Automation of Wii Play Target Identification Through OpenCV Using Robot Arm

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Executive Summary

Project:

This project utilizes a robot arm to play Wii Play Shooting Range by pointing and using the Wii Remote connected to a Raspberry Pi acting as a controller. A large computer with a discrete GPU uses computer vision to locate the targets and cursor on the screen which tells the robot arm where to point. The Raspberry Pi then activates the trigger.
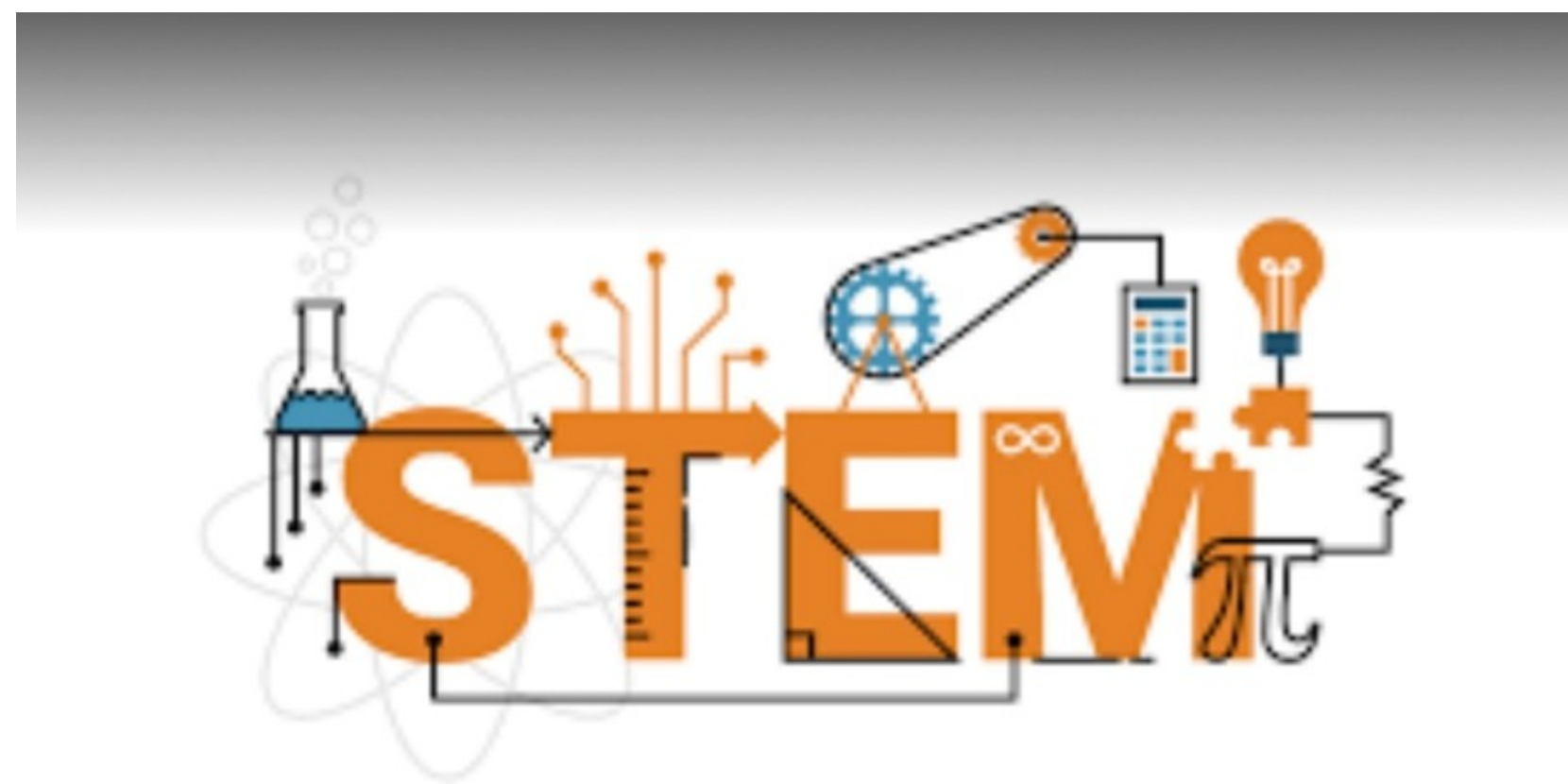
Planning:

One immense part of the project was planning. It saved a large portion of time by avoiding redundant work and improving work efficiency.

