AndroAR

github.com/alexdamian/AandroAR

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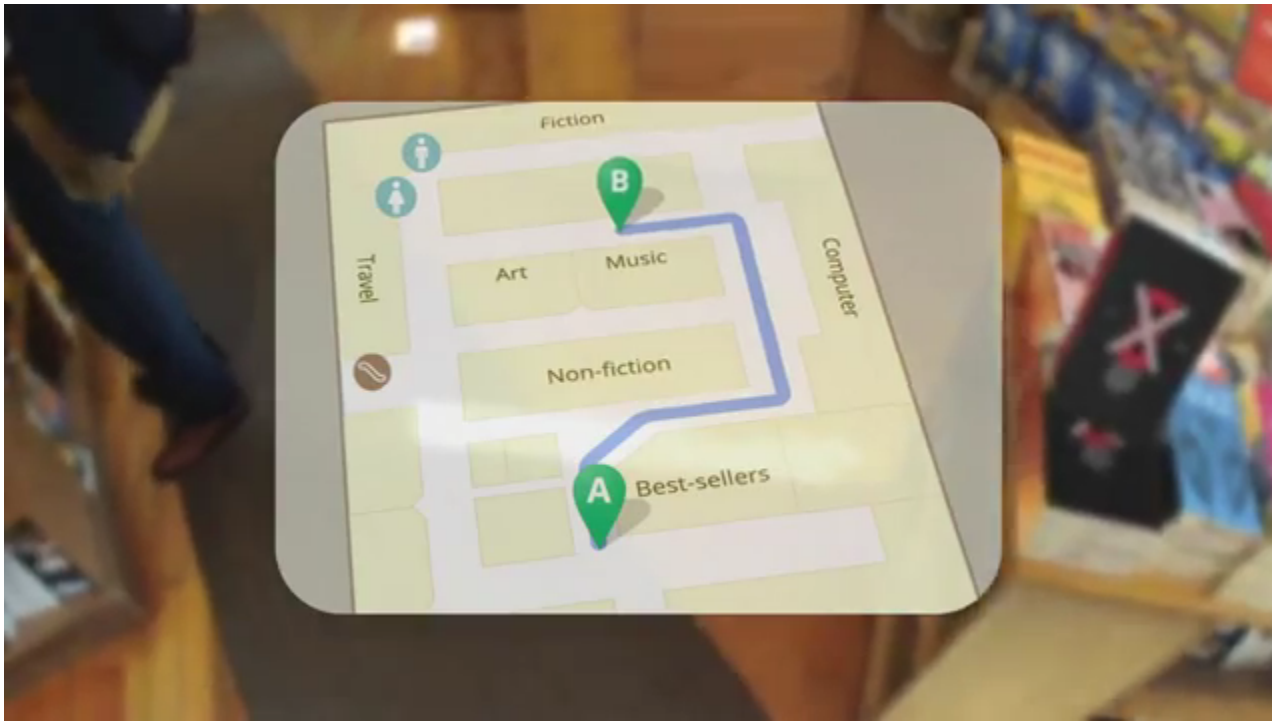
What is it? Scenario

- system (with front-end mobile application) that allows navigation through a potentially unknown environment and displays information for landmarks that are visible on the camera's phone feed

- tourists travelling through foreign cities
- freshmen getting around campus

Google Glasses

- Google IO 2012 conference
- Augmented Reality w/o smartphone



Approaches

System will use: **camera feed** and **database of object information**

And typically **one** of:

