MIDDLE EAST TECHNICAL UNIVERSITY

ELECTRICAL & ELECTRONICS ENGINEERING

Weekly Report 10

EE 494

Cat Feeding Project

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Contents

1 Works Done

- Works on identification
  - SIFT implementation
  - Research on feature matching algorithms
  - Implementation of feature matching
  - SIFT database creation and manipulation on new data
  - Method - function templates for future implementations
  - ORB and SIFT comparison
- Preparing a backbone for the critical design review evaluation report.
- Test plans for mechanical Design.
- Design of the food case.
- Test are applied for mechanical Design
- Reconfiguration for the outer design.
- Preparing ourselves for writing critical design report.

1.0.1 Test results for Mechanical design

Food mechanism is tested this week. Observations can be seen below.

- Although food is jammed between the reservoir and cylinder, it did not affect the performance of the overall system. The rotation continued without any difficulty.
- The jammed food also poured out of the box at following rotations, therefore it is observed that there can be an underestimation on the amount of the food given, if one only considers the poured food is only due to the food that was stored in the cylinder.
- It is observed that food is flowed in every rotation. There isn't any case which food flow is completely stopped when system is in ON state.
- The food flow is completely stopped when system is in OFF state.
- It is observed that when system switches from the ON state to OFF state, there exist an undesirable food flow resulting from the previously jammed food.

2 Future Work

The food system is checked and the errors are fixed in this week. The food flow is not controllable in our old system, therefore it is not reliable. This problem is fixed by rearranging the screws and the placement of the rotating apparatus. Now it become more reliable. The flow amount is more or less same in every trial and the there is almost no waste food. Planned future work is given as follows:

Future Works:

- Thinking of a more robust food reservoir and implementing it to the system.
  - Pringles cans.
  - Rectangular prism made up of model material.
- Finishing the electronic part of the system.
- Relay triggered charge mechanism design and implementation
- Fixing broken camera socket problem
- Mechanical placement of camera
- SIFT data set creation
- SIFT algorithm development
- SIFT
- Finishing testing of the components that make up the electronics subsystem.
- Preparing test results, drawings, tables for the critical report.
- Changing the old outer box with a new one.
- Rearranging the connections between the electronic devices.
- Setting the food case to the body.

3 Identification

Different methods, algorithms and implementations are developed, searched and tried. SIFT and ORB are the two alternatives which are tried with different methodologies.

3.1 Feature Extraction

SIFT and ORB default feature extractor are used in extraction process of the features. Also, dense approach is tried which is then abandoned because of it's obvious poor performance. A different approach, local dense vectors are created which are the vectors that are extracted in a dense manner but in a small local region which is most probably exists in all images. This will be tried in the next week in case of extracted features are not enough or few in the default extraction.

3.2 Feature Matching

Feature matching is tried on absolute valued threshold which is then dumped because of it's poor performance and unpredictable behaviour on unknown data. In other words, an absolute threshold on SIFT vectors for their linear distance did not generalize to all images as image parameters differ a lot. Then a research showed Lowe also encountered the same problem, and dynamic threshold based on other feature matches are used in the algorithm. There are two methods currently tried :

- Absolute constant threshold : did not work properly, too volatile
- Relative threshold based on Lowe's work : currently used

3.2.1 Brute Force Matcher

First solution was to use brute force matcher(BF Matcher) for the features which computes every combination of this images. However, this ended up with unpractical results which are basically very high computation time as there are hundreds of images in database and each image having thousands of SIFT vectors. Therefore, this approach flawed and another solution is proposed.

3.2.2 FLANN Based Matcher

FLANN based matcher roughly approximates the result that BF Matcher tries to find. It is currently in use in the project, however; it is used as a black box with some hyper-parameters whose meanings and underlying reasoning of the approach will be investigated in the next weeks.

