Mobile control interface for modular robots

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Semester project

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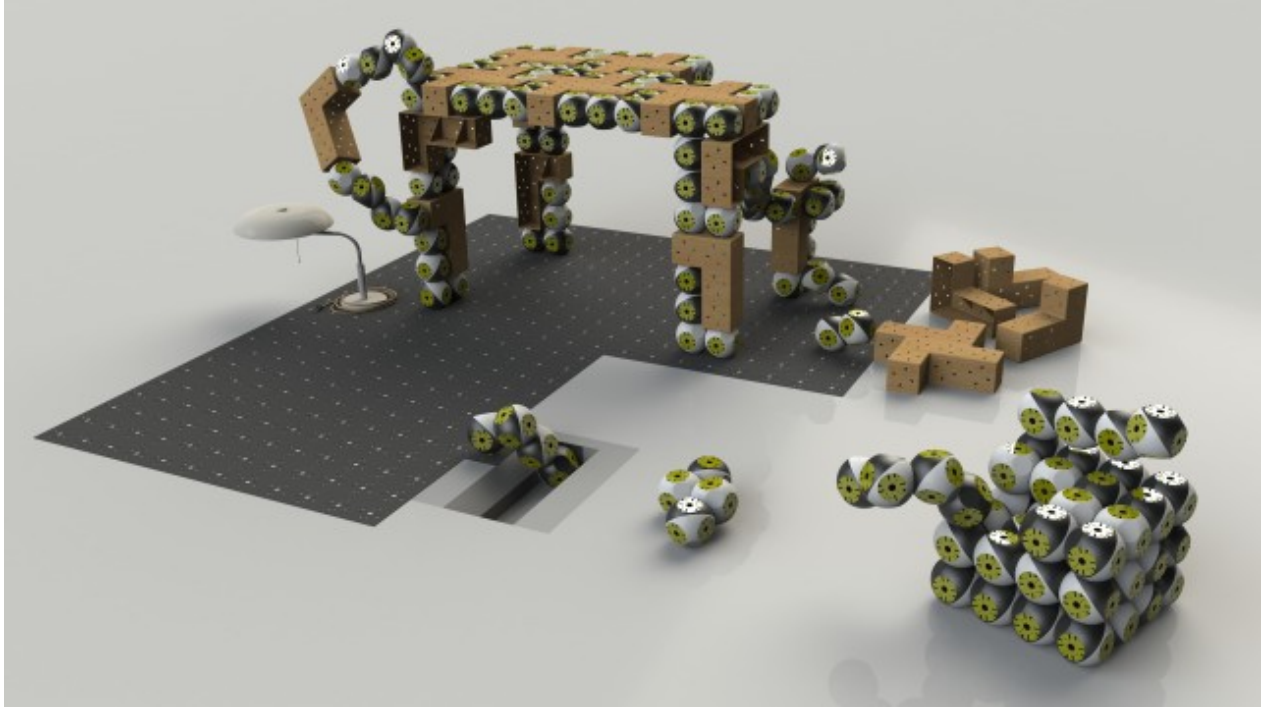
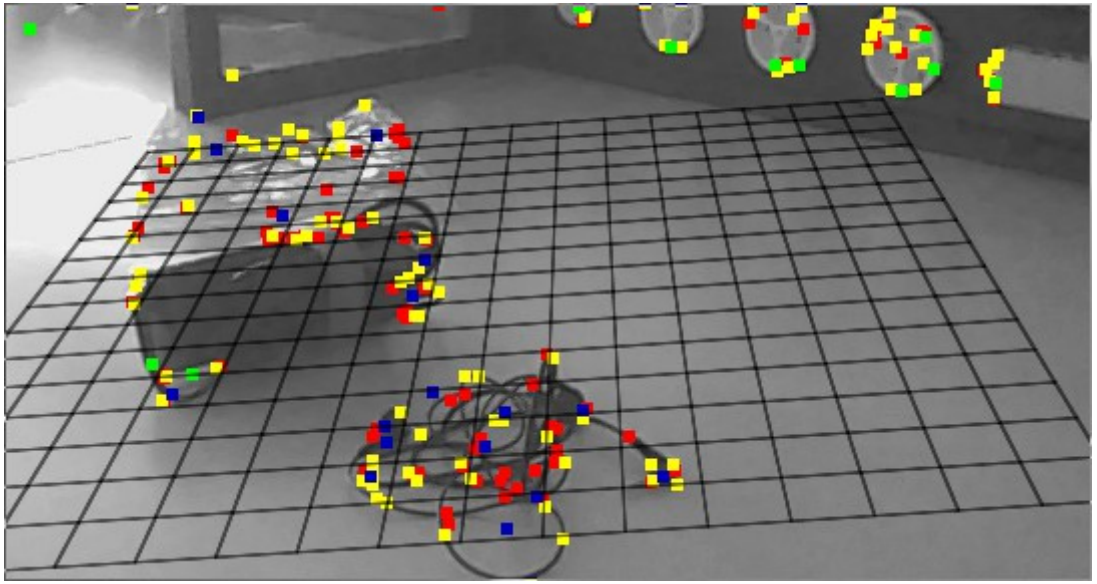
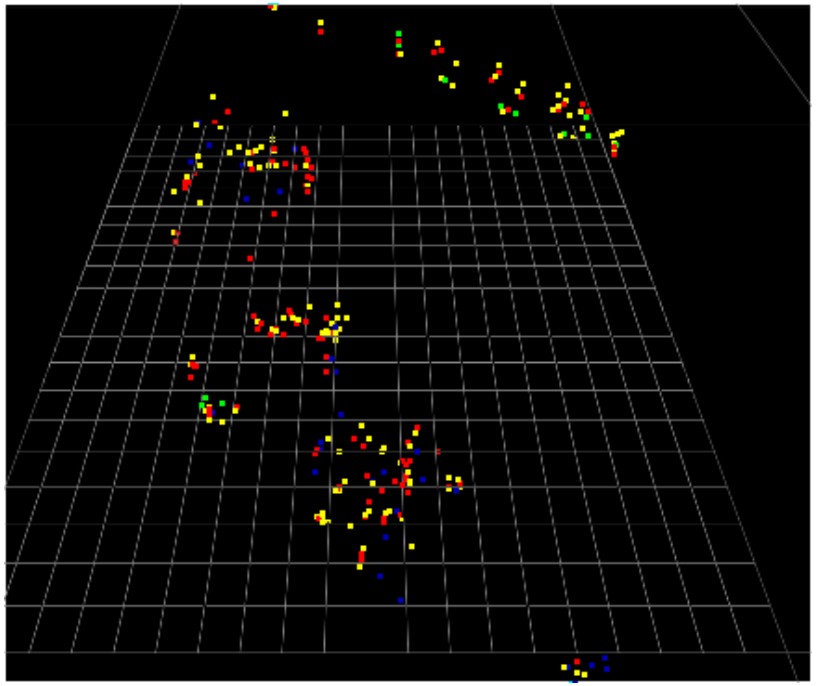
We want the current simulation on an augmented reality (AR)