- sensors (GPS, compass): Street View

- image recognition software: Layar

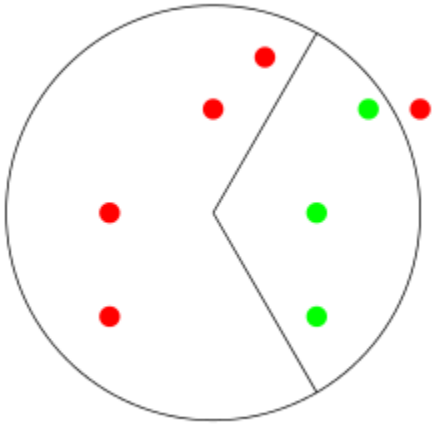
Example

- sensor generated AR

junaio Augmented Reality app

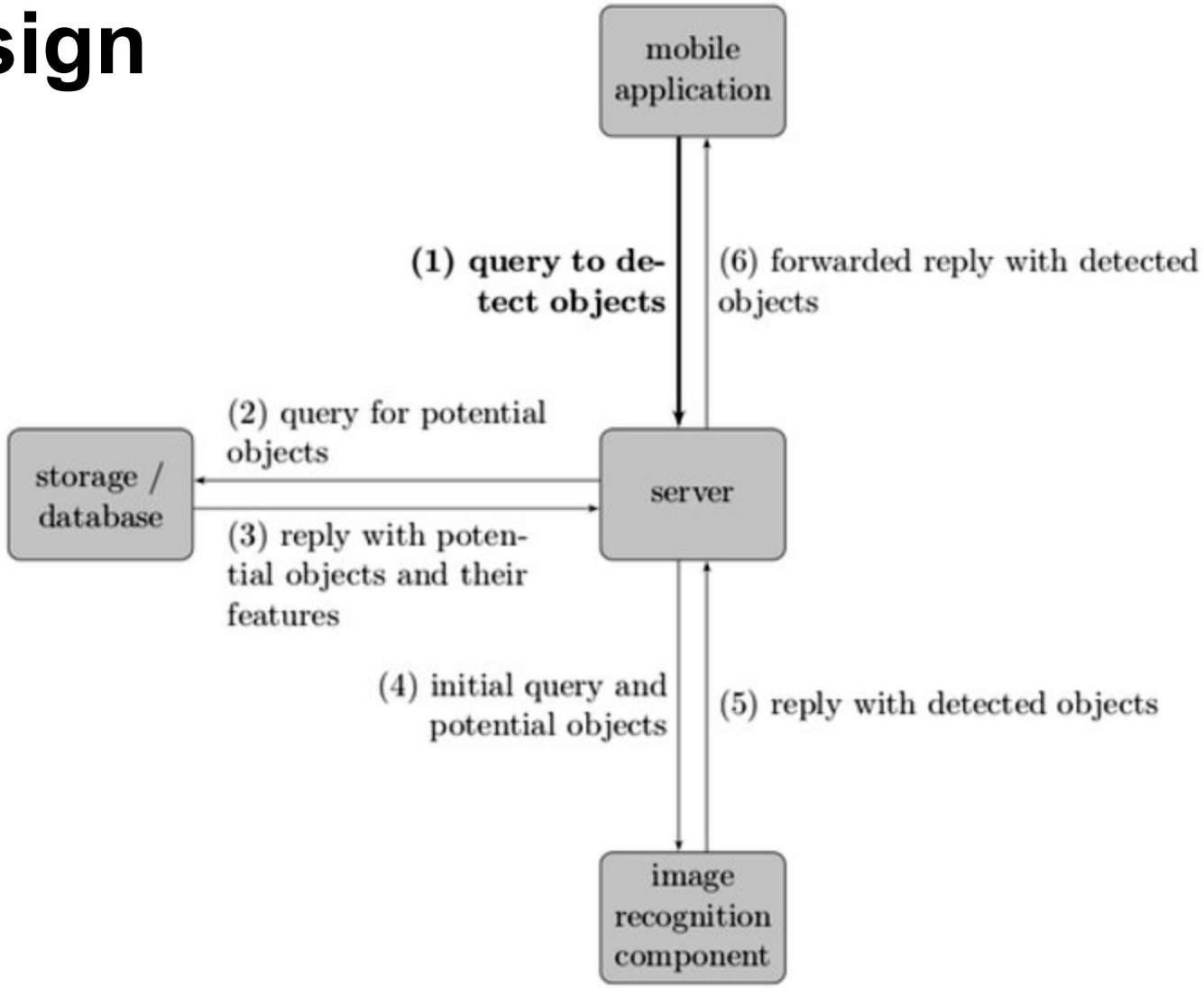
Our approach

- Combination of
  - **GPS positioning** (objects in the user's line of sight)



  - **Image recognition** (removal of false positives)

Design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(6) forwarded reply with detected objects
(2) query for potential objects
storage / database
server
(3) reply with potential objects and their features
(4) initial query and potential objects
(5) reply with detected objects
image recognition component

