Implementation of Nine Men's Morris

Lars Engel
Vikash
Ahsan Yousuf

Fachhochschule Kiel

24. Juni 2015

Outline

Introduction

- KUKA lbr iiwa 7.
- Game called Nine Men's Morris.
- Cognex Camera.
- Artificial Intelligence.

Outline

Milestones of the Project

- Human vs KUKA robot.
- Robot can detect human moves and can perform its own moves wisely.
- Robot knows its turn after human.
- Through a camera robot interacts with real world.

Outline

Software and Hardware Tools

- Robotic Arm LBR iiwa 7 R800 1 by KUKA Laboratories GmbH.
    - Sunrise Workbench
- Cognex IS 7000 Camera
    - Cognex In-Sight Explorer.

- Eclipse IDE for testing AI and server setup.
- GIT for version control.

Outline

Basic requirements to achieve target

- Understanding of Nine Men's Morris games rules.
- Getting started with some useful methods of the robot.
- Learn how to use the Camera.

Task distribution

- Story 1: As a user I want the robot to move one game piece from one point to an other point.
- Story 2: As a user I want the camera to recognize the game
    - Story 2.1: As a user I want the camera to recognize the game pieces.
    - Story 2.2: As a user I want the camera to recognize the game board.
- Story 3: As a user I want the robot to know all relevant game board points.
- Story 4: As a player I don't want to get harmed by the robot.
- ...

Outline

Program Architecture

-
-

Safety

```java
/**
 * PTP Move method, which stops when a specific force is reached
 *
 * @param destination
 */
public void savePtpMove(AbstractFrame destination) {
    ForceCondition testForceCondition = ForceCondition.createSpatialForceCond
    IMotionContainer movement = gripper.getDefaultMotionFrame()
            .move(ptp(destination)
                    .breakWhen(testForceCondition)
                    .setJointVelocityRel(0.5));
    IFiredConditionInfo firedCondInfo = movement.getFiredBreakConditionInfo()
    if (firedCondInfo != null) {
        ThreadUtil.milliSleep(1000);
        appUI.displayModalDialog(ApplicationDialogType.INFORMATION, "App Stop
    }
}
```

Outline

Difficulties faced during the project

- Understanding of robotics
    - Robot movement limitations
    - Coordination transformations
- Understanding of AI.
- Recognition by the camera.
    - Game board alignment.
    - Token recognition
- Communication of robot and camera.

Outline

1 Introduction

2 Milestones of Project

3 Software and Hardware Tools

4 Workflow
- Basic requirements to achieve target
- Task distribution

5 Implementation phase
- Program Architecture
- Safety

6 Difficulties faced

7 Conclusion

Conclusion

- Human can play Nine Men's Morris against the robot.
- Possible Improvements:
  1. Better cheat handling
  2. Board orientation and location
  3. Choosing token color and starting player

Thank You