Communication:

The software used to communicate was GitHub and GroupMe. GitHub was used to keep track of code repositories and parts, whereas GroupMe was used to keep track of group members and schedule times that suited everyone's availability.

Robot

The robot arm was controlled by ROS (Robot Operating System) for the UR5 arm. The arm has 6 different axes of rotation. This is controlled by a Python script. To trigger the Wii remote, a Raspberry Pi was used. The Wii remote buttons were soldered directly to the Raspberry Pi. The Pi was controlled via SSH. The Wii remote is attached the robot arm through a custom 3d printed part made in house. The AI will sense the closest image to the cursor in the screen. The cursor will then move closer to the object by a small amount of distance until it reaches the target. It will then use SSH to command the Raspberry Pi to press the trigger.

Planning

The Wii U console sends data to the television and capture card. The computer analyzes the frames from the capture card which then commands the arm to move according the frame. It also commands the Pi to trigger when it is within range.
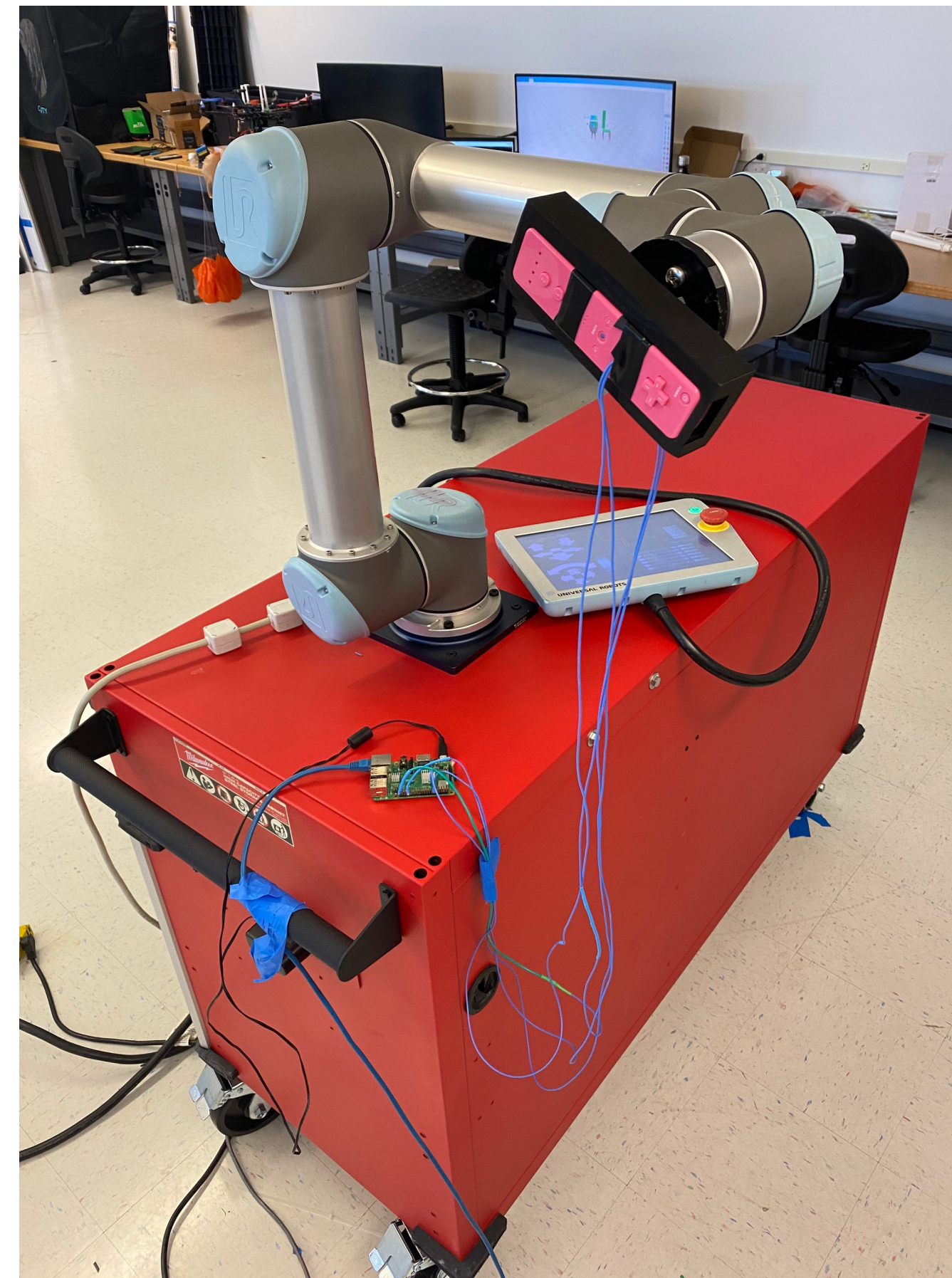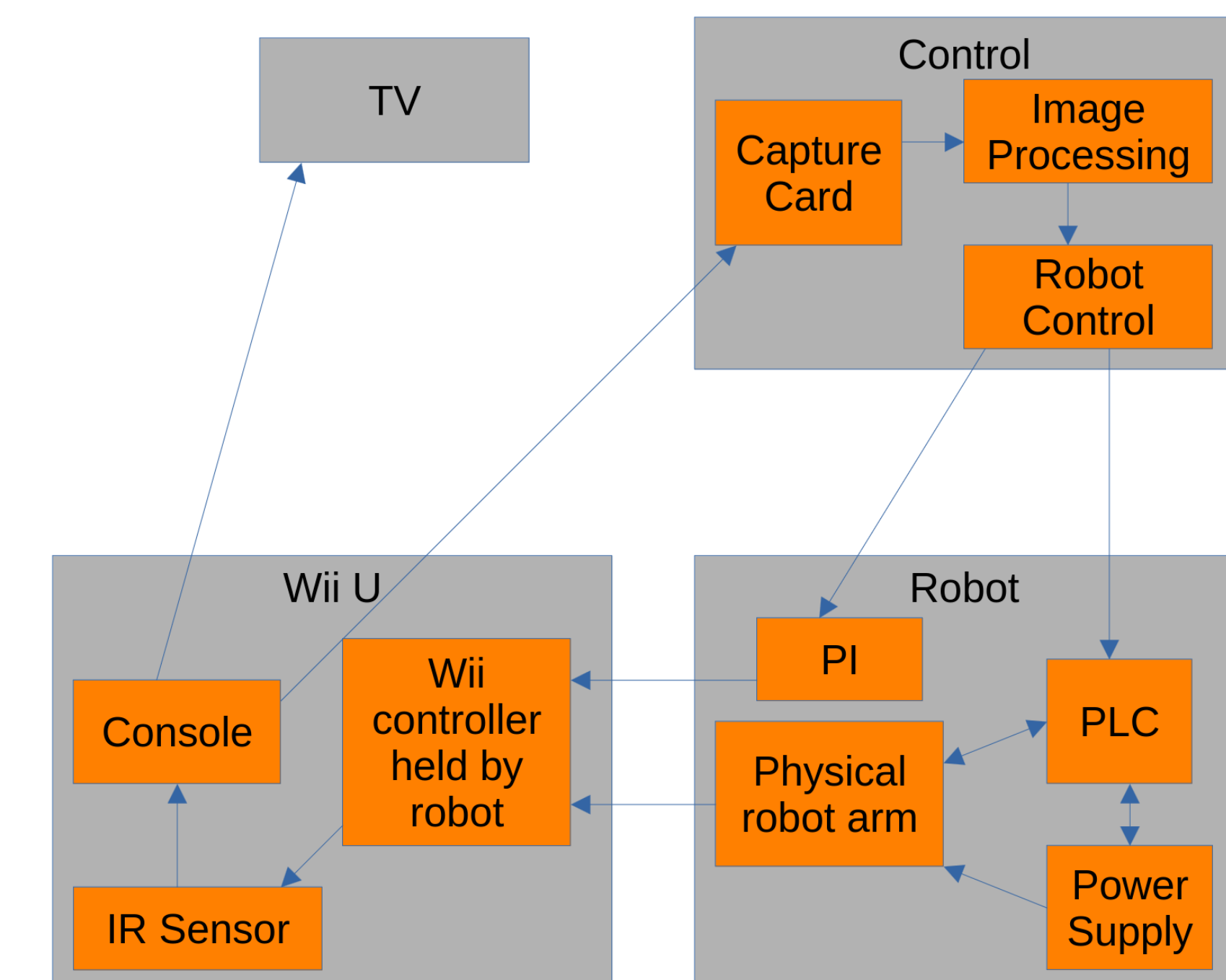

Goal

The director of senior design wanted a flashy project to encourage secondary school students to join the UTA computer engineering program. By encouraging secondary students to go to college, they can grow and help society as a whole through the research and development of science and technology. That is the mission behind this project. We decided to use a robot arm playing a video game so that it would appeal to secondary students and demonstrate the creative and fun-loving aspects of STEM.