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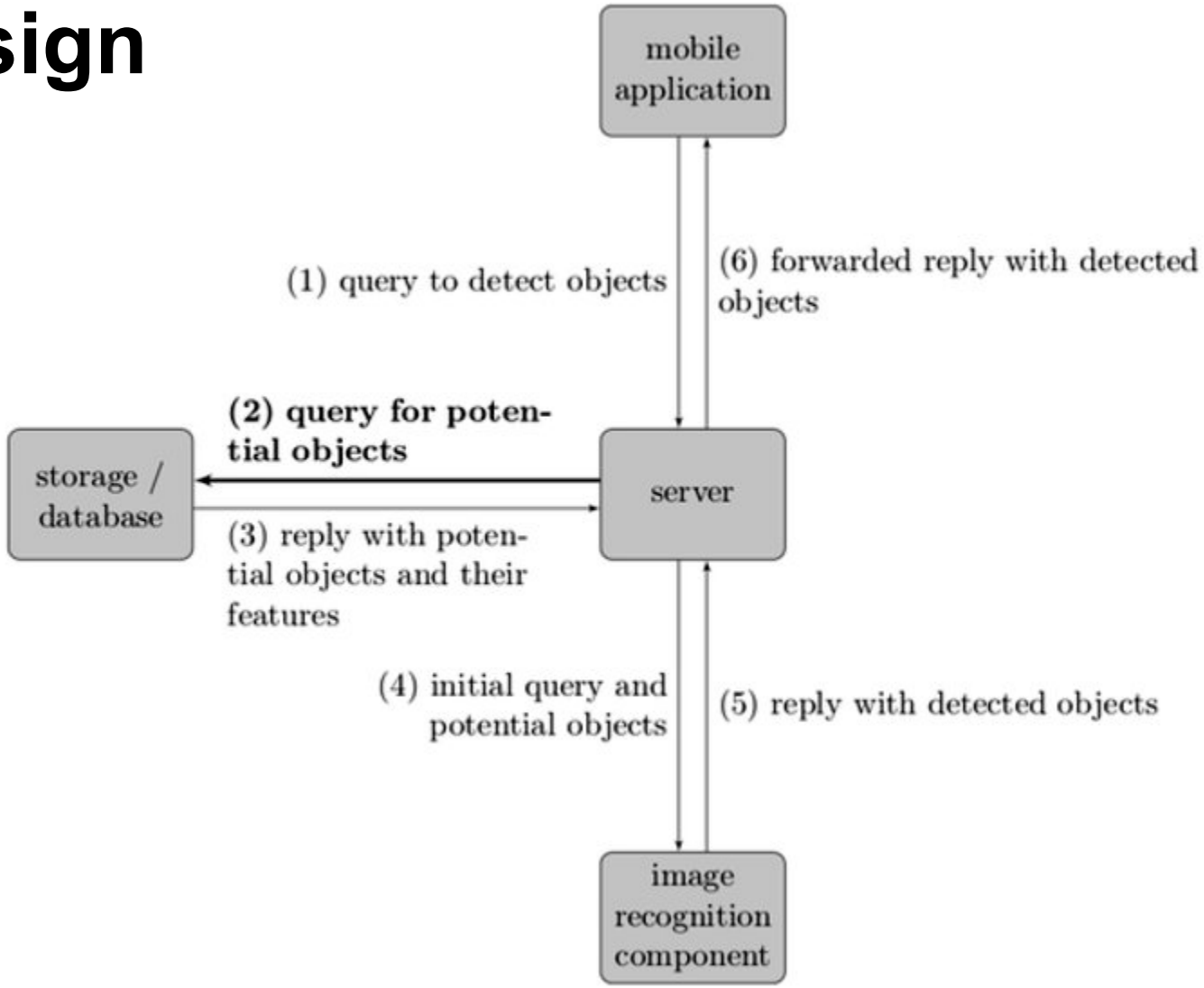
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