EE106A/206A / BIOE125

Playing with Sokoban

Fall 2017

1 Contact Information

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2 Abstract

Our project is about how to teach Baxter play Sokoban game which is a type of transport puzzle, in which the player pushes boxes or crates around in a warehouse, trying to get them to storage locations.First we control the camera to capture the environment and locate the position of boxes and walls,then we will control Baxter through keyboard or gestures to move or push the exact box as we want,if we carry a forbidden moving direction,we will receive warning from Baxter,step by step,finally,Baxter can push the box to a position we desired.

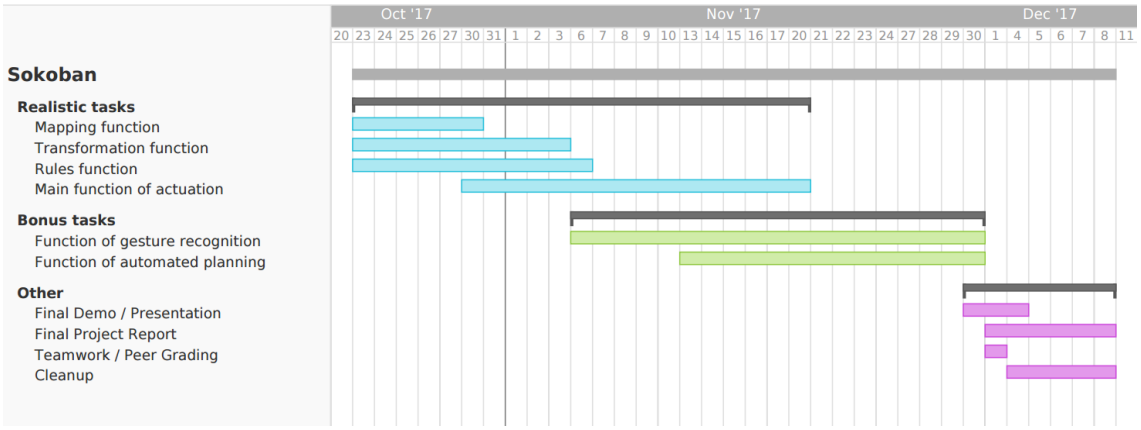
3 Project Description

- Our goal in this project is to control Baxter robot to play Sokoban successfully using either the arrow keys on a keyboard or gesture control.
- Criteria: Baxter obeys to all rules of Sokoban, it will warn us when rules are violated, it can push the exact box according to command we input. If it has push all boxes to their destination,Baxter knows that the game over.
- Robot is playing a game! Imaging that kids are play Sokoban,is it full of warm memory? It is a simple but very fun game.
- Sensing, Planning, Actuation: We use camera to sense the environment which is a map here,and gestures later.Camera will locate the position of our box and walls.Then,we will write code to teach Baxter the rules of Sokoban,and how to move to a given position,Baxter will have its own understanding of Sokoban,which means that even Baxter acts according to our inputs,but it knows that whether we input a forbidden command or whether we have finish this game.After receive feedback of camera and keyboard inputs,Baxter will move its arm and act according to inputs information.
- Future implications: Baxter robot gaming in general automated, more complicated.
- There are some other groups that also use robots to play a games before, most of them are chess.Our project is a different type of search game,which is fun and new.

4 Tasks

1. **Build the robot.**Baxter already built.
2. **Code the robot.**We will program the robot using Python and ROS.
   (a) **Mapping function.** Design the map (start with fixed and then move on using AR tags).
   (b) **Transformation function.** Transform the camera frame to the table frame.
   (c) **Rules function.** Teach Baxter rules of Sokoban, when some threshold value is eclipsed in some node, then Baxter complains:
      i. Cannot push two boxes at once.
      ii. Cannot push box past barrier.
      iii. Stop when arrive in destination.
   (d) **Main function of actuation.** When Baxter has sensed the environment,and received input from keyboard or gestures later,how it moves to right position.
   (e) **Function of gesture recognition.** Replace keyboard inputs with gestures input which is captured by camera.It will learn a few of gestures which corresponding to different action.
   (f) **Function of automated planning.** In order to fit more complex world,teach Baxter to play itself given any admissible initial map.We use gestures as starting signal,Baxter play itself,and stop when it arrive in destination it believes.