Computer Vision

The AI uses OpenCV in Python primarily utilizing background subtraction with a secondary focus on template matching. The background subtraction is used to pick up on targets, whereas the template matching is used to initially find the Wii remote cursor. The distance from these is then calculated, and then the coordinates are sent to the robot controller in order for the robot to move the Wii remote to the desired location.

Background Subtraction

The background subtraction algorithm finds a change from the initial background

Visualization
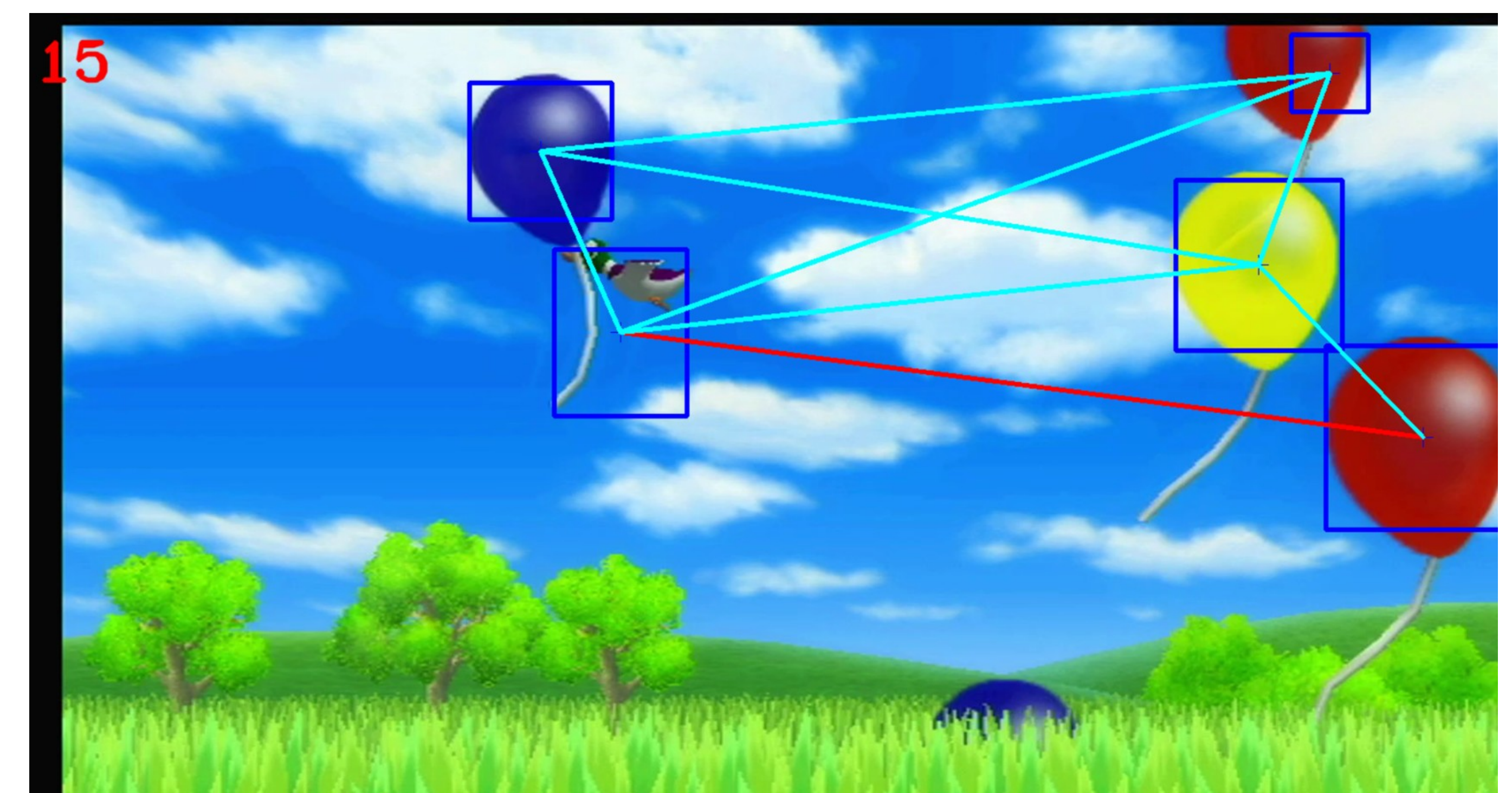
After the background subtraction is complete, the shortest distances from each target are computed and then represented.