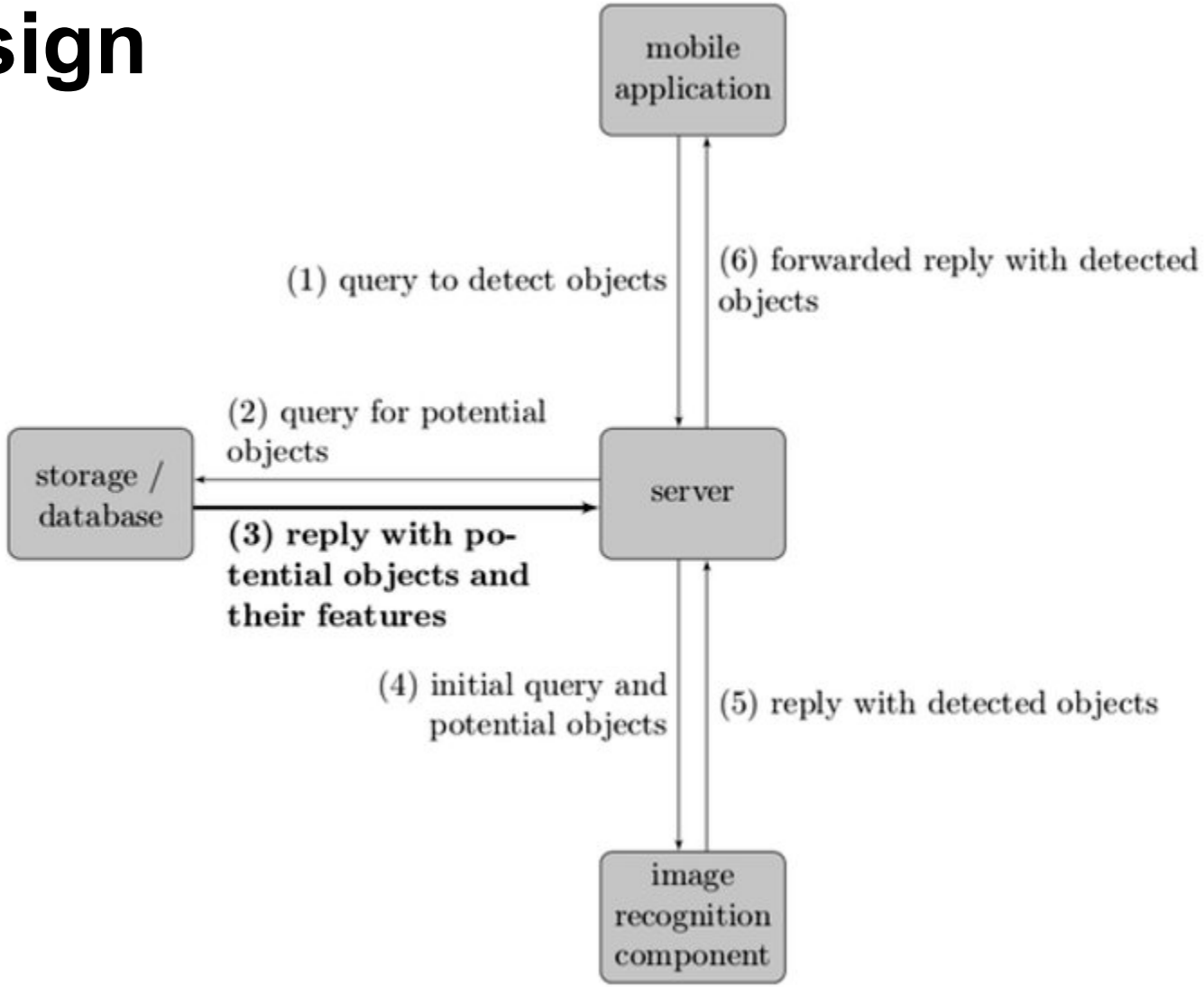
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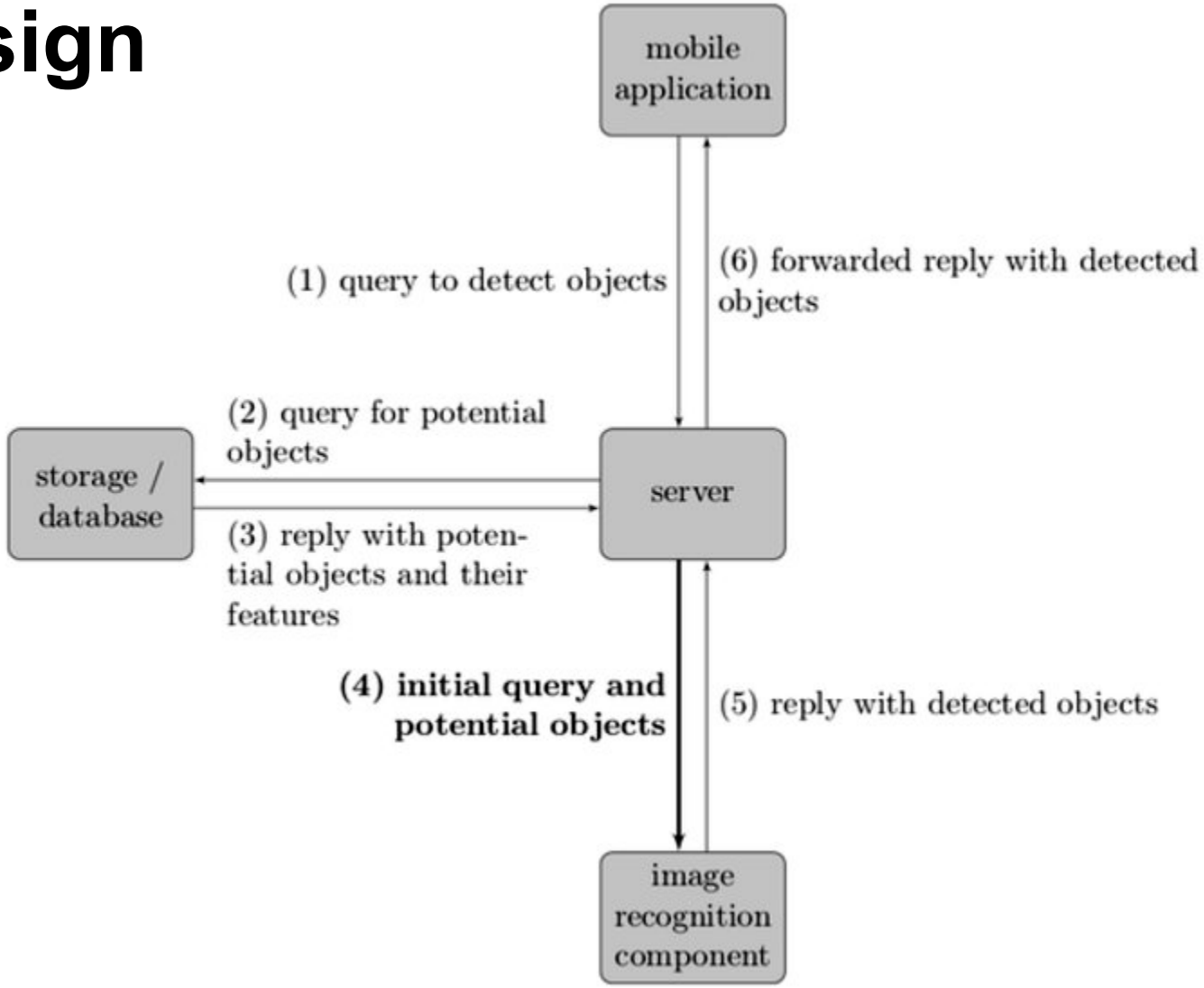
