FIRA WAREHOUSE

Laws of the Game (Pro)

Parsa Yarahmadi	**Parham Karimi riekande**	**Sajedeh Nasiri**
Faculty of Electrical Engineering	Faculty of Electrical Engineering	Robotics Engineering Department
Bio-Inspired System Design Lab	Amirkabir University of Technology	Islamic Azad University –TNB
Amirkabir University of Technology	Tehran, 158754413.Iran	Sajedeh.n219@gmail.com
Tehran, 158754413.Iran	Parhamk75@hotmail.com	
y.iparsa@yahoo.com		

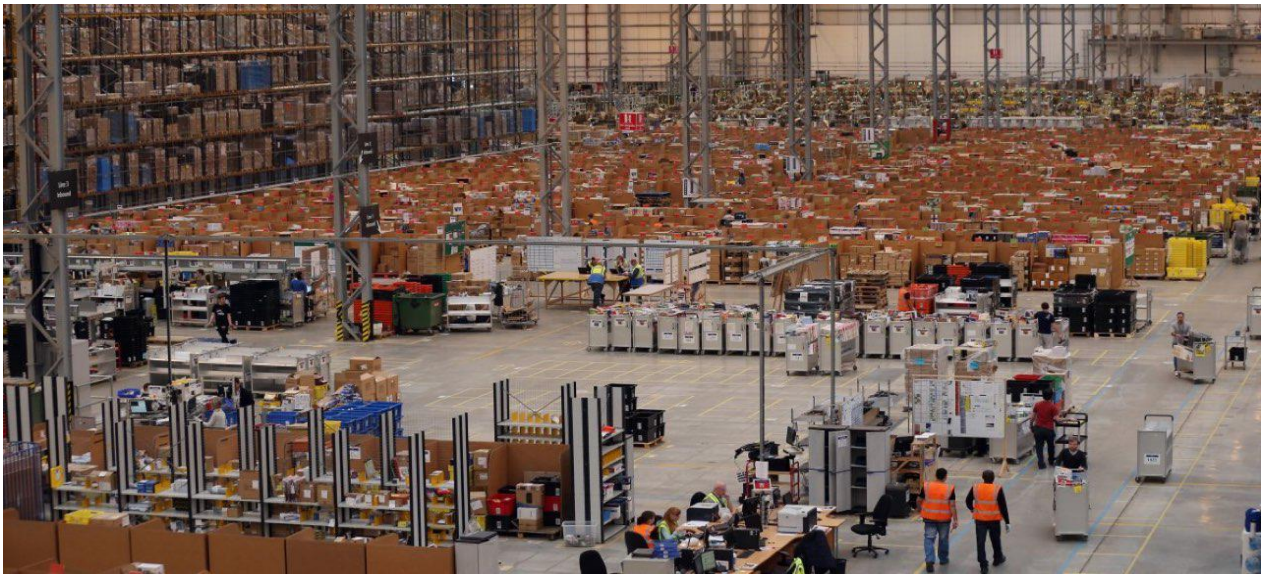
Introduction

Beginning of the robot's activities in the field of infrastructure, nowadays made it possible to do things that had already been impossible, or let the things being done as it is going on today. Among them, we can refer to the establishment and expansion of large factories and development of the ongoing production lines in the industrial process, the key component of which is warehousing. So that the progress that we are witnessing today in the industry is fully dependent on and indebted to the development of the new methods proposed in the warehousing process.

Due to the importance of warehousing in all industries, we are to hold a League of "Warehousing Robots" to be assimilated and practiced in the real environment in order to take a fundamental step towards developing the storage automation from the very moment of registration, up to the transportation, displacement and removal from the warehouse.

The robots in this League, are obliged to automatically control the goods from the moment they are arrived, registered, transported, moved, stored and getting out of the warehouse during separate missions and finally return to its starting point in order to put the thing in order at the warehouse after accomplishing each phase of the mission.

Find below the full description of each scenarios and the rules that overshadows the League.