Augmented reality techniques

- On camera sensors.
- Pattern detection.
- Simultaneous localization and mapping aka SLAM.



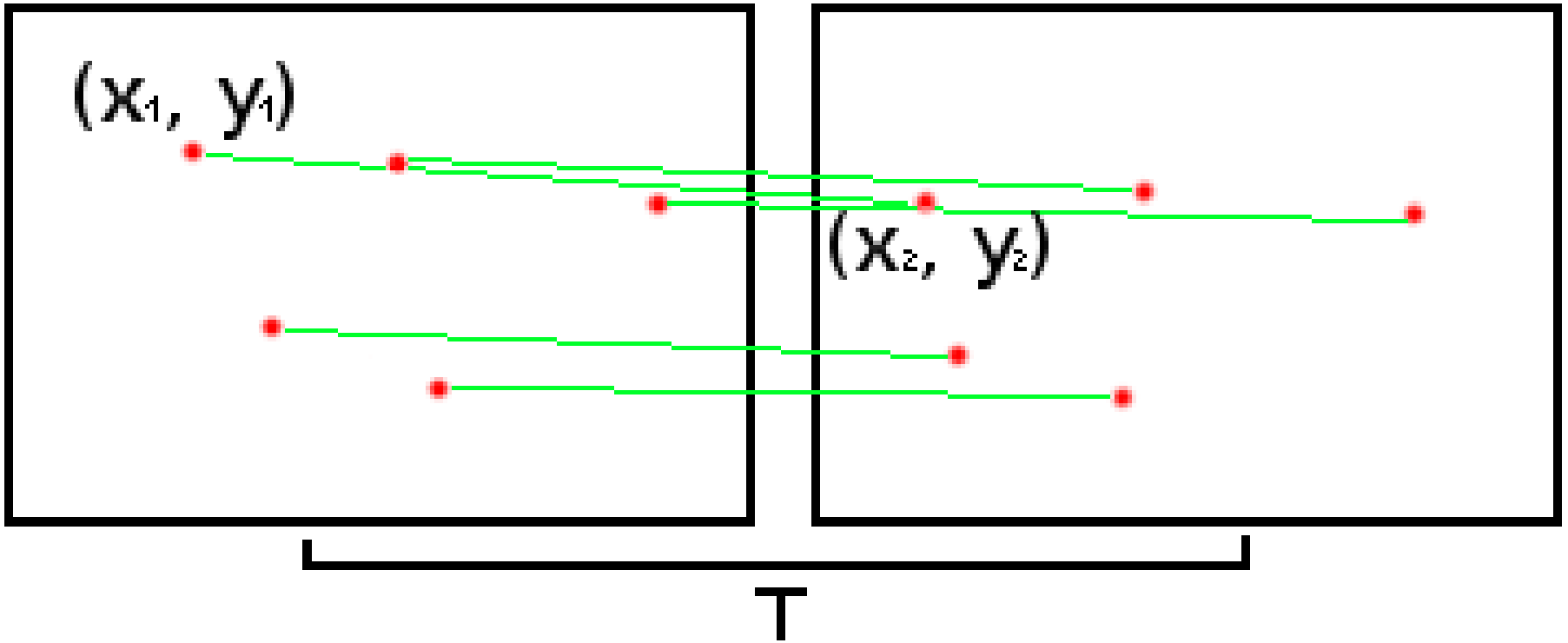


Why SLAM-like algorithm

- No need of extra markers.
- No need of sensors other that the camera.
- No need of any knowledge about the environment.