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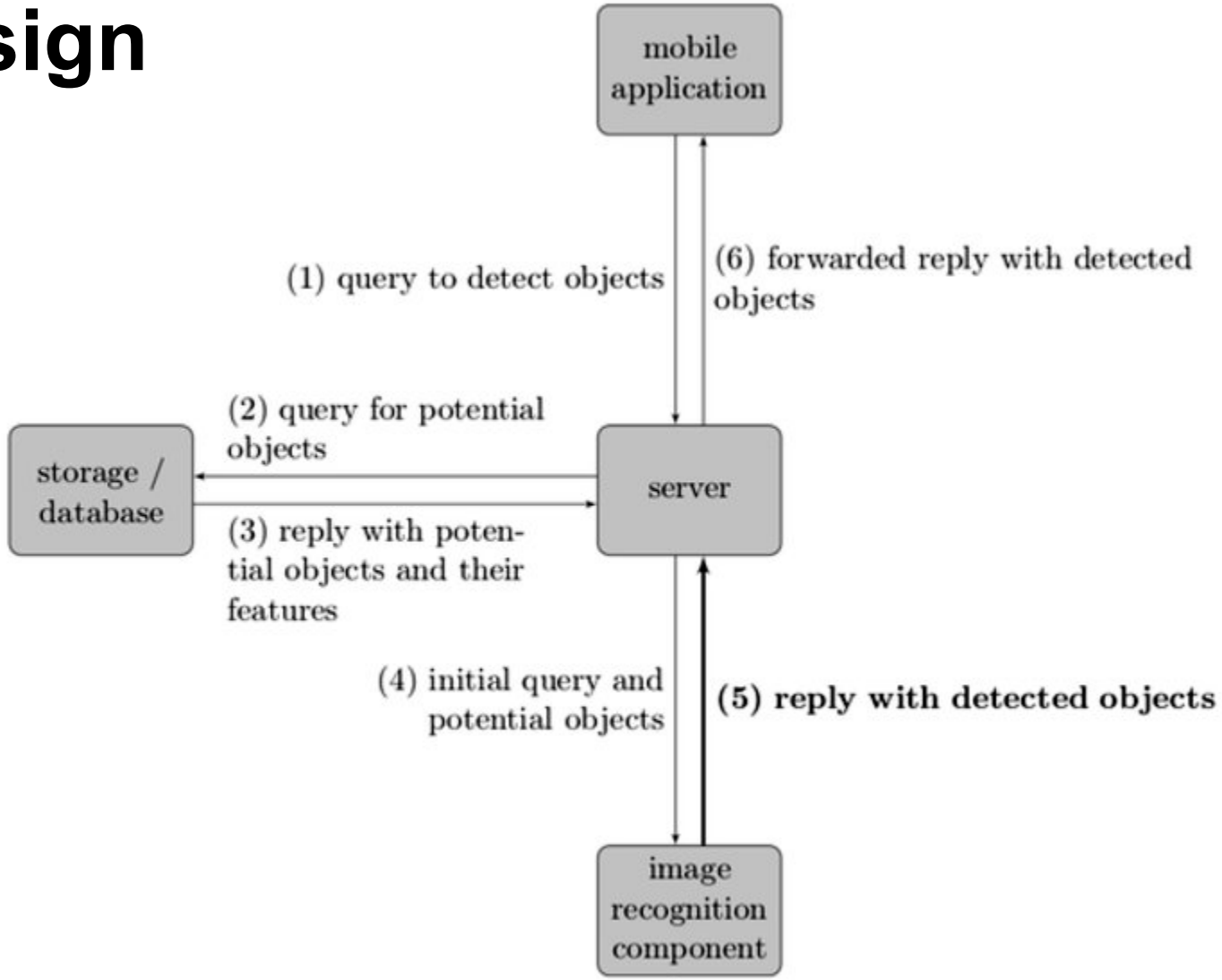
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