Foreground Report
by FELEREST

Contents

1 Future Work

1.1 Overall System

Some components lost its connection to the overall system whereas some of them stay connected. Mechanics, sensors etc. have lost their connection; however, computer vision(classification and identification), web development, decision-making parts are still functional. Therefore, their integration and test will be done in the remaining weeks.

1.2 Computer Vision

There are several methods in consideration. These will be tested one after the other until the requirements are satisfied, at which point no further tests will be done. The satisfactory status of the element queried in this list is given by the requirement satisfaction which implies 90 % of the time the system should give correct value, i.e. accuracy should be at least 90 %. We believe SIFT will work as our experiments have figured it out. However, there is still a chance that it may fail for more generalized data as previous tests were a little bit narrower. In case of such a failure, we plan to use landmark extraction.

The future works are listed below:

1. Pre-processing should be implemented
    - There is no pre-processing technique used at this point of the project. The data is directly fed to the identifier object which gives poor performance on data for different cameras. Even though this is not a practical consideration in the real life performance of the product, for tests and optimization, different cat images should be used.
    - For different illumination and different color of lights, there is a need for normalization. Daylight shows different colors throughout the day, and this effect should be minimized.
2. SIFT algorithm completion
    - The algorithm is still lack of practical results. It takes seconds to converge, sometimes in the order of 10 seconds. Also, it gives some unexpected results with edge cases, for example images with no valid SIFT vectors. It should be optimized to solve these problems.
3. SIFT hyper-parameter optimization

- There are many hyper-parameters for the identification algorithm and SIFT algorithm. These parameters should be optimized to attain the best performance.
- Some parameters play a role in system accuracy and speed. This is the second work of hyper-parameter optimization.

4. Landmark extraction and their classification
    - If SIFT fails the requirements, landmark extraction is going to be used as an alternative. In this configuration certain landmarks will be extracted from data, eyes and nose are the two important landmarks.
5. Landmark extraction vector matching
    - After landmarks and their relation is found, learning based algorithm will be utilized to learn the similarities. This is the first proposed approach.
    - If learning fails since the requirements state that a single shot should be enough to identify a cat, then distance between landmarks and their location vector differences will be used.

1.3 Web Interface

This section can be divided into two parts:

- The information about cats
- The information about devices

1.3.1 Information about cats

- Calendar will be added.
- There will be an option for users to control and change the amount of food poured.

1.3.2 The information about devices

- There will be a button to open or close the system.
- The charging status of the device will be shown.
- The last updated time for food status will be shown.
- There will be an option to decide when the lights turn on/off.

1.4 Demo and promotional video

1.4.1 A demonstration video

It will explain how the overall system and each subsystems works. A simple test will be done to elaborate how the system works and the overall performance will be discussed. More tests might be included depending on the expectations of the client. More elaborately the demo video will include:

- A general overview of the features of the website.
- A test demonstrating the performance of the computer vision part.
- A short demonstration of the steps included in the computer vision part.
- An overall demonstration of the system working in unison.
- Some performance parameters and test results conducted in the development stages.
- The demo video might be done on living cats depending on cat availability.

1.4.2 A promotional video

The promotional video will present our product. It will be a demonstration of how we have changed our marketing strategy towards the product due to the world pandemic. The viewer will know what we are offering, what solution we are proposing to which solution, what the product's features are and so on. The answers to these questions will be as follows:

- The problem is we can't track cat's dietary plans where there are numerous cats residing in a given area whether it is indoors or outdoors.
- The solution is to create an algorithm using computer vision techniques to identify new cats and track registered cat's dietary plans while offering specialized online features.
- The product is the knowledge. Our customers will have the main algorithm that tracks cat's dietary plans. This is the entirety of the computer vision part and some basic features of the website.
- An additional package will be offered to the costumer at an additional cost. This package will contain a link to the customer's own food container. The customer itself will have to install some sensors and connect them via the website. To name a few, these sensors will be a weight or a sonar sensor which will feed information to our web servers. Using this information the user will

be able to track how much each cat weighs, how much food is left in the container, how much battery is left and so on.

2 Test Plans

2.1 Overall System

Test procedure for the overall system is going to include only software outputs. Image and user inputs are also available. We propose a test procedure such that we give real inputs to the system using Raspberry Pi and get real outputs through the web interface. Also, setting web interface to exploit user inputs and make some decisions on the Raspberry Pi. The test are not quantitative but qualitative and may include a video or real time presentation based on the opinion of the advisor. We just propose an overall test for the system with working parts. Tests we think of are as follows:

- We show an image to the Pi camera which is then processed, classified, identified, required decisions are made and user interface shows the result. The result includes decisions taken, identification - classification results.
- We give some input from the user interface, such as "sleep for 15 minutes" and we expect the system to go to sleep for 15 minutes and then wake up.
- Sending manually feeding cat command and receiving the information on the Raspberry Pi.

3 Computer Vision

Test procedure is straightforward for this part of the project. Test data is going to be collected and different tests are going to be done. There are

Target data set description:

- Cat images found on internet
- Cat images taken by Pi Camera that are displayed onto screen
- Cat images taken by Pi Camera that are printed onto paper (total of 20 cats printed present, unfortunately printing new ones are impossible since there is no printer home)

The following tests are going to be conducted:

- – Many train data
  – Moderate validation data
  – A few test data

  This test aims to benchmark the performance of the identifier under many data, mainly to benchmark its speed with larger data sets. This is the worst case scenario for the computation time requirements.

- – Average train data
  – Average validation data
  – Average test data

  This test aims to find average case results for the product. This is the most suitable performance of the identifier.

- – A few train data
  – A few validation data
  – Many test data

  This is for the benchmark of single shot performance and accuracy. Single shot performance can be shown best in this configuration. This is the worst case scenario for the accuracy requirements.

4 Work Distribution

We propose a work distribution based on the proficiency we got so far. The distribution is as follows:

4.1 Asude Aydin

- Promotional Video
- Help in computer vision where necessary

4.2 Furkan Aldemir

- Completion of web interface
- Help in videos if necessary

4.3 Fatih Eser

- Works in computer vision part
- Integration of computer vision part to the overall system

4.4 Utku Suicmez

- Preparing and conducting tests for subsystems
- Preprocessing of images for computer vision

4.5 Doga Tolgay

- Demo Video
- Help in web design where necessary

5 Time Management

We prefer weekly plan instead of a Gannt chart to demonstrate the time management. The works are mostly independent and their order are straightforward. Therefore, we decided that week based plan is best fits for our purposes.

5.1 Computer Vision

It is expected that each of the weeks contains approximately 6 hours of working on the specified objectives, and we The proposed works for this task is given as follows: Please note, there is also writing of the report in parallel to these processes. Our

Week 1	Completing the deficiencies in SIFT algorithm
Week 2	Preparing the data set mentioned in future works and test procedure
Week 3	Writing test scripts, data set preparation and starting of the huge number of tests for the parameter optimization
Week 4	Getting the results of the tests and deciding on the hyper-parameters, re-running deficit tests
Week 5	Integration to overall system (actually it is expected to be very easy; however, we allocated a week for this since there may be some pending works that remains from the earlier weeks)

Figure 1: Future Works in Planned Manner

main goal is to add as many tests as possible to show the reproducibility, reliability, scalability results of the system proposed.

6 Deliverable

- Test results for each section as a report
- Data sets for computer vision part
- A video of real-time test of the system
- A promotional video
- All code written and working
- Detailed documentation for the code