"Spider Square" Robot Final Project Report

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Abstract

Haris Godil and I spent this semester working on a robotics and computer science project in which we attempted to build a robot cable of playing the popular mobile phone game "Spider Square". The game revolves around tapping the screen to propel the player through a side-scrolling field of obstacles, and was seen as a prime candidate to apply artificial intelligence due to the simple output states: touching or not touching the screen. The project combined our experience with low-level hardware controllers and high-level artificial neural networking and computer vision. We were able to fairly accurately determine the game state with computer vision, train a basic neural network, and run various tests on our finished robot including reaction time.

1 Introduction

"Spider Square" is a side-scrolling mobile game in which the player taps the screen to swing their character to the right. The screen continually scrolls from right to left and the player's objective is to advance as far as possible without colliding with the floor, ceiling, or any obstacles that appear in the course.

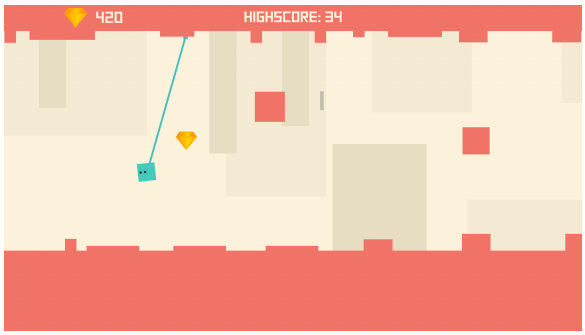

Figure 1: Spider Square screenshot

As shown in Figure 1, the blue square is the player's character, with the red floor, ceiling, and blocks represent obstacles that destroy the character and cause the game to end. The player moves the square through the level by tapping anywhere on the screen to cast the "web", a blue line drawn from the square to the ceiling that pulls the square to the right and upward, progressing through the level. The blue square's horizontal position never changes, the level moves around the player. Moving obstacles and narrower passages appear as the player progresses in the game.

The goal for this project was to create a standalone robotic controller for a mobile phone capable of capturing the phone's screen and driving the input to the game in such a way that the player progressed as far as possible without colliding with the stage.

2 Methodology

We began the project by performing general research in computer vision, artificial neural networks, camera delay metrics, and USB general purpose input-output (GPIO) controllers. For our research stage, I focused on the computer vision and web camera research while Haris opted to plan the

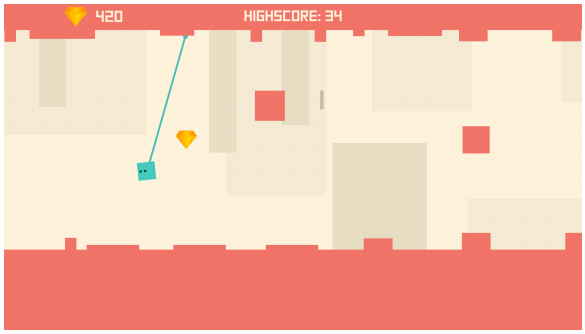

Figure 2: Spider Square screenshot

construction and wiring of the robot and begin research on artificial neural networks and evolutionary algorithms. We then constructed the robot and wrote the software to play the game, both on a real device and on an emulated one.

2.1 Hardware Setup

We used a Logitech C270 USB2.0 web camera with a resolution of 1280x720. This camera is capable of up to 30 frames per second video, for a time-between-frames of 33 milliseconds. Unfortunately the sensor is at a fixed focal distance and doesn't contain the functionaility to manually set the ISO, both of which can be overcome by sanitizing the test environment (namely turning off the lights and setting the phone's brightness to a high value).

Since image processing can be fairly intense and optimization was not a goal of this project, we opted to use a desktop machine for the processing power and a USB GPIO controller to control the stylus arm of the robot. We decided to use an Adafruit FT232H USB breakout board as it met our specifications: output a high or low voltage over USB given some trigger in either C++ or Python code. Since the GPIO pins are all digital and our servo motor runs on an analog control signal, we created a small voltage divider to step the 3.3V output to a reasonably small value, as the full 3.3V would cause the servo to move in a large arc. The final setup is pictured in Figure 2.

3 Results

4 Conclusion

5 References