[FW-1]: First scenario - routing the warehouse

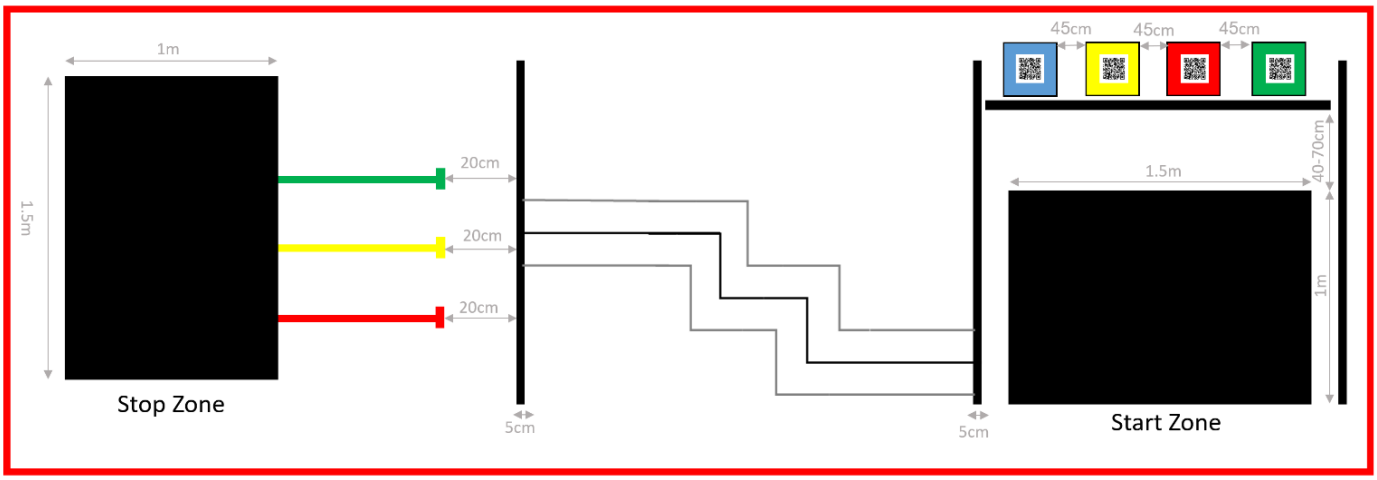
At this stage, the robot confronts with four commodities in cubic shape with different colors (green red, yellow blue) as shown in Figure 1, on each of which a QR code attached. Each QR codes consists a number which well depicts the expiration date of each item.

The robot starts its mission from the start zone which is a black rectangle measuring 1 by 1.5 meters, and goods rests at a 40 to 70 cm distance from the start zone. It should be noted that the goods are spaced 45 cm from one another in rows.

At the first step, the robot should make a list of the goods which consists of some features as: color and the expiration date, then they have to prioritize the goods according to their expiration dates, in a way that the sooner expiring ones should be the more prioritized one. Finally, it must list the goods at the operator's room according to their hierarchal priorities.

At the next phase, the robot must enter a route with the black guide line, which starts at a distance 20 to 40 cm from the last item. It should be noted that the path can be started from anywhere in the black vertical line.

The robot must go through the path to the end. It also follows three following robot paths, i.e. the guide lines which have colors corresponding to colors of the goods. The robot must select the routes according to the priority list which was prepared in the previous step with a higher priority. (If there is not a path corresponding to the first priority among the routes ahead, the robot should select and follow the path with the next priority). By following the route, the robot will stop at a black rectangle with 1meter width. The robot must reach the stop zone and finalize its mission on the screen in the operator's room.



(Fig.1)

