Proposal: Octaculus - 8-way directional gesture detection using machine learning and light dependent resistors

DAN SCOTT, ADAM MCDANIEL, and LOGAN WRINKLE, University of Tennessee, USA

Light dependant resistors are a cheap substitute for detecting gestures to control devices. Lighter, cheaper and and faster than cameras or cloud-point sensors, a small array of light dependent resistors can detect 8-way directional gesture movement.

MAIN COMPONENT: Data Collection
SECONDARY COMPONENT: Feature Selection

Additional Key Words and Phrases: machine learning, gesture,

ACM Reference Format:
Dan Scott, Adam McDaniel, and Logan Wrinkle. 2022. Proposal: Octaculus - 8-way directional gesture detection using machine learning and light dependent resistors. 1, 1 (November 2022), 2 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

Traditional touchless gesture recognition uses cameras or infrared point projection sensors. Cameras introduce a possible privacy concern while both methods increase energy usage and cost. We propose a method of simple gesture recognition using a small number of LDRs to sense the direction of movement under normal light conditions. In the long term this technology could provide a smaller and cheaper method of gesture recognition which could be adapted to a multitude of user interfaces. We plan to test three different configuration of LDRs: three in a triangle shape, four in a diamond or square shape, and five in a pentagon shape. Our goal is to minimize the number of LDRs while maintaining a high prediction accuracy. Over the course of a few weeks, we'll build a device to measure gestures using a number of LDRs, train a machine learning classifier to detect the 8-way, linear direction of movement and then validate the accuracy of the model to predict those directional gestures.

2 DATA

The data for the project wholly consists of the voltages of the light dependent resistors on the measuring device. Because the measuring device is unique to the project, there aren't any existing data-sets on the subject. As a result, data will need to be collected using the measuring device once it is created. The data itself is very friendly to machine learning: the fast, periodic measurements of voltage across the light dependent resistors is directly proportional to the light received by the component. So, when someone's hand moves over the photo-receptors, it becomes very straightforward to determine the direction of the movement based on the relationships of the values reported by each of the LDRs. When a hand begins to move in a direction over the device, the sensors which read a voltage drop *first* determine the origin of the movement. When the hand passes over the device entirely, the sensors which read an electrical resistance change *last* determine where the hand moved relative to the origin. Additionally, gestures such as movement away from or towards the device can be detected by a consistent increase or drop across all of the sensors at once.

Authors' address: Dan Scott, dscott57@vols.utk.edu; Adam McDaniel, amcdan23@vols.utk.edu; Logan Wrinkle, lwrinkle@vols.utk.edu, University of Tennessee, Knoxville, TN, USA.

XXXX-XXXX/2022/11-ART $15.00
https://doi.org/10.1145/nnnnnnn.nnnnnnn

3 PROPOSED METHODS

For each of the different configurations of light dependent resistors on the device, the machine learning model will look very similar: every case is still a classification problem.

(1) First, the measuring device will consist of three LDRs in a triangle shape. This device will likely not be able to accurately predict all of the 8-way directions due to the simplification of the problem into three voltage values. Likely, though, the device will be very successful at cardinal directions, and some of the diagonal directions as well.
(2) Second, the measuring device will consist of four LDRs in a diamond shape. This will make the device symmetrical across both the X and Y axes, which would allow the model a better understanding of how the user's hand is moving relative to the plane.
(3) Finally, the measuring device will consist of five LDRs in a pentagon shape. The LDRs will not be symmetric across the X and Y axes, but the model will have more information to base predictions on, and perhaps a better accuracy.

The data will be collected by recording LDR values from the device while performing the desired hand gestures to be predicted. For each of the approaches above, the data will be labeled by the hand gesture performed during the recording. Then, the data and the labels will be fed to a classification models like support vector classifier to learn the 8 linear directions: left, right, up, down, and the four diagonals.

4 EXPECTED RESULTS

The capability to use low cost, and energy efficient LDRs makes integrating gesture control into consumer devices more controllable and affordable. The added benefit of no-touch controls emphasize hygienic options. Eliminating the privacy concerns of cameras to detect movement reduces consumer concerns. The proposed configuration should have a high degree of accuracy to allow consistent, dependable and accurate directional control.

5 PROPOSED TIMELINE

(1) Device Build and Program - Nov 8
(2) Data collection and cleaning - Nov 10
(3) Feature Engineering - Nov 13
(4) Machine Learning - Train, Test, Validate - Nov 18
(5) Draft Paper - Nov 19
(6) Final Paper - Nov 21
(7) Video Recording - Dec 1
(8) Presentation - Dec 2