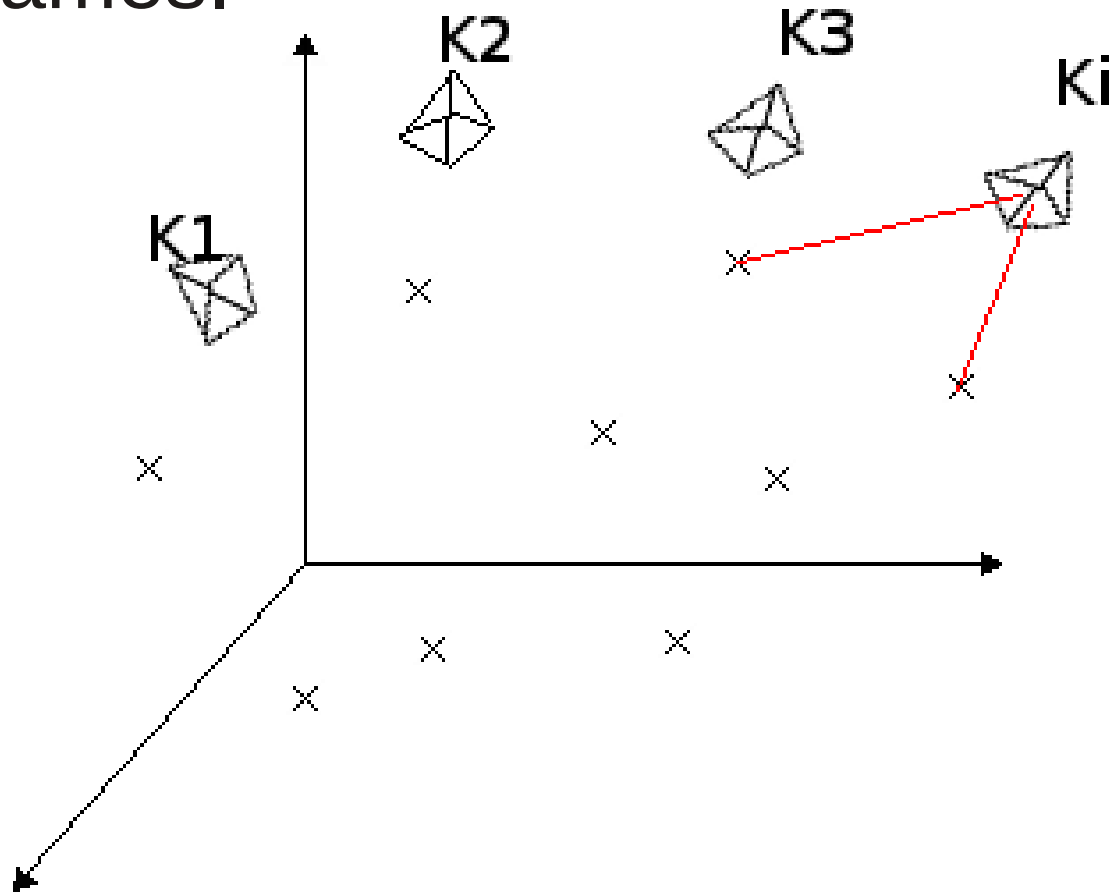
How SLAM works

- Initialization
- T is a supposed known translation. But in fact we don't have any idea of it.
- Give an idea of the real position of features.



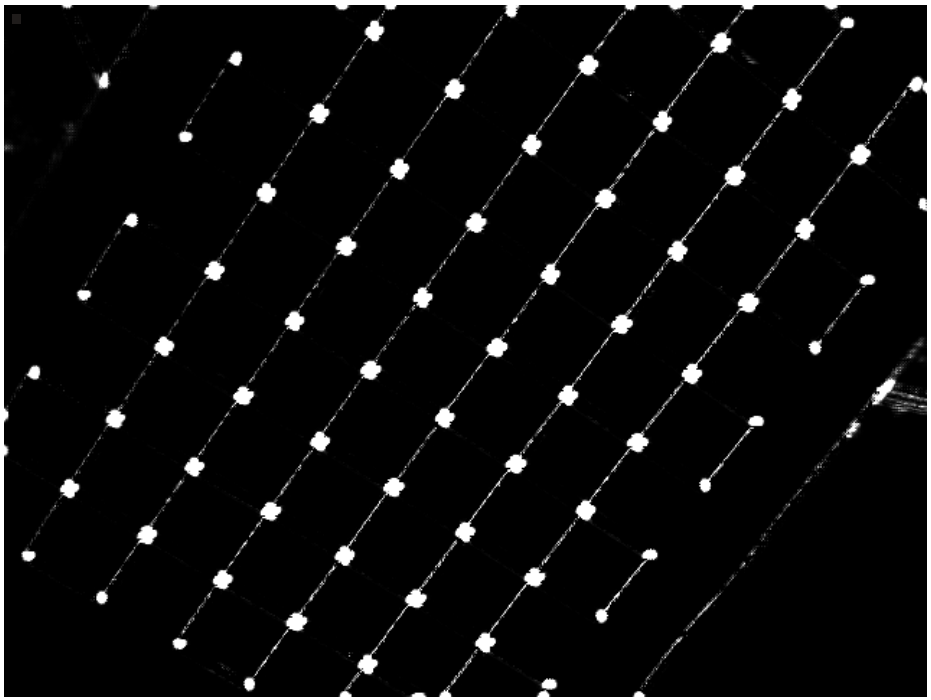
How SLAM works

- A plane is computed relatively to the points.
- Points of interests and camera position are stored into key-frames.



How SLAM works

- Update camera position with known points.
- Add new points of interest.
- Add key-frame when good tracking.
- Adjust known mapping



What is PTAM

- PTAM stands for Parallel tracking and mapping.
- Similar that SLAM but do tracking and mapping parts in separate threads.
- Currently works on PC (Linux/Windows) and iPhone.
- Actually in GPLv3 license.

PTAM tests

- Always draw something even when the camera doesn't catch any points of interest.
  - Solved by testing a tracking quality threshold.

