UNIVERSITÀ DEGLI STUDI DI PARMA

HELICOPTER

# Using Stochastic Optimization to Improve the Detection of Small Checkerboards

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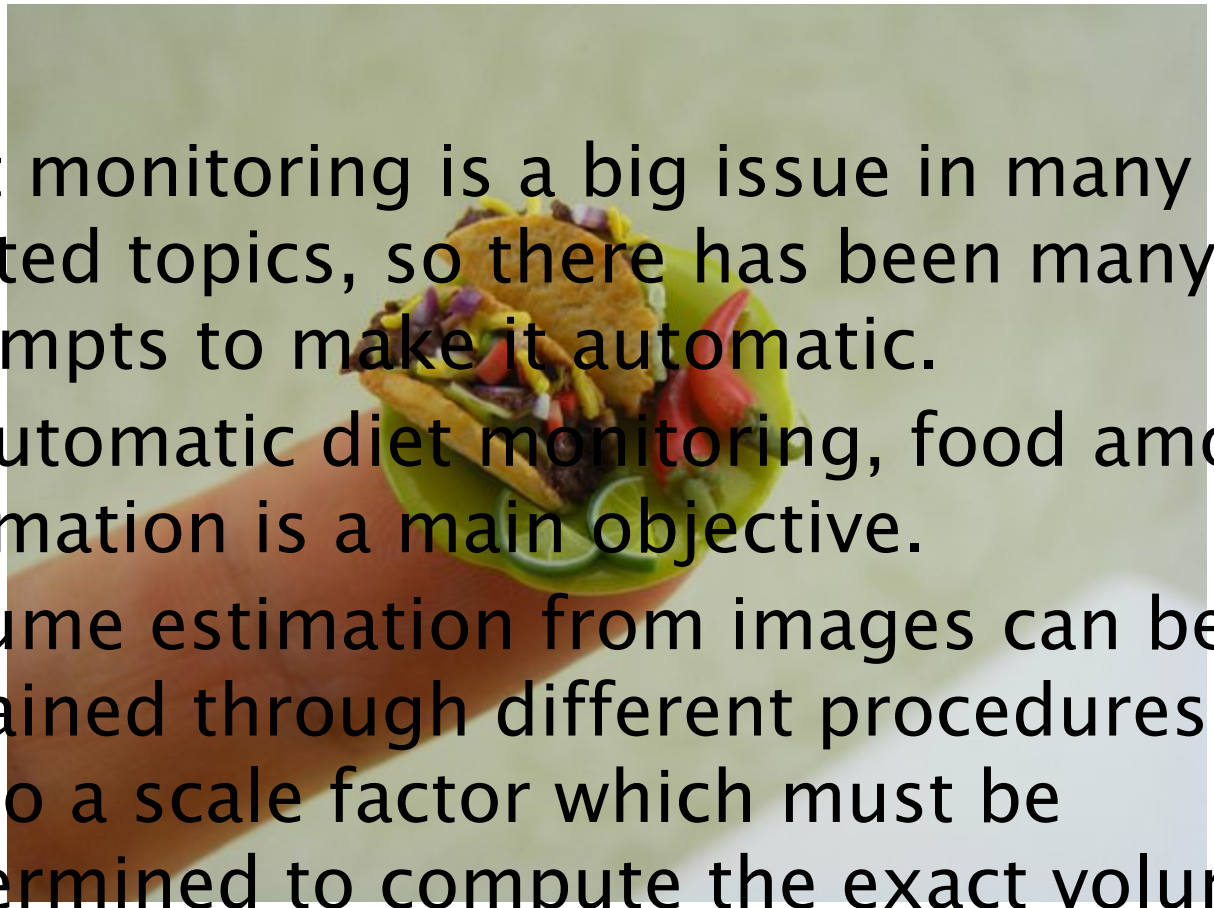
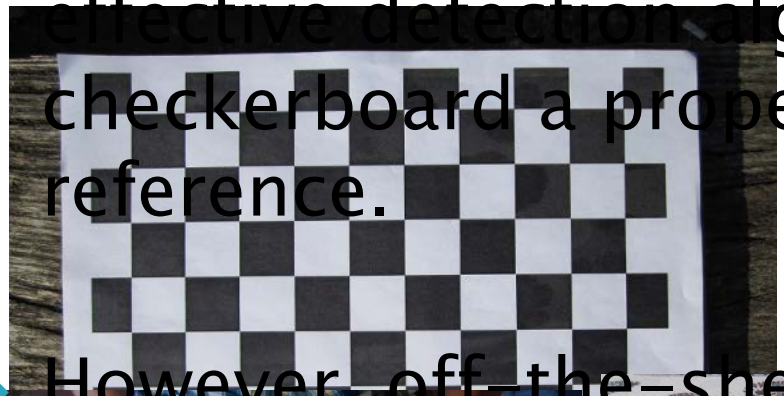
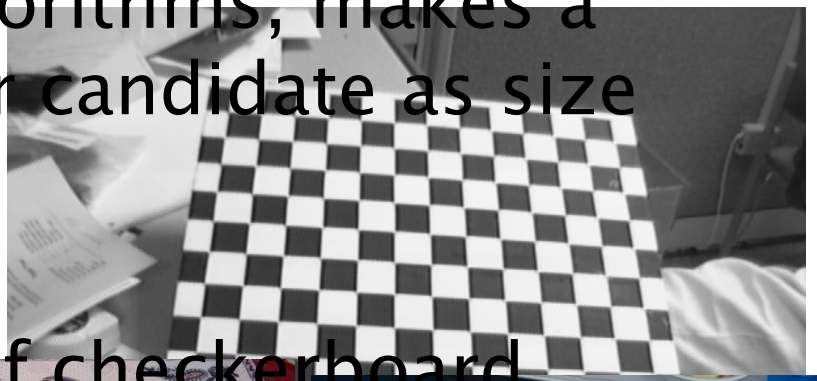
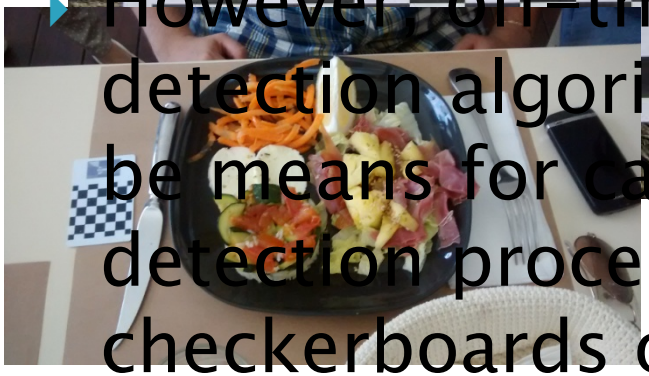
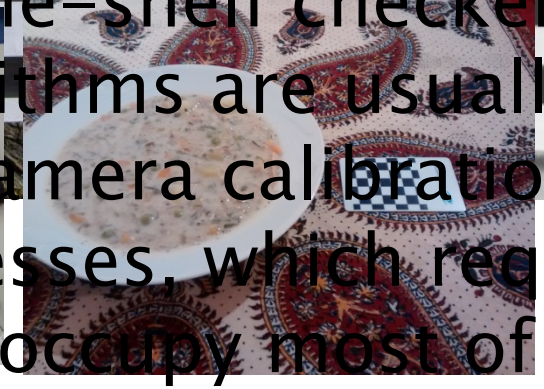
# Introduction



