**ABSTRACT**

Our project aims to identify known target through ALDEBARAN NAO and then to throw an object towards it. In our project we first detect the known target using Image Processing techniques, then we compute the position of that object and finally we perform the throwing action.

**INTRODUCTION**

- The interest in humanoid robotics has increased manifold especially in creating intelligent and autonomous bots. Humanoids are expected to perform day to day task and actions so that they become more interactive with humans.
- Performing throwing action is one such task which fulfills a whole lot of needs. It enable one to manipulate places out of ones direct reach. This procedure has many applications in army, humanoid game playing and several other fields.
- In our project, we detect the known target, estimate the depth and direction of the target using prior knowledge of the target size and specifications, perform throwing action using its right hand.
- Then we process the video and find the angle of throw and then calculate new angle of trajectory needed.

**PREVIOUS WORK**

- In [1] authors discuss the control for throwing manipulation by one joint robot. The present paper proposes the control strategy based on the iteration optimization learning to perform the throwing action effectively.
- In [2] authors formulises the idea of task-level learning to make a robot throw a ball at a target. Task-level learning can compensate for the structural modelling error of the robot’s lower control system.
- In [3] author shows that reinforcement learning can be employed to refine the hitting skill acquired by imitation learning according to a roll of inverse kinematics of Aldebaran Nao has been achieved.
- Object recognition and depth estimation is proposed in [4]

**METHODOLOGY**

- **Detect Target**
  - Capture Video
  - Feedback
  - Determine co-ordinates of the target
  - Get target center and height.
  - From the prior knowledge of height and width of the target, calculate x and y coordinates in nao torso frame.
  - naoX = (imgX - imgWidth/2)*W_real/W
  - nayo = (imgHeight - imgY)*a
  - Using binary search find the containing learned angles.
  - Learn parameters for throw in specific angles.
  - For the given angle do the following:
    - Using binary search find the containing learned angles.
    - Assuming linear model: estimate parameters for the given theta.
    - Perform throw actions following these parameters.

- **Throw Action**
  - Joints Used: RShoulderPitch, RShoulderRoll, RElbowYaw
  - Learn parameters for throw in specific angles.
  - For the given angle do the following:
    - Using binary search find the containing learned angles.
    - Assuming linear model: estimate parameters for the given theta.
    - Perform throw actions following these parameters.

**RESULTS**

- The method was tested with random position and average error is 5-10 degrees.

**REFERENCES**


**IMPROVEMENTS AND FUTURE WORK**

- If the target is not in field, nao does nothing. This can be treated by moving head to detect target and then performing throw action.
- Detecting target of different geometry and shape.
- Able to throw directly at the target.

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