- Designed to run in small area.
  - Using multiples maps can solve this problem.
  - A fork exists **PTAMM.**

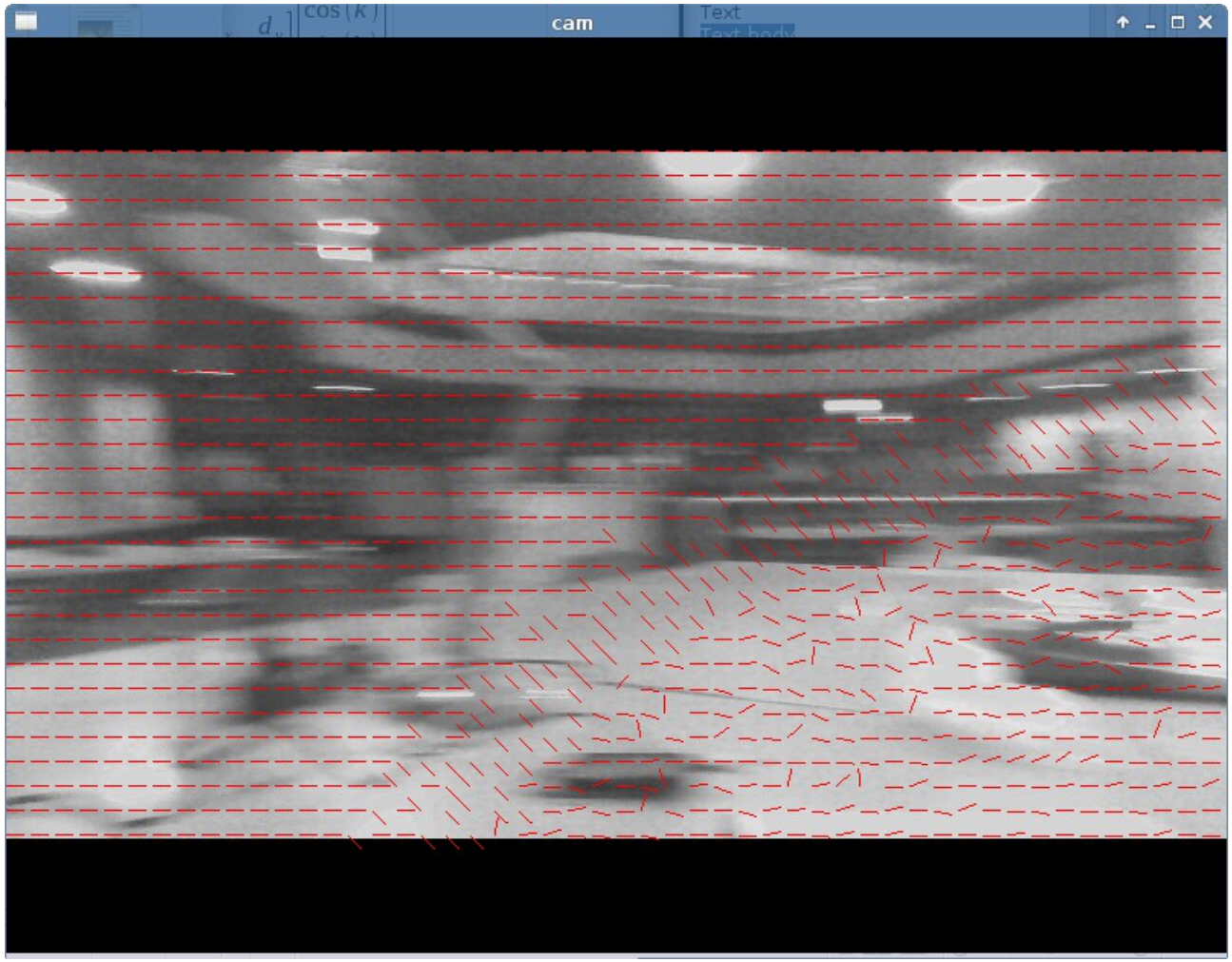
PTAM tests

- AR scene dimension can vary according to the initialization phase.
  - A perfect solution isn't possible with only a single camera.
  - User should be aware of that.