- Diet monitoring is a big issue in many health-related topics, so there has been many attempts to make it automatic.
- In automatic diet monitoring, food amount estimation is a main objective.
- Volume estimation from images can be obtained through different procedures, but up to a scale factor which must be determined to compute the exact volume.

# Size Reference vs. Calibration

- Simplicity of the pattern and availability of effective detection algorithms, makes a checkerboard a proper candidate as size reference.
- However, off-the-shelf checkerboard detection algorithms are usually designed to be means for camera calibration or pose-detection processes, which require that the checkerboards occupy most of the image.

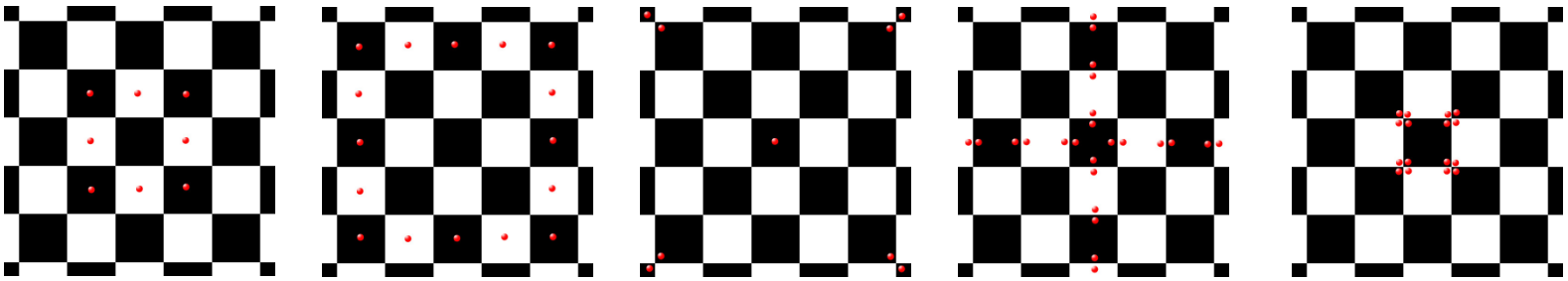






# Method

- Phase 1: Detect approximate location of the checkerboard.
- Phase 2: Detect the exact position of the corners using a corner-detection algorithm applied only to the region where the pattern was detected.

