

Progress Presentation-I

e-Yantra Summer Internship-2018

A System for Solving Jigsaw Puzzle using Multiple Robots

Aniket Anantraj Navlur

Ashis Kumar Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar, Kalind Karia

IIT Bombay

June 7, 2018

Overview of Project

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Project Name: A System for Solving Jigsaw Puzzle using Multiple Robots
- Objective:
 - To develop an autonomous system that can solve any Jigsaw Puzzle given its image using multiple robots
- Deliverables:
 - 1 Go-to-Goal controller for robot in a given frame
 - 2 Autonomous solving of any Jigsaw Puzzle given just its image
 - 3 Proper documentation and report on the system

Overview of Task

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

Task No.	Task	Deadline (in Days)
1	Python, OpenCV, Firebird V Intro, Xbee Communication	3
2	Pose and orientation calculation of 2 Firebird robots using color/Aruco markers	4
3	Programming the Go-To-Goal Controller for single Firebird V robot. Tuning the PID values to perfection	4
4	Implementing path planning with Firebird V where obstacles have been placed in arena	3
5	Detection of jigsaw puzzle blocks using Template Matching	2
6	Pick and place of blocks - gripper mechanism building	4
7	Implementing the entire solution for a given jigsaw puzzle	5
8	Documentation and reporting results	4

Task Accomplished

Progress
Presentation-1

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Established communication with the robot using XBee

Task Accomplished

Progress
Presentation-1

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Established communication with the robot using XBee
- Found the pose and orientation of the robot using ArUco markers

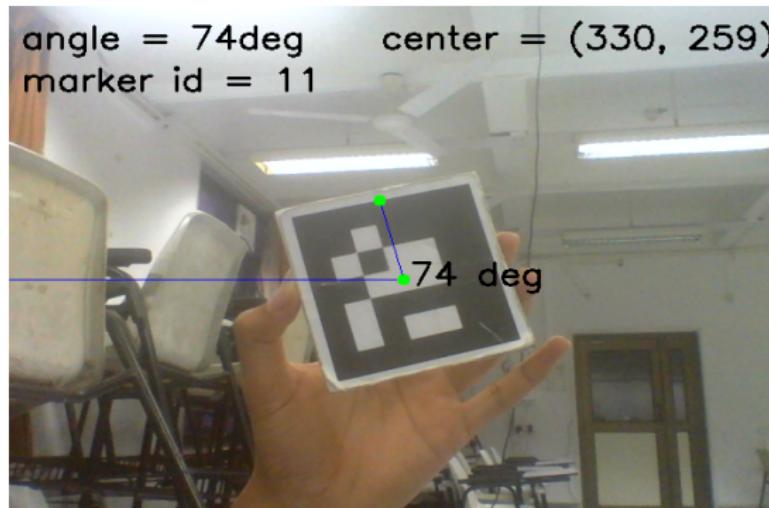


Figure 1: ArUco id, center position, orientation

Task Accomplished

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Formed the data packets to be sent, received and parsed correctly