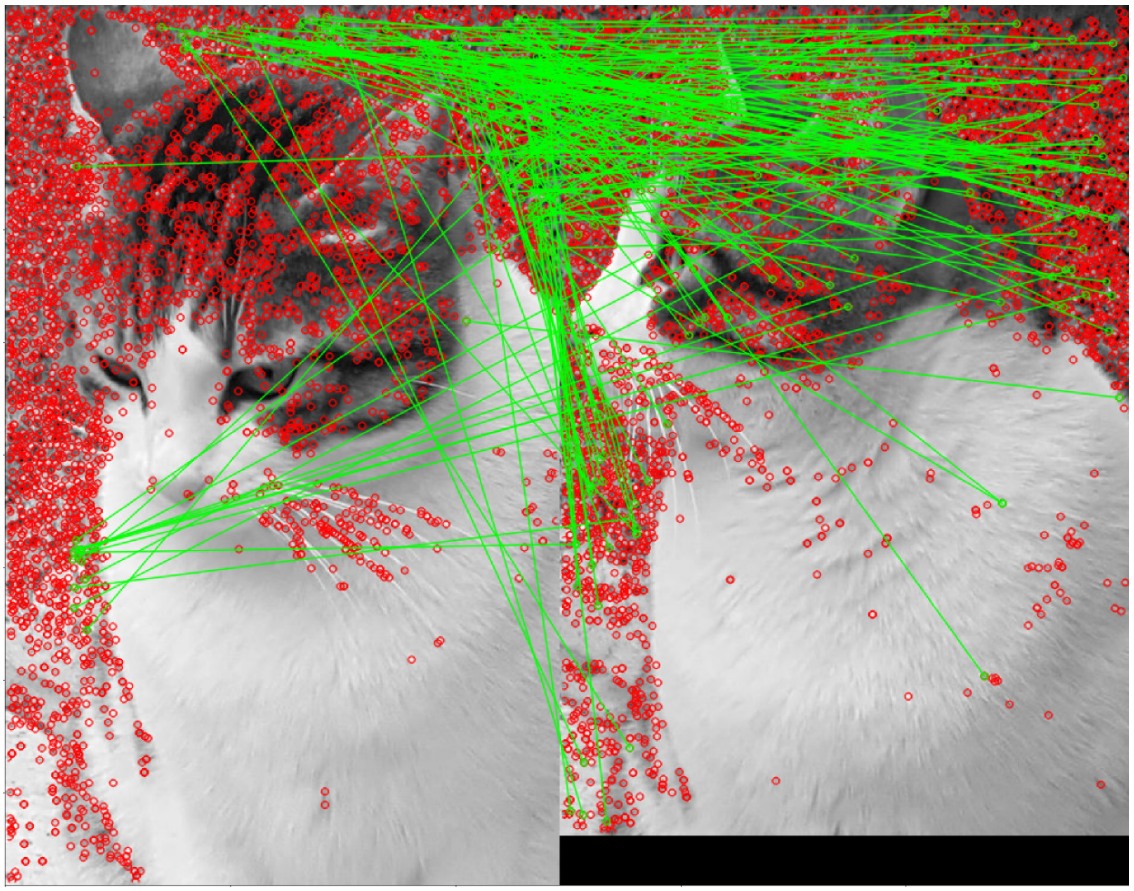
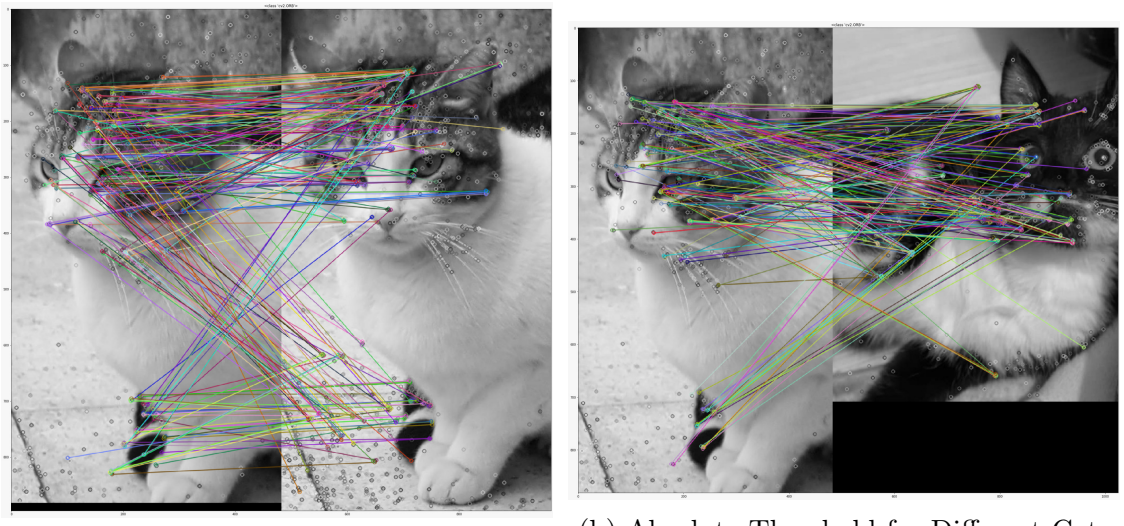


Figure 1: Noisy Background

There are some results based on different approaches. Noisy background mathces wrong vectors leading to false identification in figure 1 whereas absolute threshold makes the distinction impossible in figure 2.



(a) Absolute Threshold for the Same Cats

(b) Absolute Threshold for Different Cats

Figure 2: Absolute Threshold