# Locating the Checkerboard

- In this work, a stochastic approach is used to find the object pattern in the image.
- To find the pattern, if the relative position of the camera and the checkerboard was known, we could determine the corresponding point on the image by perspective projection.



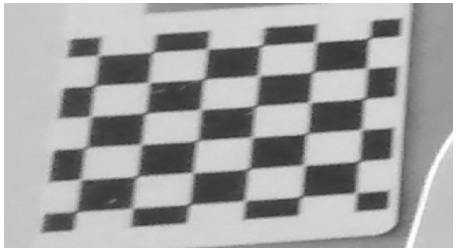
# Locating the Checkerboard

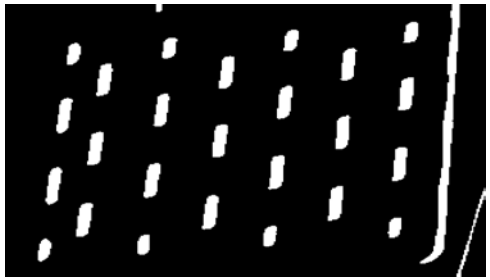
# Corner Detection

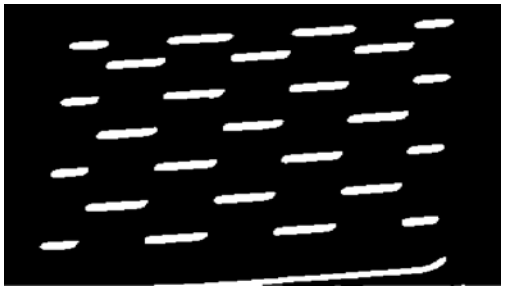
- The image region where the checkerboard was detected in the first phase can be cropped.

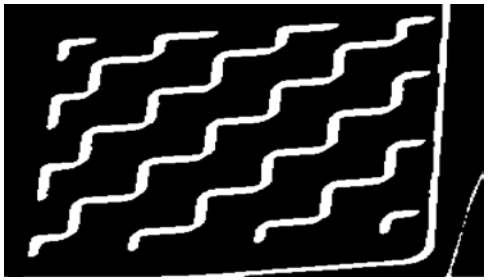
- A customized algorithm was designed to detect the checkerboard corners on the cropped image and refine the checkerboard position estimation.

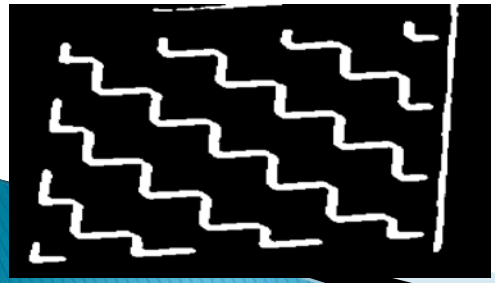
# Corner Detection

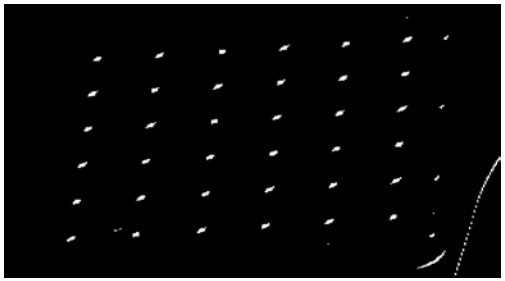


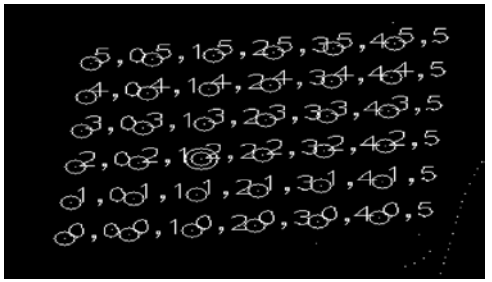












# Results

- The algorithm was tested on four image sets, including 458 food images in total.
- DE was iterated up to 1000 times for every image. Also, DE was allowed to run up to four times for each image if a satisfactory match had not been found.
- After locating the checkerboard, corners were located by two basic algorithms (OpenCV and Matlab) and by our customized algorithm.

