Semester Thesis: "Object Recognition with Mobile Phones"

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1. Introduction
2. Approach 1
3. Approach 2
4. Results
5. Conclusions

Mobile Phone Technologies

Mobile Phone Technologies

- SMS, MMS

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- infrared, bluetooth

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- SMS, MMS
- infrared, bluetooth
- Cameras

Combine OR with Mobile Phones

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- Use as input a picture taken with mobile phone camera
- Send it to a server which applies OR algorithm
- Server sends information based on the result back to the users mobile phone

Applications

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- Advertising campains

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- Museum guide

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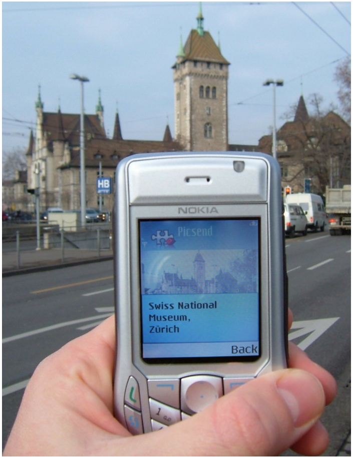
- Museum guide
- City guide (no barcode needed)



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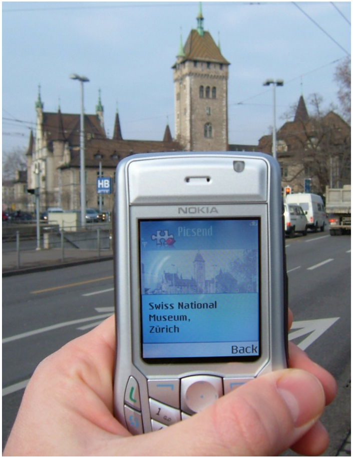

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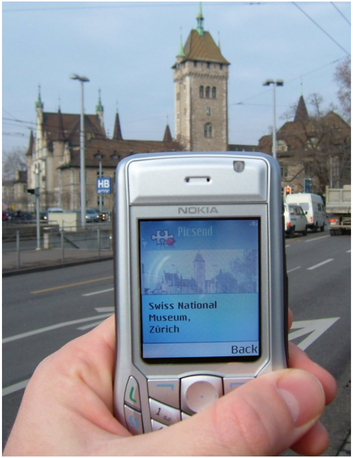
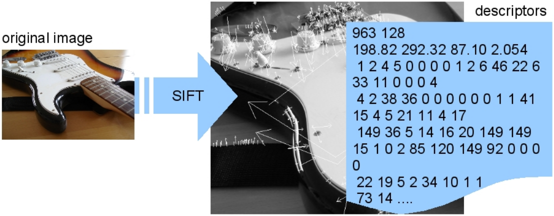
- Advertising campains
- Museum guide
- City guide (no barcode needed)
- Product information (books, etc.)
- Help for the blind