Task Accomplished

- Formed the data packets to be sent, received and parsed correctly

```
<T|69|45|P|200|0|0|R|389|224|405|202|A101|>
<T|69|45|P|200|0|0|R|389|224|405|203|A103|>
<T|69|45|P|200|0|0|R|389|224|405|202|A101|>
<T|69|45|P|200|0|0|R|389|224|405|203|A103|>
<T|69|45|P|200|0|0|R|388|225|404|204|A102|>
<T|69|45|P|200|0|0|R|386|226|402|206|A103|>
<T|69|45|P|200|0|0|R|383|228|400|207|A103|>
<T|69|45|P|200|0|0|R|380|229|398|209|A106|>
<T|69|45|P|200|0|0|R|378|231|396|211|A106|>
<T|69|45|P|200|0|0|R|373|234|393|215|A109|>
<T|69|45|P|200|0|0|R|371|236|391|217|A109|>
<T|69|45|P|200|0|0|R|367|238|387|220|A110|>
<T|69|45|P|200|0|0|R|364|240|385|222|A111|>
<T|69|45|P|200|0|0|R|0|0|0|0|A180|>
<T|69|45|P|200|0|0|R|356|243|379|227|A115|>
<T|69|45|P|200|0|0|R|353|244|376|228|A115|>
<T|69|45|P|200|0|0|R|350|246|372|231|A115|>
<T|69|45|P|200|0|0|R|346|248|369|233|A115|>
<T|69|45|P|200|0|0|R|343|249|365|235|A115|>
<T|69|45|P|200|0|0|R|339|251|363|237|A117|>
<T|69|45|P|200|0|0|R|335|252|359|239|A118|>
<T|69|45|P|200|0|0|R|331|253|355|241|A120|>
<T|69|45|P|200|0|0|R|326|255|352|242|A117|>
```

Figure 2: Data Packets

The data packet is formed by the following values

$< T | tar_x | tar_y | P | kp | ki | kd | R | head_x | head_y | tail_x | tail_y | A | deg | >$

Task Accomplished

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Formed the data packets to be sent, received and parsed correctly

```
<T|69|45|P|200|0|0|R|389|224|405|202|A|01|>
<T|69|45|P|200|0|0|R|389|224|405|203|A|03|>
<T|69|45|P|200|0|0|R|389|224|405|202|A|01|>
<T|69|45|P|200|0|0|R|389|224|405|203|A|03|>
<T|69|45|P|200|0|0|R|388|225|404|204|A|02|>
<T|69|45|P|200|0|0|R|386|226|402|206|A|03|>
<T|69|45|P|200|0|0|R|383|228|400|207|A|03|>
<T|69|45|P|200|0|0|R|380|229|398|209|A|06|>
<T|69|45|P|200|0|0|R|378|231|396|211|A|06|>
<T|69|45|P|200|0|0|R|373|234|393|215|A|09|>
<T|69|45|P|200|0|0|R|371|236|391|217|A|09|>
<T|69|45|P|200|0|0|R|367|238|387|220|A|10|>
<T|69|45|P|200|0|0|R|364|240|385|222|A|11|>
<T|69|45|P|200|0|0|R|0|0|0|0|A|180|>
<T|69|45|P|200|0|0|R|356|243|379|227|A|115|>
<T|69|45|P|200|0|0|R|353|244|376|228|A|115|>
<T|69|45|P|200|0|0|R|350|246|372|231|A|115|>
<T|69|45|P|200|0|0|R|346|248|369|233|A|115|>
<T|69|45|P|200|0|0|R|343|249|365|235|A|115|>
<T|69|45|P|200|0|0|R|339|251|363|237|A|117|>
<T|69|45|P|200|0|0|R|335|252|359|239|A|118|>
<T|69|45|P|200|0|0|R|331|253|355|241|A|120|>
<T|69|45|P|200|0|0|R|326|255|352|242|A|117|>
```

Figure 2: Data Packets

The data packet is formed by the following values

$< T | tar_x | tar_y | P | kp | ki | kd | R | head_x | head_y | tail_x | tail_y | A | deg | >$

