Rune Auto-activation System

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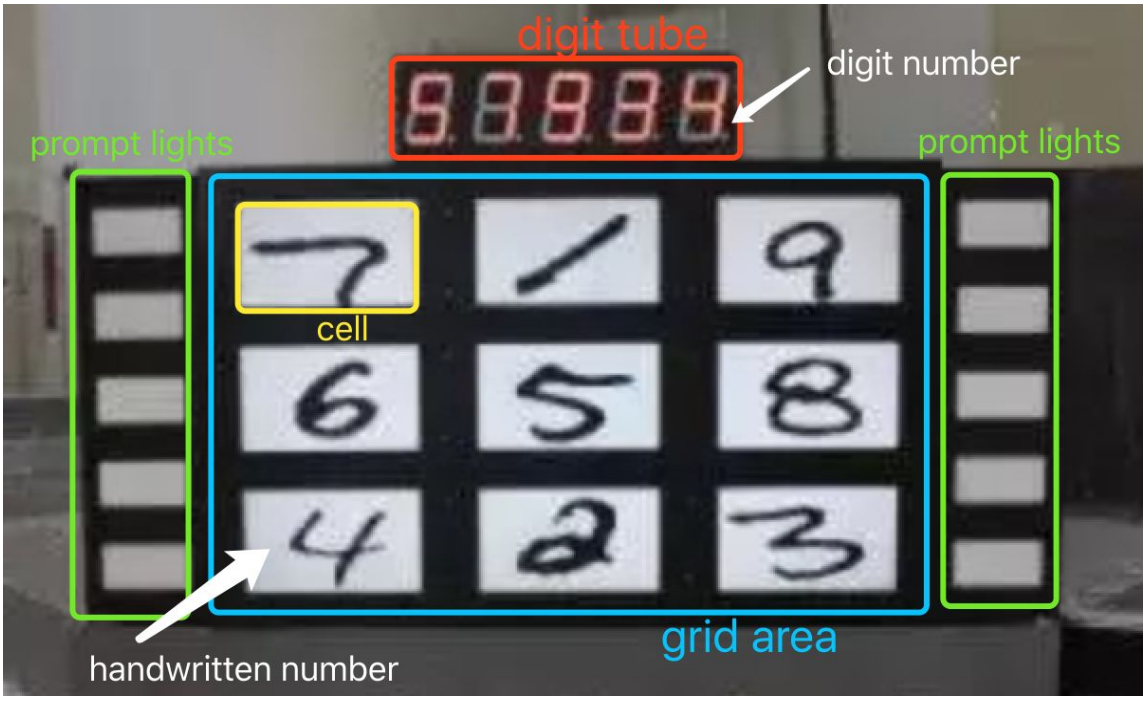
Intro

The task is coming from RoboMaster Competition, a largest and most complex student robotic competition. The details of the competition itself could be found from their website: https://www.robomaster.com/en-US

In short, the competition is a robot shooting game. Two teams of robots shoot against each other to win the game. The thing that related to this project is, during the competition, there is a ground rune on the competition's battle field. This ground rune is like a magic energy for the robots. The team that could successfully activate the rune will gain 3 times of shooting power for all the robots in their team.

A ground rune have been shown in Graph 1. There are 4 components to form the ground rune: grid area, cells, digit tube, and prompt lights. The grid area is a 3 by 3 grid that contains 9 cells. Each cell contains a handwritten number range from 1 to 9 without replicated numbers (each number will only display in one cell at a time, e.g, not two "3" displayed in two cells at a time). The digit tube contains the 5 number digit code which the robot will need to use for ground rune activation.



Graph 1

The Rune Auto-activation System is a system that could activate this ground rune automatically. In order to activate the ground rune, a robot needs to read the digit code and shoot the handwritten number cell with that digit code order. To solve this task, it require

image processing technologies. First, the system will need to find the place of digit tude, then apply number recognition method to read the digit code. Secondly, the system will need to locate the cells individually and apply handwritten number recognition method to identify which cell contains the number it wants. Finally sent the command with location of the cell to hardware control board and let the robot shoot the target cell. Those steps will need to be completed under 1.5 second, otherwise the rune will be reset (digit code and the place of handwritten number will change). If 5 handwritten number have been shooted correctly in digit code order the ground rune will be activated.

Note,

- After each correct shooting, the place of handwritten number will be randomly shuffled but the digit code will remain the same.
- If there is any mistake made by the algorithm (not able to find the correct number under 1.5 second, or find a wrong cell to shoot, or reads the digit code wrong), the ground rune will be reset. So, the system have to solve the problem from the beginning again.

Input

The input for the Rune Auto-activation System will be the video capture from the camera mounted on the robot.

Goal

The goal of the Rune Auto-activation System is: (1) find where is the digit tude in a frame, (2) recognize the digit code in digit tube, (3) find where is the grid and cells in a frame, (4) recognize the handwritten number in a cell, (5) analysis the information from (2) and (4) then output a location of the correct cell.

Testing

Manually label each frame in input video with a corresponding ground truth location of cell for testing.

References

1. Competition web: https://www.robomaster.com/en-US
2. Competition rules 2017 v1.9 (Ground rune on page 33~34): https://cdn-hz.robomasters.com/robomasters/public/document/RM2017CompetitionRulesV1.9.pdf
3. Video explanation of general competition rudes 2017: https://www.youtube.com/watch?v=5Xy6flWkJQQ
4. RoboMaster2017 Final SCUT VS SDUST recoding 2017 (ground rune activated by blue team on 3’16’’, 6’10’’~15’’, 16’02’’, 19’57’’~20’02’’, 32’51’’~54’’, 34’41’’~49’’, 43’34’’~40’’, and 45’10’’. red team tried to activate ground rune at 41’28’’~37’’) https://www.youtube.com/watch?v=q1o3wda4Gl8
5. Competition video documentary 2016: https://www.youtube.com/watch?v=ECr4zgK6cPA