

# Implementation of Nine Men's Morris

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# Outline

- 1 Introduction
- 2 Milestones of Project
- 3 Software and Hardware Tools
- 4 Workflow
  - Basic requirements to achieve target
  - Main User Stories
- 5 Implementation phase
  - Program Architecture
  - Safety
  - Visual Analysis
  - Communication between Robot and Camera
- 6 Difficulties faced
- 7 Conclusion

# Introduction

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

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# 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.

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# Software and Hardware Tools

- Robotic Arm LBR iiwa 7 R800 1 by KUKA Laboratories.
  - Sunrise Workbench.
- Cognex IS 7000 Camera.
  - Cognex In-Sight Explorer.
- Eclipse IDE for testing AI and Modbus TCP/IP Connection.
- GIT for version control.

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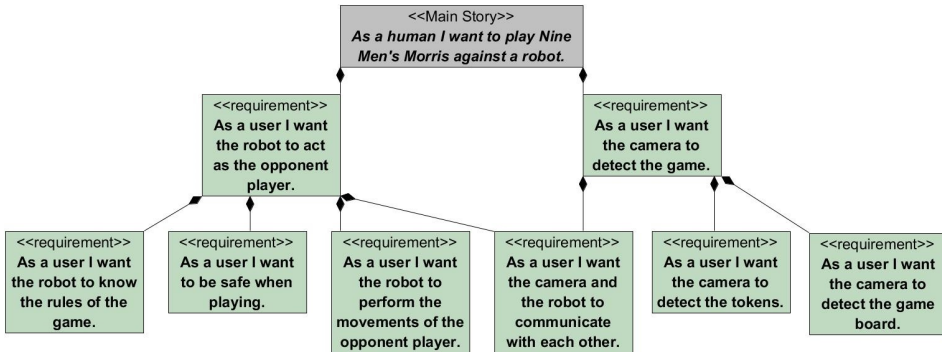
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# Basic requirements to achieve target

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

# Main User Stories

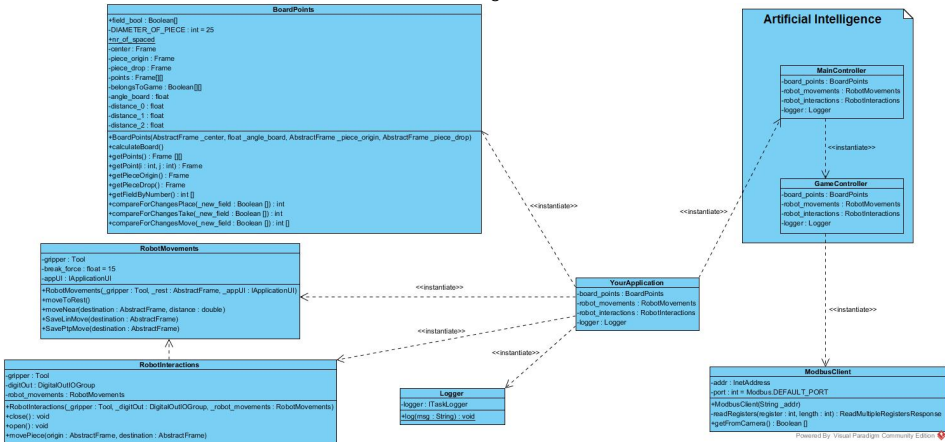


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# Program Architecture

Class Diagram



# Safety

Listing 1: Extract from the Class RobotMovements

```

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

```

Listing 2: Call for save PTP Movement Method

```
robot_movements.savePtpMove(getApplicationData().getFrame("/piece_origin"));
```

# Visual Analysis

# Communication between Robot and Camera

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# 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.

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# 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