Artificial Intelligence Project

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Artificial Vision

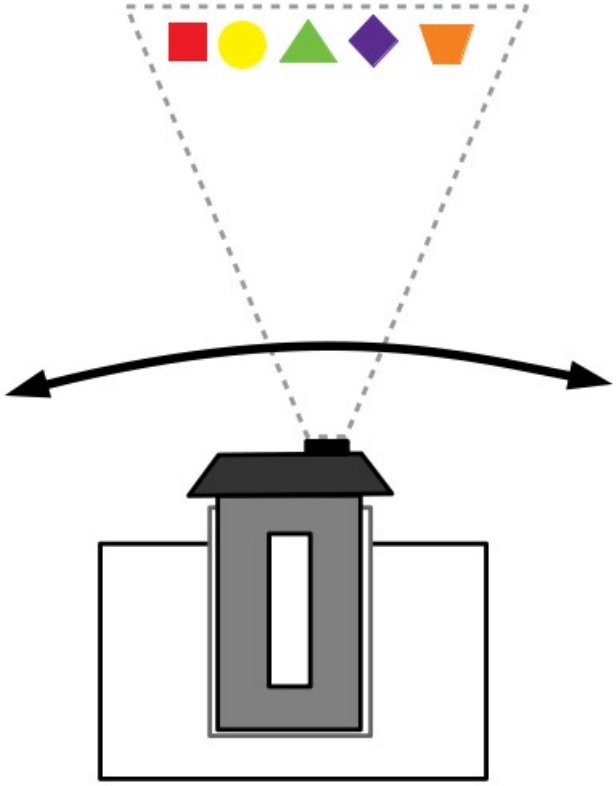
Definition

This project is about the implementation of the OpenCV artificial vision library for the recognition and tracking of objects of certain color, also known as Object Tracking.

First, artificial vision is a subfield of artificial intelligence that includes all industrial and non-industrial applications where a combination of hardware and software provide operational guidance to devices in the execution of their functions based on information capture and processing. (images).

The OpenCV library is an API of approximately 300 functions written in C language that are characterized by the following: *Its use is free for both commercial and non-commercial use.* Do not use external number libraries, although you can use any of them, if available, at runtime. The OpenCV library is primarily aimed at computer vision in real time. Among its many areas of application, the following stand out: human-machine interaction (HCI4); object segmentation and recognition; gesture recognition; motion tracking and mobile robots.

For the project we use the OpenCV and Arduino library, through the application of several filters we obtain the figure and position of the object of the color that the program is segmenting.

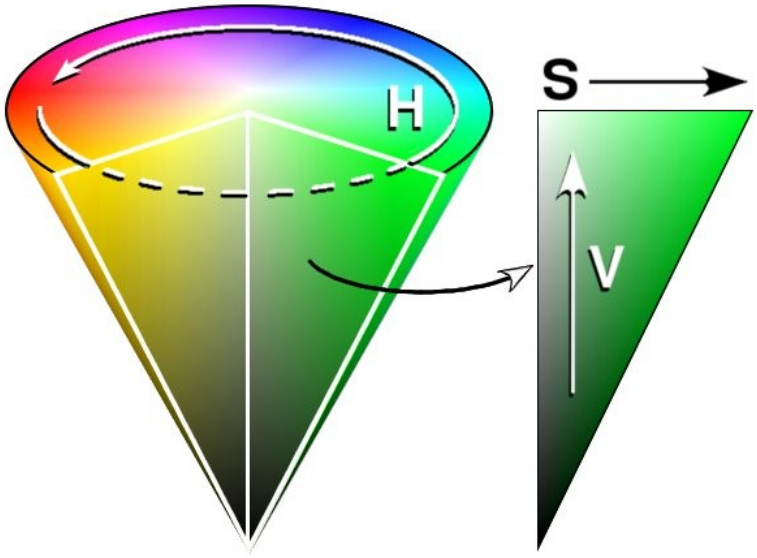


For the recognition of objects the 7 moments of Hu are calculated, they are a set of seven descriptors invariant to the translation, rotation and scale, which quantify the shape of an object, where the first two moments are computed as:

$$
\begin{aligned}
\phi_1 &= \eta_{20} + \eta_{02} \\
\phi_2 &= (\eta_{20} - \eta_{02})^2 + 4\eta_{11}^2 \\
\phi_3 &= (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})^2 \\
\phi_4 &= (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2 \\
\phi_5 &= (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})\left[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2\right] \\
&\quad + (3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})\left[3(\eta_{30} - \eta_{12})^2 - (\eta_{21} + \eta_{03})^2\right] \\
\phi_6 &= (\eta_{20} - \eta_{02})\left[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2\right] \\
&\quad + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03}) \\
\phi_7 &= (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})\left[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2\right] \\
&\quad + (3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})\left[3(\eta_{30} - \eta_{12})^2 - (\eta_{21} + \eta_{03})^2\right]
\end{aligned}
$$

HSV color model

The HSV model (from Hue, Saturation, Value - Hue, Saturation, Value), also called HSB (Hue, Saturation, Brightness - Hue, Saturation, Brightness), defines a color model in terms of its components.



Recognition of red figures.