SIFT

Scale Invariant Feature Transform (SIFT) by David G. Lowe



```
963 128
198.82 292.32 87.10 2.054
 1 2 4 5 0 0 0 0 1 2 6 46 22 6
33 11 0 0 0 4
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15 4 5 21 11 4 17
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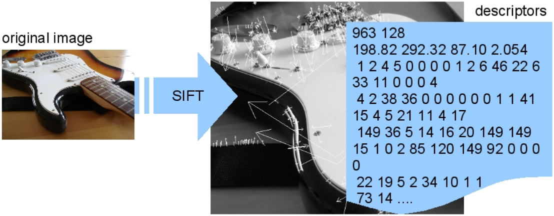

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Features:

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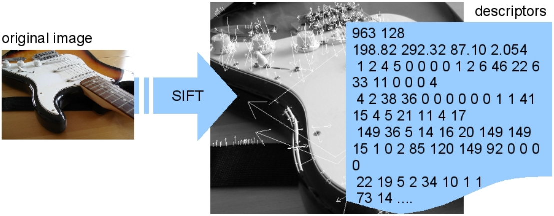

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Features:

- Scale invariant

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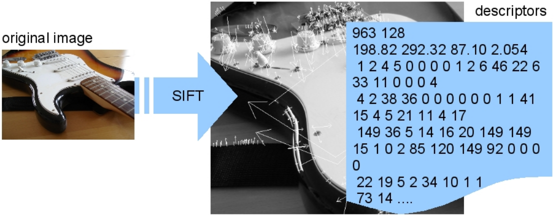

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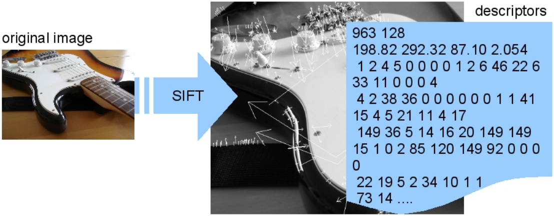

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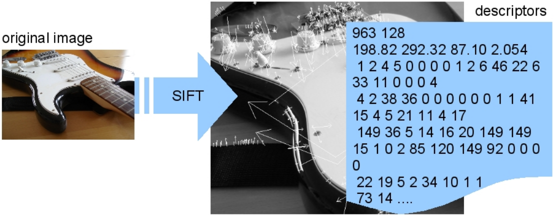

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Features:

- Scale invariant
- Rotation invariant
- Robust against noise and change in illumination
- Also small changes in 3D viewpoint are possible

Two Approaches

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- Approach 1: server side calculation

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- Approach 2: calculation fully on mobile phone

Approach 1: Server Side Calculation

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Approach 1: Server Side Calculation

- Do the expensive algorithms on a server
- Take the picture with mobile phone and send it to the server
- No need to install something on the mobile phone
- Large database possible

Communication with Server

Transmission of a picture from the mobile phone to the server.
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- **internet**: bad usability and rarely supported
- **MMS**: standard on most mobile phones

Approach 1: Server Side Calculation

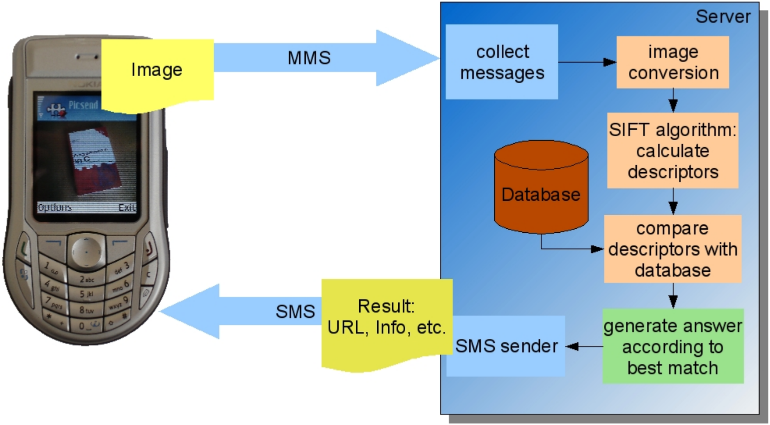
Image
MMS
Server
collect messages
image conversion
SIFT algorithm: calculate descriptors
Database
compare descriptors with database
generate answer according to best match
SMS sender
Result: URL, Info, etc.
SMS
Picsend
Options
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Symbian Application

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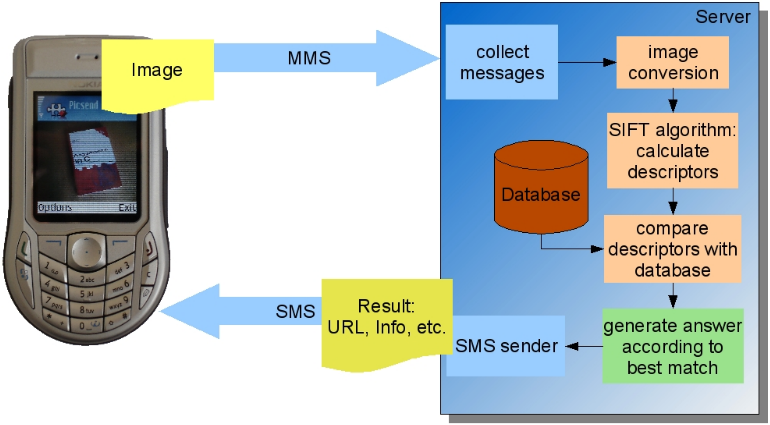