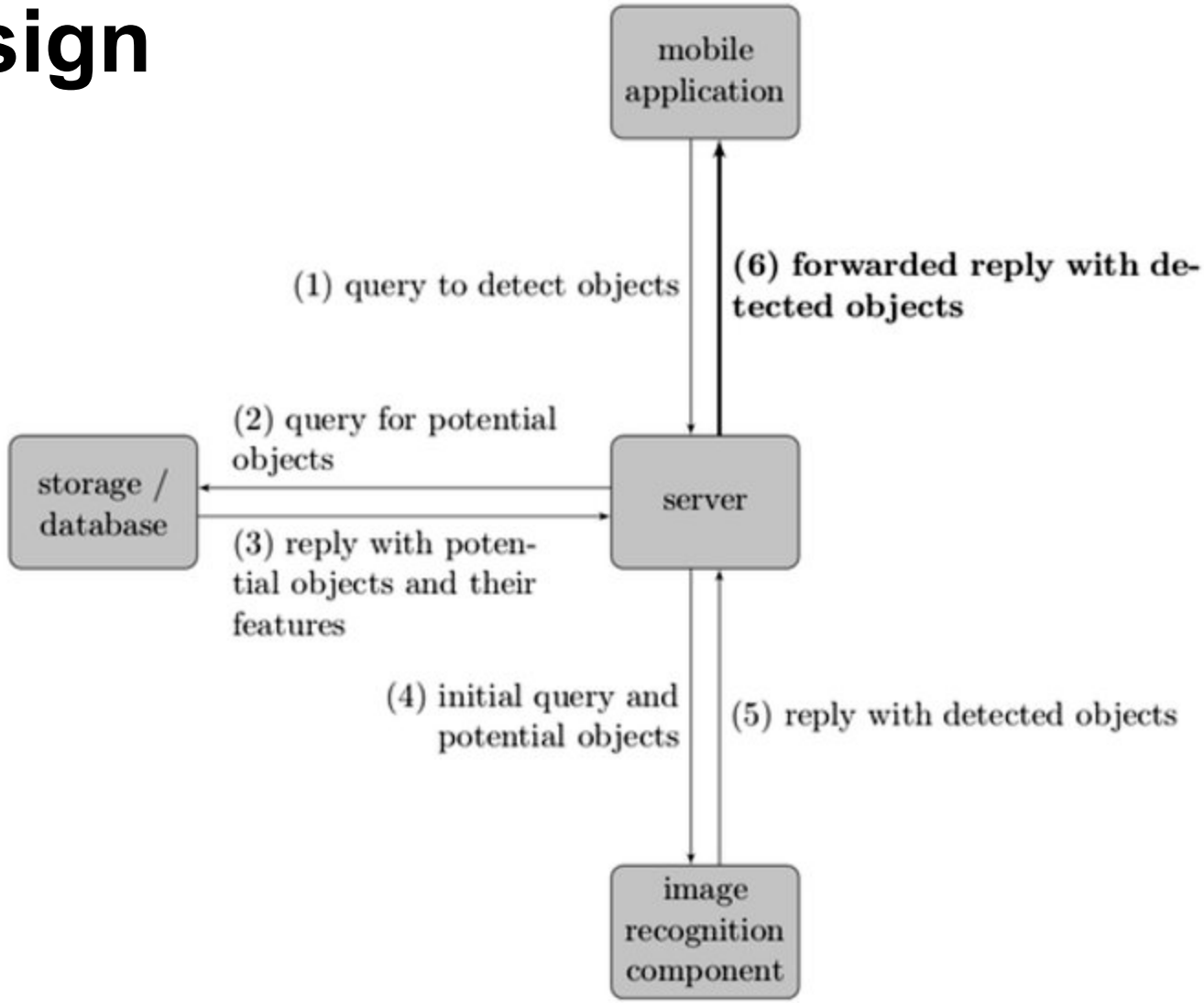
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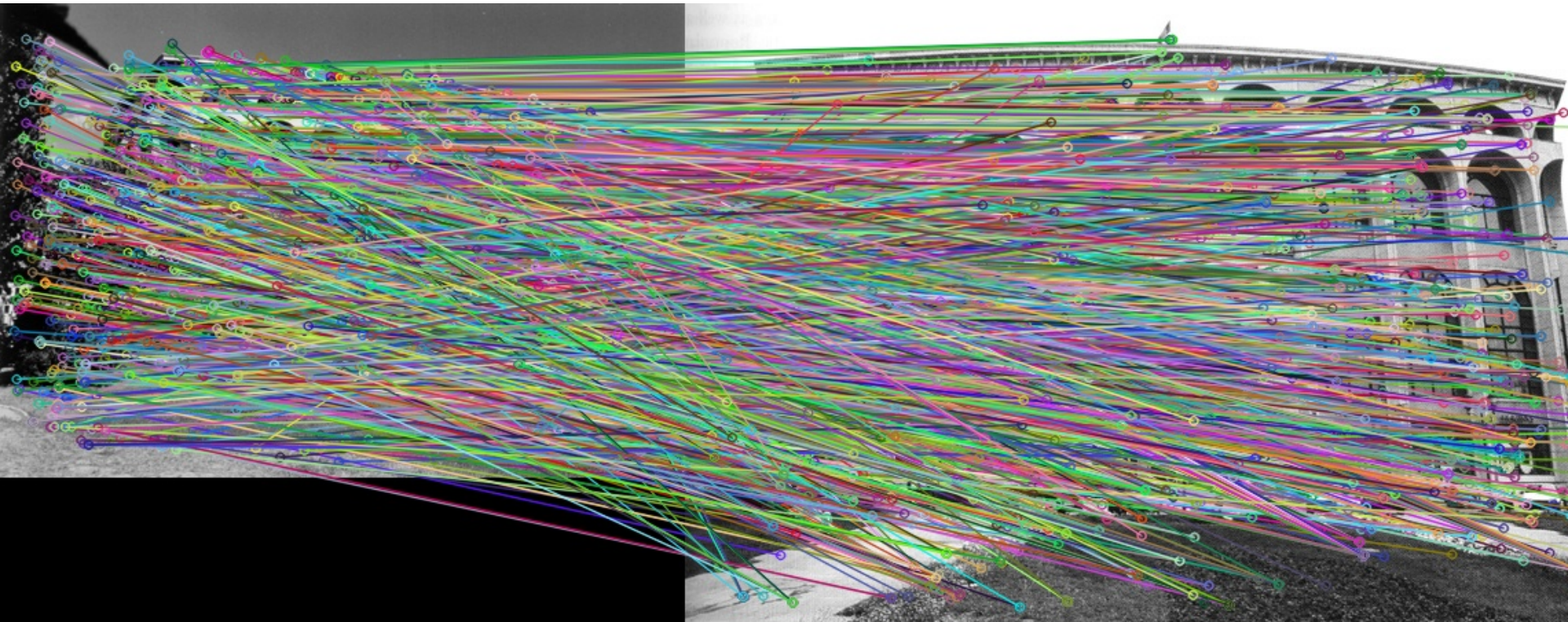
Database