5 Milestones



6 Assessment

- Test and assess: Whether we achieve realistic goals?In another word,Whether Baxter can play the game as we expected,for example,Baxter can always push the right box to the position we command.That is to say we successfully achieve realistic goals below. **Note:** Task 2 part(e) and part(f) is bonus and optional.
- Realistic goals: Baxter can play it according to keyboard inputs,play under the rules,and finally win this game.
- Desired goals: With gestures control, Baxter play according to gesture commands rather than keyboard inputs.Then,let's go deeper,Baxter can play itself.Given any consistent initial map,without any input such as keyboard or gesture,Baxter can act according to its own algorithm.

7 Team Member Roles

- Haofan will be in charge of whole project,and he will write the code of task2 Part(c),part(d),part(e),part(f) to part5.His background is in artificial intelligence and computer vision.He has taken courses about algorithms and image processing,and he is taking CS188 and EECS127 besides EECS106A this semester.He is good at utilizing the camera to understand the environment.
- Jiarong will be in charge of the same parts like Haofan. His background is in electronic engineering, and he is experienced in image processing and have rich research experience in this filed.
- Jingjun will be in charge of task2 part(a), part(b) and part(d).His background is in mechanical engineering.He is familiar with ROS and experienced in building the map using AR tags.Especially,he is good at Dynamic of robotics.He will assist Haofan and Jiarong controlling the arm of Baxter when coding.
- Neal will assist Jingjun to finish task2 part(a) and part(b),and after that,he will devote himself to help Haofan and Jiarong write and check the code.He is unfamiliar about Robotics,but he is eager and excited to do it.

8 Bill of Materials

8.1 Use of Lab Resources

Item	**Quantity**
Baxter	1
AR tags	TBA
Table	1

8.2 Other Robotic Platforms

In this project,we only use Baxter to carry all of our parts.

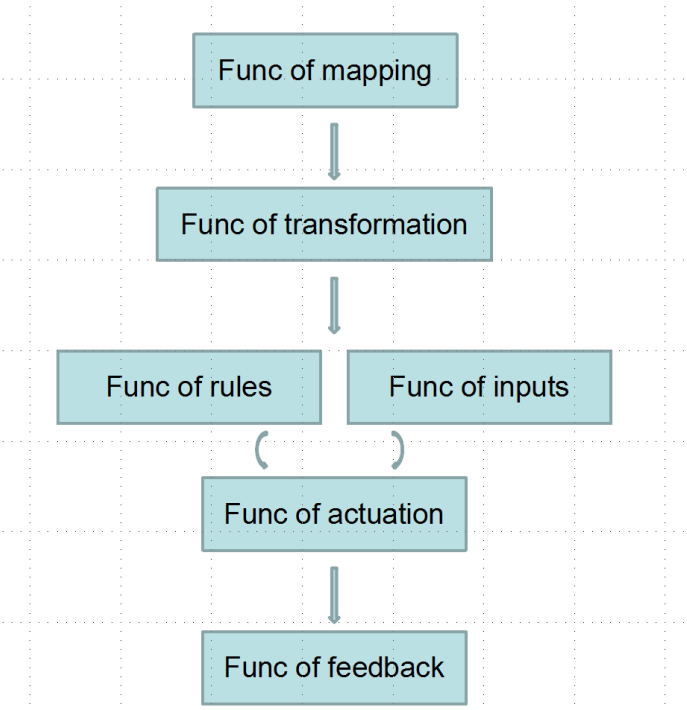
8.3 Items for Purchase

As we use Baxter which is already built,we don't need to purchase anything.

9 Other

This section contains all additional information necessary to convince us that *a)* you are equipped to complete the project you propose, and *b)* you have thought specifically about your project implementation. This section is optional, but some things you might mention include:

- ROS packages you'll need (with pointers to relevant websites);
- preliminary code structure/skeleton is shown below.
- mechanical designs/drawings/sketches of your project.



preliminary code structure