- Tuned the PID values to perfection

Task Accomplished

- Formed the data packets to be sent, received and parsed correctly

```
<T|69|45|P|200|0|0|R|389|224|405|202|A|01|>
<T|69|45|P|200|0|0|R|389|224|405|203|A|03|>
<T|69|45|P|200|0|0|R|389|224|405|202|A|01|>
<T|69|45|P|200|0|0|R|389|224|405|203|A|03|>
<T|69|45|P|200|0|0|R|388|225|404|204|A|02|>
<T|69|45|P|200|0|0|R|386|226|402|206|A|03|>
<T|69|45|P|200|0|0|R|383|228|400|207|A|03|>
<T|69|45|P|200|0|0|R|380|229|398|209|A|06|>
<T|69|45|P|200|0|0|R|378|231|396|211|A|06|>
<T|69|45|P|200|0|0|R|373|234|393|215|A|09|>
<T|69|45|P|200|0|0|R|371|236|391|217|A|09|>
<T|69|45|P|200|0|0|R|367|238|387|220|A|10|>
<T|69|45|P|200|0|0|R|364|240|385|222|A|11|>
<T|69|45|P|200|0|0|R|0|0|0|0|A|180|>
<T|69|45|P|200|0|0|R|356|243|379|227|A|115|>
<T|69|45|P|200|0|0|R|353|244|376|228|A|115|>
<T|69|45|P|200|0|0|R|350|246|372|231|A|115|>
<T|69|45|P|200|0|0|R|346|248|369|233|A|115|>
<T|69|45|P|200|0|0|R|343|249|365|235|A|115|>
<T|69|45|P|200|0|0|R|339|251|363|237|A|117|>
<T|69|45|P|200|0|0|R|335|252|359|239|A|118|>
<T|69|45|P|200|0|0|R|331|253|355|241|A|120|>
<T|69|45|P|200|0|0|R|326|255|352|242|A|117|>
```

Figure 2: Data Packets

The data packet is formed by the following values

$< T | tar_x | tar_y | P | kp | ki | kd | R | head_x | head_y | tail_x | tail_y | A | deg | >$

- Tuned the PID values to perfection
- Developed a Go-To-Goal controller for multiple robots

Videos

Progress

Presentation-I

Aniket Anantraj

Navlur

Ashis kumar

Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar,

Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You



Figure 3: PID tuned



Figure 4: showing error angle being corrected



Figure 5: travelling to the nearest node

Challenges Faced

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Determining the angle of ArUco Marker in the frame with proper resolution

Challenges Faced

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Determining the angle of ArUco Marker in the frame with proper resolution
- Finding the right library for serial communication

Challenges Faced

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Determining the angle of ArUco Marker in the frame with proper resolution
- Finding the right library for serial communication
- Understanding the parameters of
Xbee('DH','DL','MY',channel='C', API, AT, etc...)

Challenges Faced

Progress
Presentation-I

Aniket Anantraj
Navlur
Ashis kumar
Maharana
Kiran S Patil

Mentors:
Abhinav Sarkar,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Determining the angle of ArUco Marker in the frame with proper resolution
- Finding the right library for serial communication
- Understanding the parameters of Xbee('DH','DL','MY',channel='C', API, AT, etc...)
- Creating data packets to hold the information about robot (its orientation, position, etc...) and parsing it once received by the robot.

Future Plans

Progress

Presentation-I

Aniket Anantraj

Navlur

Ashis kumar

Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar,

Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

■ Path Planning of Robot

Future Plans

Progress

Presentation-I

Aniket Anantraj

Navlur

Ashis kumar

Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar,

Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Path Planning of Robot
- Designing and building Gripper Mechanism to pick and place Jigsaw blocks and implementing the entire solution for Jigsaw puzzle

Future Plans

Progress

Presentation-I

Aniket Anantraj

Navlur

Ashis kumar

Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar,

Kalind Karia

Overview of Project

Overview of Task

Task Accomplished

Videos

Challenges Faced

Future Plans

Thank You

- Path Planning of Robot
- Designing and building Gripper Mechanism to pick and place Jigsaw blocks and implementing the entire solution for Jigsaw puzzle
- Solve a Multi-Robot Cooperative Box-pushing problem

Thank You

Progress

Presentation-I

Aniket Anantraj

Navlur

Ashis kumar

Maharana

Kiran S Patil

Mentors:

Abhinav Sarkar,

Kalind Karia

Overview of
Project

Overview of Task

Task

Accomplished

Videos

Challenges Faced

Future Plans

Thank You

THANK YOU !!!