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A SYSTEM FOR SOLVING JIGSAW PUZZLE USING MULTIPLE ROBOTS



Aniket Anantraj Navlur
Kiran Suvas Patil
Ashis Kumar Maharana
Mentor 1: Abinav Sarkar
Mentor 2: Kalind Karia

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A System for Solving Jigsaw Puzzle using Multiple Robots

Abstract

The prime motive of this project is to develop a multi Robot based Autonomous Puzzle Solver system that can solve a Jigsaw puzzle.

Overview of Task

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

Completion status

The project is completed till task.6 i.e. building Gripper mechanism. Implementation of the entire solution for a given puzzle is in progress.



1.1. HARDWARE PARTS

1.1 Hardware parts

- FireBird Robots(2)
- XBee(3)
 - Xbee module
 - xbee usb adapter board
 - usb type B to type A converter
- overhead camera
- ArUco markers
- Servo motors for gripper mechanism
- flex sheet for arena

1.2 Software used

- python
- openCV
- AVR Studio 5.1
- XCTU(latest version)
- AVRDude
- Fusion360

1.3 Assembly of hardware

Circuit diagram and Steps of assembly of hardware with pictures for each step

Circuit Diagram

Circuit schematic, simplified circuit diagram , block diagram of system



1.4. SOFTWARE AND CODE

Step 1

Steps for assembling part 1

Step 2

Steps for assembling part 2

Step 3

Steps for assembling part 3

1.4 Software and Code

1.4.1 Dependencies

Before configuring the XBee modules one should first understand the different parameters of it. This [article](#) should help. For configuring the xbee modules latest XCTU software is used. The channel is chosen so, such that no other device interfere the communication.

Detection of ArUco markers using python requires integration of aruco library to the current python version installed. The aruco library can be found in opencv-contrib module. For installing opencv-contrib follow these [steps](#)(installing modules using pip).

```
pip install opencv-contrib-python
```

For communicating to xbee module using python requires xbee and pyserial module. There are many similar modules for serial communication and xbee, but we need these two modules. If you want to learn you can search and go through other modules also.

1. [pyserial](#)

```
pip install pyserial
```

2. [xbee](#)

```
pip install xbee
```

3. optional [digi-xbee](#)



1.5. USE AND DEMO

```
pip install digi-xbee
```

The xbee model provided(XBee S2C) cannot be read properly using the earlier versions of XCTU. So it is recommended to use the [latest version](#).

[Github link](#) for the repository of code

Brief explanation of various parts of code

1.5 Use and Demo

Final Setup Image

User Instruction for demonstration

[Youtube Link](#) of demonstration video

1.6 Future Work

What can be done to take this work ahead in future as projects.

1.7 Bug report and Challenges

Any issues in code and hardware.

Any failure or challenges faced during project

Bibliography

- [1] Ad Kamerman and Leo Monteban, *WaveLAN-II: A High-Performance Wireless LAN for the Unlicensed band*, 1997.

