IEEE REGION 5 ROBOTICS COMPETITION

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BACKGROUND

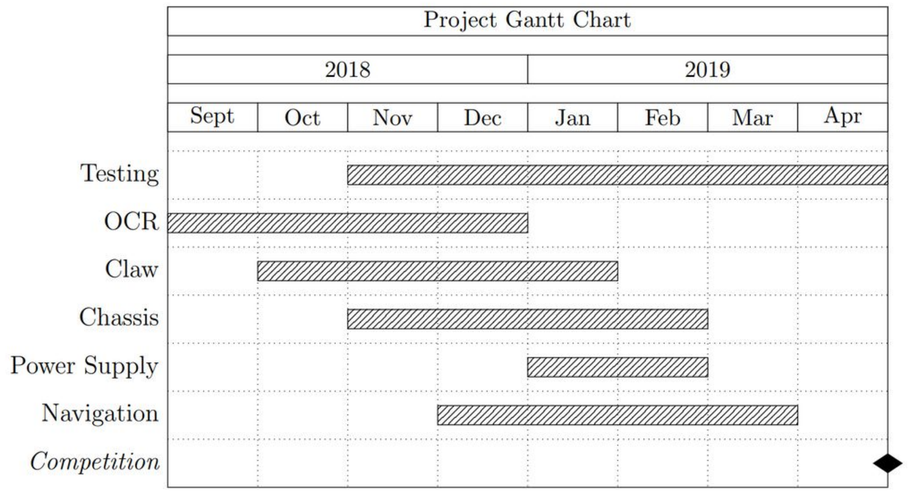
- Institute of Electrical and Electronics Engineers (IEEE)
- Region 5 Student Robotics Competition
  - Sponsored by the Region 5 IEEE Committee.
  - Region 5 includes over 90 students branches in the central United States.

OBJECTIVE

- Design a fully autonomous robot
  - Sort cubes into slots with matching letters
  - Pick up cubes, identify letters, navigate to mothership
  - Drop cube in the correct slot
  - Avoid obstacles placed pseudo-randomly throughout the competition board
  - Return to starting location when all cubes have been put into their slots
  - Achieve in the least amount of time possible

MATERIALS

- Raspberry Pi Model 3
- Raspberry Pi Camera Module
- Custom Claw - 3D printed (Coleman)
- Chassis - Vex (Guo)
- Battery (Wang)
- Voltage Regulator (Wang)
- Replica competition board, mothership, etc..



METHODS

- OCR for Cube Character Recognition

  Use image manipulation & OCR libraries such as OpenCV and Tesseract OCR OCR fails if letter is more than ~20 degrees off axis, so rotate image until successful
- Utilize provided JSON file to navigate field

  Exact cube position is unknown, so explore square until cube is found
- Movement is done using a simple 4-wheeled chassis design
- Use shape recognition to find obstacles

  Obstacles are circularly symmetrical

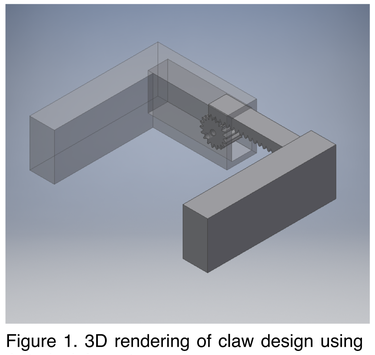


Figure 1. 3D rendering of claw design using Autodesk Inventor

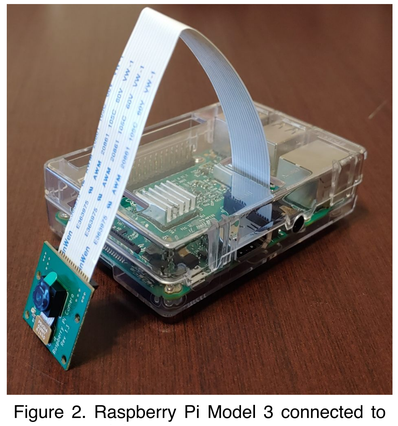


Figure 2. Raspberry Pi Model 3 connected to camera module

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RESULTS

OCR has been achieved with good success using the OpenCV and Tesseract libraries. While the letters cannot be identified if they are more than around 20 degrees from their correct orientation, we can fix this problem by rotating the images by values less than 20 degrees and testing at each points. Once we implemented this in the detection code, the only remaining problems are with C & D. When C is upside down it is identified as a D, and vice versa for D. We have yet to find a solution to this problem. Overall, the OCR works as intended in the vast majority of situations, and it should provide a good basis for our design.

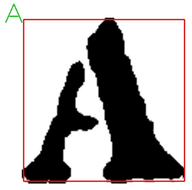

Figure 3. Output of the OCR code highlights the shape then returns the character

REFERENCES

- Robert Shapiro, IEEE Region 5 Website, 2018, http://ieeer5.org/.
- IEEE Region 5 Robotics Competition, 2018, http://r5conferences.org/competitions/roboticscompetition/.
- Kaehler, Adrian, and Gary R. Bradski. *Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library*. 1st ed., vol. 1 1, O'Reilly Media, 2017.

ACKNOWLEGEMENTS

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