- When the camera move fast, motion blur make points disappear, tracking quality decrease.
  - Motion blur direction and intensity can be detected.

    Missing points position can be estimated.

Motion blur



Adapt PTAM

- PTAM already compute the scenery quality.
  - Needed to add new key-frames and readjust the current known map.
- Here a Boolean was added to indicate if the threshold is enough high to draw or not the scenery.

Adapt PTAM

- Change the example scenery.
- Relatively easy to replace it by a similar class.
  - All it needs internally is a **Init**, a **Reset** and a **Draw** function.
- The camera position is given as an argument in the draw function.
- The transformation to place the origin is already done in the OpenGL projection matrix.

Adapt PTAM

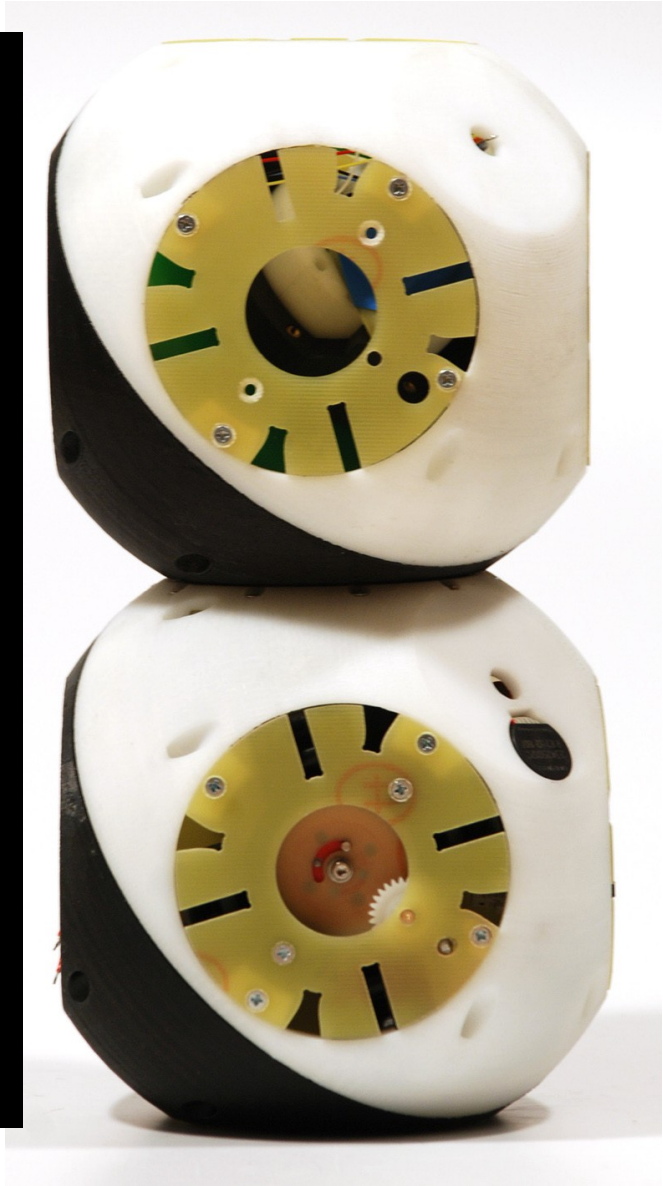
- Some extra tools were added:
  - A mesh loader.

    The mesh format used is Wavefront obj.
  - A texture loader.