- Stores: **images, features, objects' metadata**
- **2** types of queries: **query** and **store request**
- **easily and optimally distributed**
- **schema-less**

- Netflix & Cassandra: 3.3 million writes/sec, w/ 288 machines

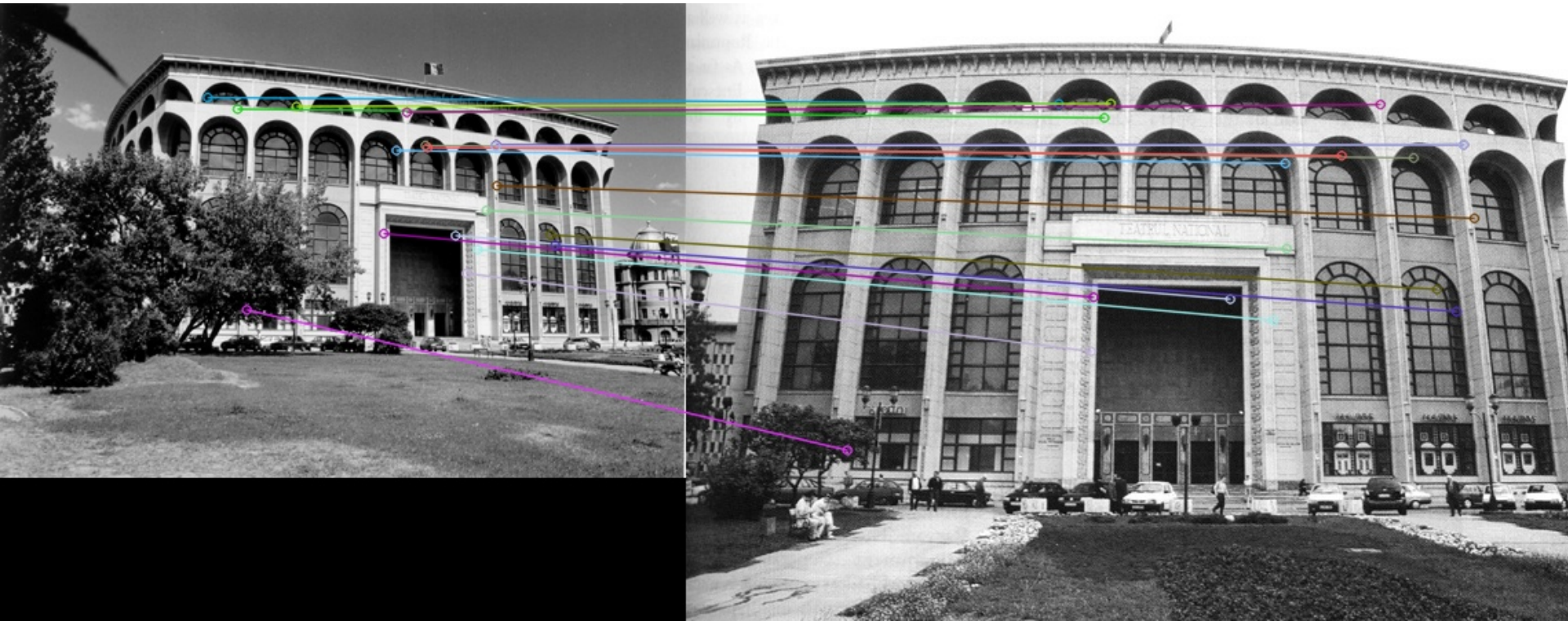
OpenCV

- most well-known library
- SIFT, SURF
- FLANN-based matcher



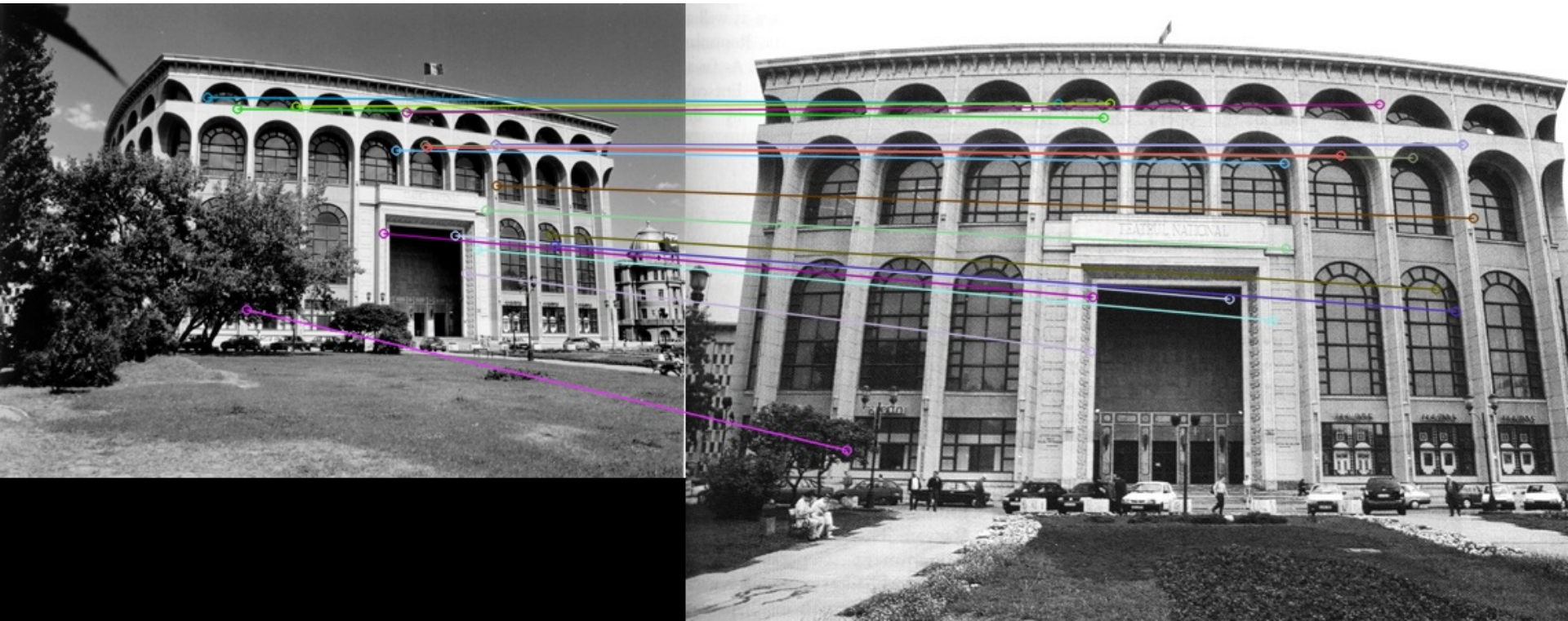
OpenCV(2)