# Results

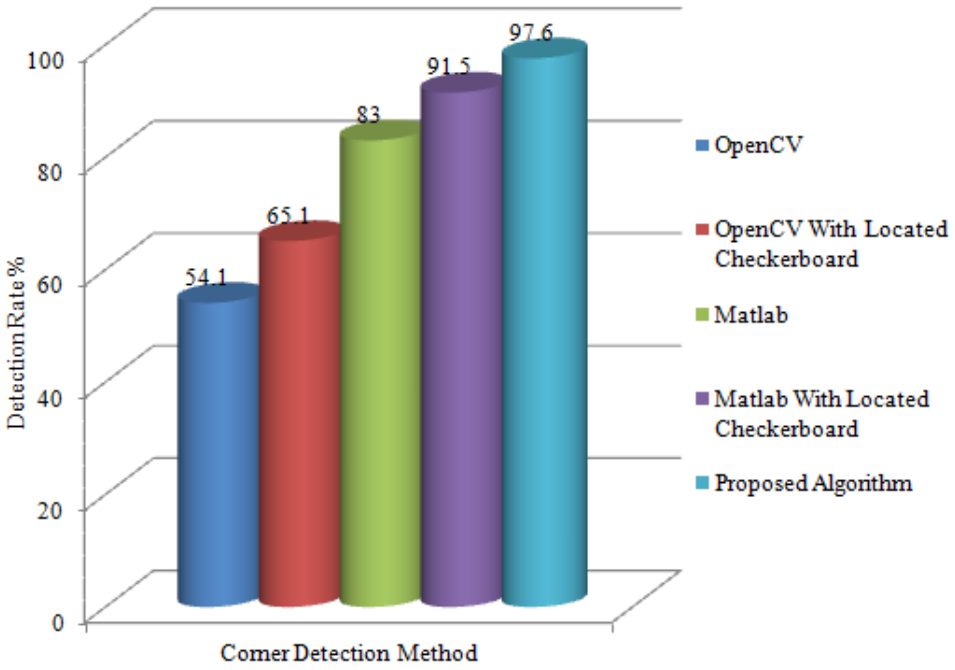
Results of the DE-based checkerboard locating algorithm.

| | Images No. | Success | First try Success | DE tries |
|---|---|---|---|---|
| Motorola MotoG | 179 | 176 | 143 | 1.34 |
| Samsung Galaxy Note 1 | 19 | 19 | 11 | 1.3 |
| Samsung Galaxy S3 | 130 | 129 | 123 | 1.2 |
| Samsung Galaxy S3 scaled (0.5) | 130 | 127 | 125 | 1.13 |
| Total | 458 | 451 | 402 | 1.24 |

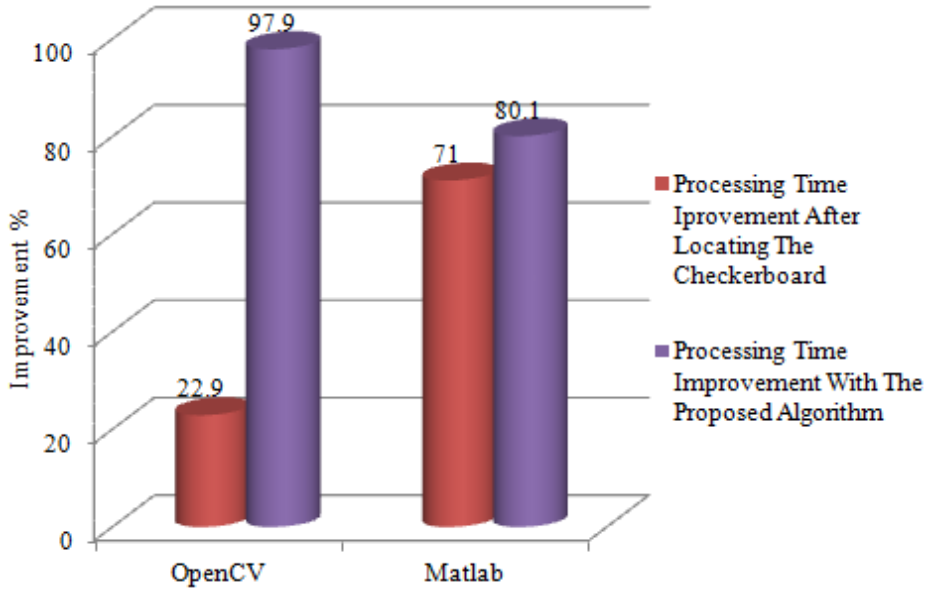
- In 98% of the cases the checkerboard was correctly located.

# Results

## Detection rate




## Processing time



# Summary

- The pre-processing phase based on DE allows one to focus on the image region where the pattern is located.
- This improves the performance of corner detection algorithms and, at the same time,
- Reduces the execution time of such algorithms whose speed is usually inversely proportional to the difficulty of the task.

# Thank you!