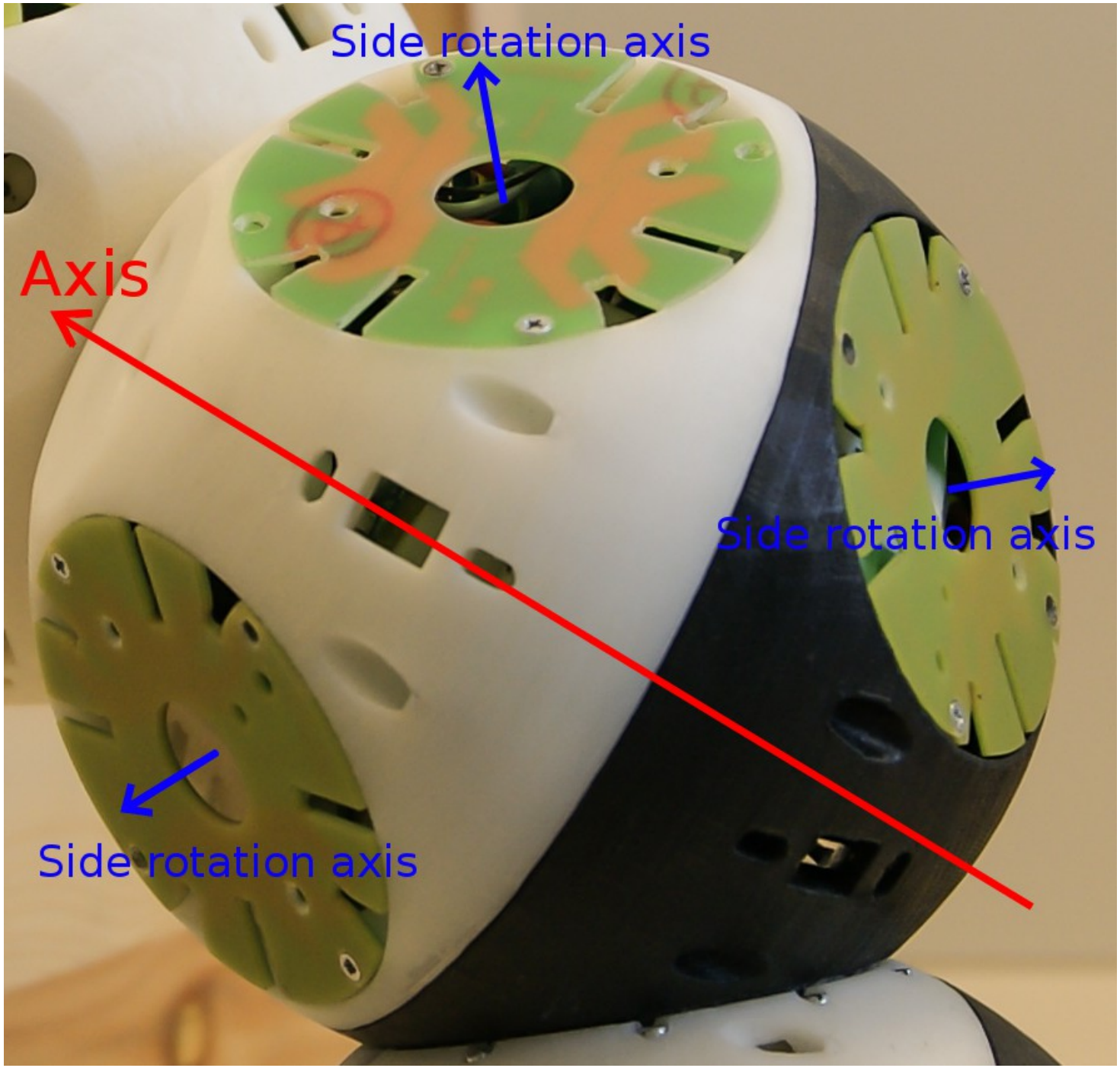
AR programming interface

```
class Bot
{
 public:
  Bot * up;
  Bot * down;
  Vector<3> v3Position;
  int fixedPart;
  Vector<3> v3RotationAxis;
  float axisAngle;
  Vector<3> v3RotationSide[6];
  float sideAngle[6];
  Bot * connected[5];
  Bot();
  Bot(int x, int y);

  static Bot * createUnit();
  void SetPosition(Vector<3> pos);
  unsigned int NearestFace(Vector<3> v);
  void RotateOnSide(float angle, unsigned int side);
  void RotateOnAxis(float angle);
  void Attach(Bot * bot);
  void Attach(Bot * bot, unsigned int a, unsigned int b);
  void Attach(int x, int y);
  void Draw();
};
```



One side is always fixed.



What should be done now?

- Complete the 3D scenery.
- Improve the user interface.
  - Permit the user to place a Roombot in front of the camera, to choose between different scenery, ...

Thank you for your attention!

Questions?