- How it should look like:



Purgers - problems

1. **repetitive features** (*i.e. windows*)
2. **features matched incorrectly**



Purgers - solutions (1)

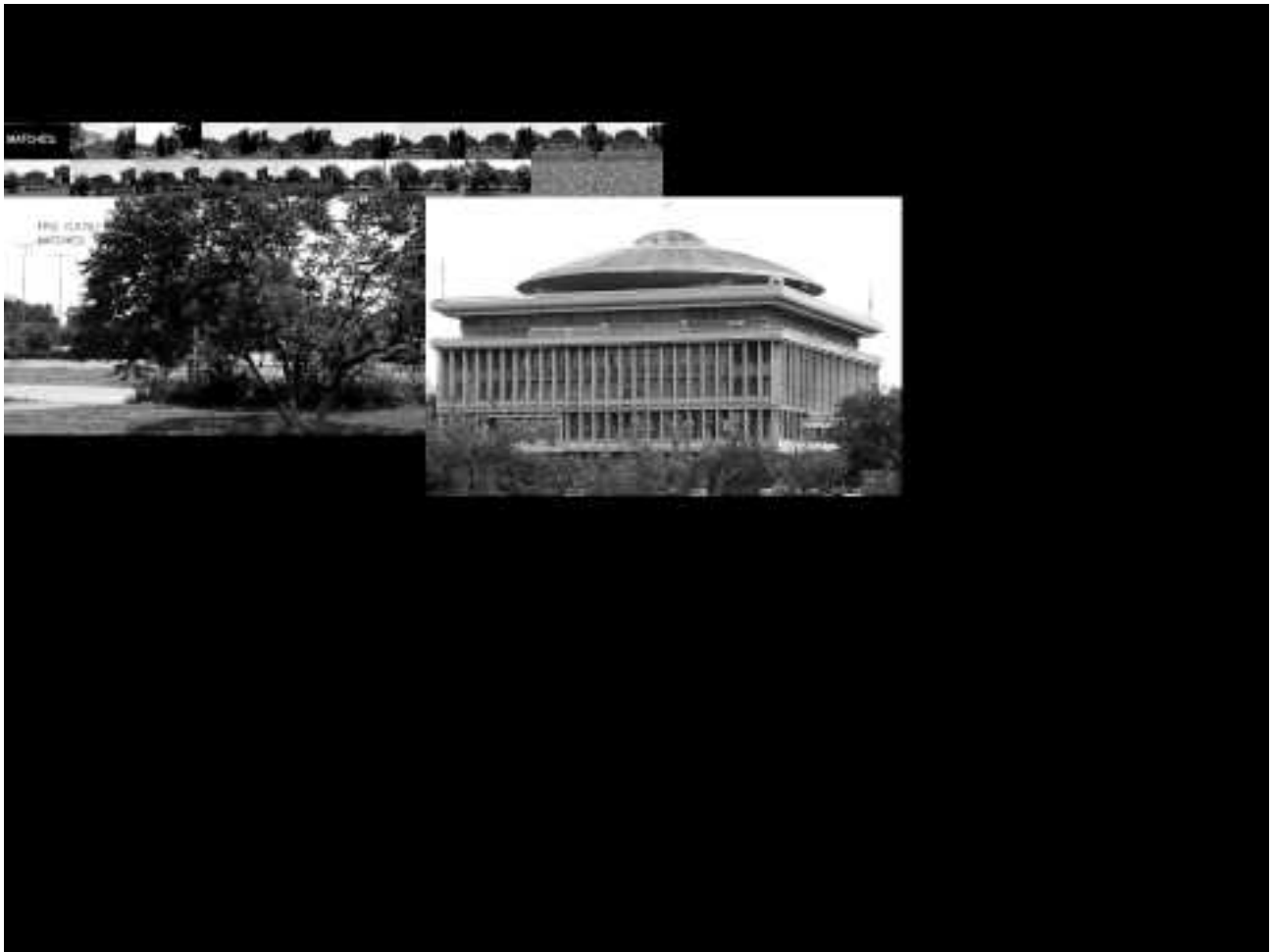
- Problem: **repetitive features** (*i.e. windows*)
  - we're matching query image **(Q)** to existing image **(E)**;
- Solution:
  - for any feature in **(Q)**, get the top 2 choices for matches in **(E)**;
  - if they have roughly the same certainty of being valid, drop the match;
  - swap **(Q)** with **(E)** and repeat;
  - keep matches that are symmetric.

Purgers - solutions (2)

- Problem: **features matched incorrectly**
  - we're matching query image **(Q)** to existing image **(E)**;
- Observations:
  - **(Q)** and **(E)** are *looking* at the same object, from different viewports (**stereovision**);
  - matches lie on the **epipolar line;**
- Solution:
  - compute the **fundamental matrix (F):**
    (Q) = (F) * (E) using **RANSAC;**
  - remove all matches **(Q) - (E)** that do not have the same epipolar lines.

End-result

- simulation of the mobile app behaviour:



Crowdsourcing

- user input (**store requests**)
- **passive example generation**
  - from queries;
  - from storage requests.

purple - query frame; green - valid passive examples; red - invalid examples

Future work

- sparse queries, backed by feature tracking on the mobile application;
- passive example generation;
- better inference of localization features;

- database improvements (sharding);
- security

Thanks

- Thanks to **Andrei Petre (yr. 2)** for implementing the **Android application**.

Questions