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Approach 2: Calculation Fully on Mobile Phone

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One application that runs completely independent on a mobile phone.

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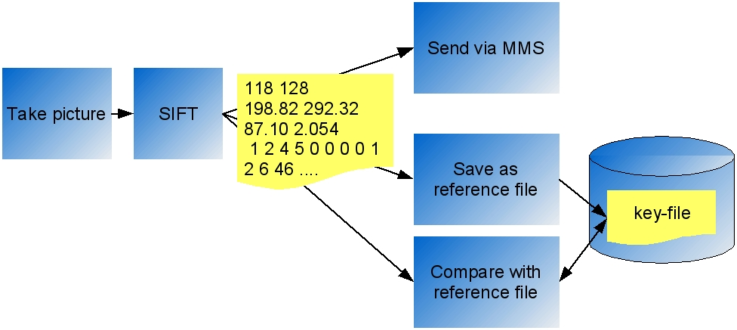

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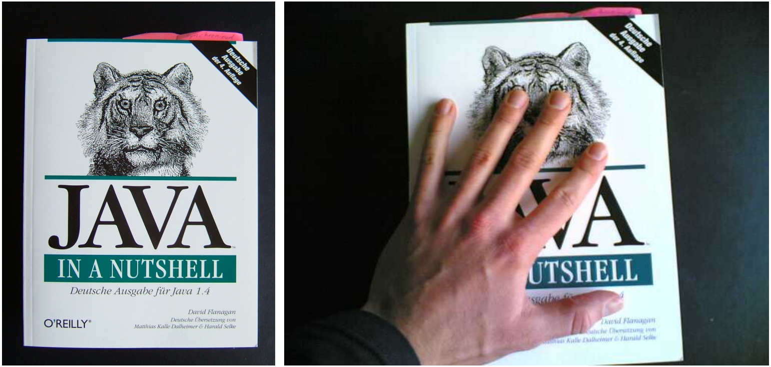
- Implementation on Symbian v8.0
- Symbian is 'kind of' C++
- Problems with Symbian:
  - Error handling
  - No global writable variables
  - Very very small stack
  - Heap is limited at 5 MB. This is e.g. too small to hold more than four 640*480 pictures with float pixels!
- Application calculation with different image sizes: 320*240 (slower) and 160*120 (faster)

Results - Approach 1

Results - Approach 1

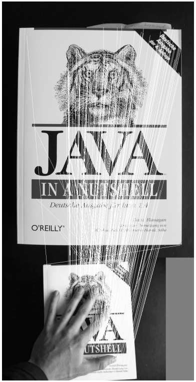
Specific example:


Deutsche Ausgabe der 4. Auflage
JAVA
IN A NUTSHELL
Deutsche Ausgabe für Java 1.4
David Flanagan
Deutsche Übersetzung von
Matthias Kalle Dalheimer & Harald Selke
O'REILLY

Left: Original picture gives 3233 keypoints. Right: Picture received by MMS gives 853 keypoints.

Results - Approach 1

Server side matching:



⇒ 268 matches

Results - Approach 2

Keypoints calculated on the mobile:
Fast calculation (image size 160*120) takes ≈ 13 sec and gives 35 keypoints.

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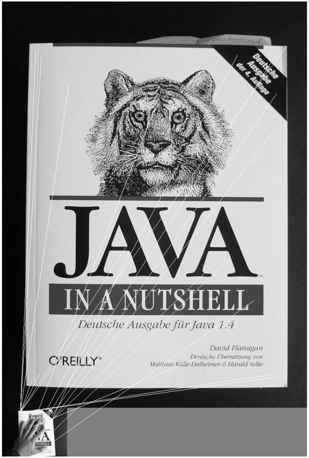
Result: ⇒ 25 matches



Results - Approach 2

Keypoints calculated on the mobile:
Slow calculation (image size 320*240) takes ≈ 50 sec and gives 61 keypoints.

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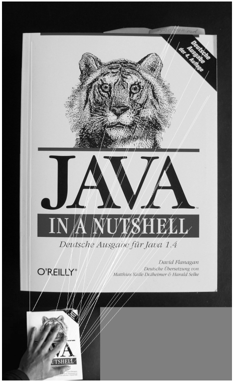
Result: ⇒ 27 matches



Results

Demo ...

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- Results are promising - even those with keypoints calculated on the mobile phone.
- Server side approach can be used to e.g. build up a city guide.

Future Work

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- Solutions for a large database

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- Improve the SIFT implementation on the mobile phone

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- Solutions for a large database
- Specific application (e.g. city guide)
- Improve the SIFT implementation on the mobile phone
- SURF instead of SIFT

End

Thank you!