

Here are some project ideas. You are encouraged to create your own project idea, these are intended principally to stimulate thought and give examples.

1. Read about the visual system in some animal far removed from humans evolutionarily - for instance, the octopus eye, which rotates automatically keeping its slit vertically aligned, the sea snail, which has only a few neurons and cannot focus images, the fly, with its "fly's eye," or the eagle, which has two fovea. Devise vision algorithms which would work for your selected creature. Compare to algorithms which have been proposed for human vision.
2. The Marr paradigm suggests sequential processing, low order to high order, without feedback. Devise a combined segmentation and object recognition algorithm for static 3-D objects. Show cases in which it can do things that sequential algorithms cannot.
3. Assume you are holding a piece of food in your hand, which is visible to you. Devise an algorithm for visually servoing the food into your mouth.
4. Epipolar geometry with camera distortion: modelling, compensation, modifications to the basic algorithms. Ref: Xu and Zhang, "Epipolar Geometry in Stereo, Motion and OR."
5. Epipolar geometry with three or more cameras. How is stereopsis changed? Design an algorithm for depth recovery and/or correspondence.
6. Extend and test Hartley's algorithm for egomotion estimation to the case where you have multiple images and smooth motion parameters, eg. where the rotational and translational velocities are constant.
7. Suppose you are given a "point cloud" of surface points on an object. Similarly to the way region-growing is used in segmentation, devise an algorithm for surface-growing from one or more seed points. You should end up with a complete surface model of the object that is consistent with the point set.
8. Show how you can use horopter analysis to solve the correspondence problem. Ref: Oshiro et al, "Using foveated vision for robust object tracking: 3-D horopter analysis." A horopter is a circle in 3-D on which the binocular disparity is zero.
9. Implement Wang and Freeman's characteristic view approach to OR. Apply it to a simulated "blocks-world" environment you create. Ref: Wang and Freeman, "The use of characteristic view classes for 3-D OR."
10. Devise a tree-search algorithm for solving the 3-D OR problem. Start with Grimson's "OR by constrained search" paper, and build on it by adding trinary constraints to their unary and binary.
11. Compare methods for computing optical flow with the goal to use

optical flow at occlusive boundaries to determine motion parameters. Simulate a "moving blocks-world" environment to try your resulting algorithm. Ref: Beauchemin and Barron, "The computation of optical flow."

12. Devise an algorithm based on some kind of censored averaging to improve the constant flow algorithm in regions where there are boundaries between rigid object motions or non-rigid flows.
13. Study the literature on control of eye movement. Considering eye movement as a behavior, compare passive and active approaches to gaze control, perform simulations which show their relative strengths and weaknesses.
14. Devise an active segmentation algorithm, in which the principles of active vision are used to develop a segmentation scheme.
15. Construct a virtual 3D space in which you can place simple 3D objects, specify light source directions, and visualize how the space will look using any pinhole camera model M .
16. Improve the Barth-Tsuji egomotion estimation scheme by allowing for more than two pointsets F^+ and F^- . Explain how you would determine these sets and how they would be incorporated in the algorithm.
17. Take a bunch of digital images and determine the degree to which the Kundur-Raviv claim that $d(IQM)/dt$ is a proxy for the VTC is corroborated by your data. Use Matlab to convert the jpegs to a form that can be computed.