ball machine both with and without the LEDs activated to determine whether a visual cue improved shot accuracy in trying to hit tennis balls into the target area. The system I built provided the visual cue required to improve my shot accuracy when trying to hit tennis balls into the target area at all speeds. The visual cue did help the interaction between the human and the machine.</p> <p>Conclusions/Discussion The results appear to indicate that a ball machine can be modified to better approximate a human tennis swing by providing a visual cue. Modifying the ball machine by attaching LEDs to alert a player just before the ball is shot out of the machine provides a visual cue similar to an opponent taking their racquet back. The results show that activating LEDs just before the ball is shot out of the ball machine does improve accuracy.</p> <p>This research demonstrates that in certain scenarios providing technology with visual cues that are normally provided by one human to another human can be helpful. Providing technology such as robotic machinery that interacts with humans with visual and/or audio cues that are typically provided by one human to another may help improve the interaction between the human and the robotic machine.</p>	
Summary Statement I constructed an optical/electronic system that provides a ball machine with a visual cue (LEDs that light up prior to a tennis ball being shot out) that improves shot accuracy of a tennis player trying to hit the tennis balls.	
Help Received I built the optical/electronic system myself under the supervision of my father. I programmed the system by myself. My father helped me debug the program, and helped me get the system to work on the faster ball machine speeds. I hit all the tennis balls, tabulated the data, and produced the graphs by myself.	