Real-Time Localization Framework for Autonomous Basketball Robots

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***Abstract*— Localization is a fundamental capability for autonomous robots, enabling them to operate effectively in dynamic environments. In Robocon 2025, accurate and reliable localization is crucial for improving shooting precision, avoiding collisions with other robots, and navigating the competition field efficiently. In this paper, we propose a hybrid localization algorithm that integrates classical techniques with learning-based methods, relying solely on visual data from the court's floor to achieve self-localization on the basketball field.**

***Keywords*—Robot Localization, Autonomous Navigation, Neural Networks, Robocon**

I. Introduction

Section II reviews existing methods and prior research related to this work. **Section III** provides a detailed description of our proposed algorithm, approach, and model architecture. **Section IV** provides the results obtained from our experiments. **Section V** evaluates the accuracy of our approach and discusses potential directions for future work.

II. Related Work

III. Methodology

Our approach is a two-step process that begins with **Preprocessing** the image, followed by passing it to the model for **Inference**.

A. Preprocessing

The input image is converted from the RGB color space to the HSV color space, then the white regions are masked out using two predefined HSV ranges. The image is downsampled through a radial scan, flattened, and finally passed through the neural network.

Algorithm 1 Downsampling

Input: Image
$H \leftarrow$ Image.height
$W \leftarrow$ Image.width
$R \leftarrow$ Black Image
for angle $\leftarrow$ 0 to 180 step 2 **do**
    $lastPixel \leftarrow 0$
    $cx \leftarrow$ H / 2
    $cy \leftarrow$ W
    for d $\leftarrow$ 0 to max(H, W) **do**
        $x \leftarrow cx + d \times \cos(angle)$
        $y \leftarrow cy - d \times \sin(angle)$
        if $0 \leq x <$ W **and** $0 \leq y <$ H **then**
            $pixel \leftarrow Image[y][x]$
            if lastPixel = 255 and pixel $\neq$ 255 **then**
                $R[y][x] \leftarrow 255$
            end if
            $lastPixel \leftarrow pixel$
        end if
    end for
end for
Return R

IV. Results and Analysis

V. Conclusion and Future Work

VI. References