1.1 The height of the route walls is 40 cm and in white color

1.2 The thickness of all lines on the ground is 30-34mm

1.3 The dimensions of the cubes are 15×15×15 cm

1.4 The dimensions of QR Code are 6×6cm

[FW-2]: Second scenario - keeping and removing goods

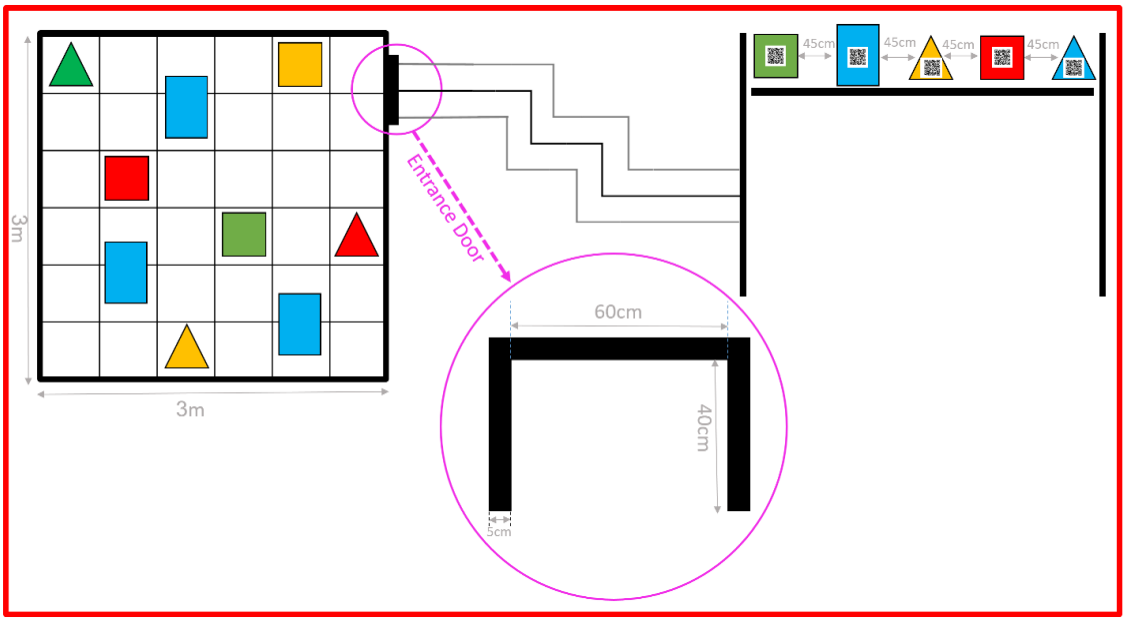
At first phase, there are 5 goods in different colors, shapes and expiration dates in front of the robot, and the robot should inspect each goods and store them in its memory. These goods are arranged in rows in a 45 cm distance from each other. The robot must prepare a list of information for the goods according to their types, colors and expiration date and then display them on the display screen in the operator's room. Noting that, the goods with the same shape and color will definitely have the same expiry dates.

In the next step, the robot must reach a line which starts with the black guide line at a distance from 20-40 cm from the last commodity. The beginning and end of the path is marked with a black bar that is perpendicular to the path. The robot must follow its path to the beginning and the end.

At the end of the route, **precisely** rests the entrance of the warehouse which is marked with a black line perpendicular to the path. The entrance of the warehouse is a black frame with the internal dimensions of 60 cm width, 40 cm high and 5 cm thickness.

Then the robot must enter the warehouse and review the goods in it. There are 8 goods in the warehouse, some of which can essentially be identical in terms of characteristics, and some of them would be the same as they had already been listed; considering the fact that these products are not attached with the QR code box and are not directly visible due to the goods expiration date, as well. So the robot must rely on the other goods characteristics (color and shape) and refer to the list provided at the first step according to the expiration date of the commodities. Then select one of the items in the first step which has an expiration date close to expiration (with the same shape, color, and expiry date) and identify all available items of the same sorts in the chamber and remove them from the cycle of warehousing: This can be done by alarming in front of the product. It means the robot should stop at the maximum distance of 10 cm from the product. So, the robot camera will point to the desired product and then beep for 3 seconds while shown in the Operator's Desk. Note that, the first item in the list may not be available in the room, in this case the robot should select the first item in the list in the room.

Finally, the robot must display the number of goods needed to be removed from the chamber after completely leaving the chamber and stopping behind the mentioned frame and then finish the contest at the operator's room display.



(Fig.2)

2.1 The wall height is 40 cm and white.

2.2 The thickness of all lines in the field is 30-34 mm.

2.3 The dimensions of the room are 3x3 m and the walls are 30 cm high.

2.4 The colors of the walls of the room are white and the field has checkered effect that each square is50 x50 cm.

2.5 The entrance is completely black with 5 cm thickness and the dimension of the interior part of the entrance is 60×40 cm.

2.6 The dimensions of the cubes are 15×15× 15 cm

2.7 The dimensions of the rectangular cube are 15×15× 30

2.8 The dimensions of the pyramids are 20×20 cm

2.9 The dimensions of QR codes are 6×6 cm

[FW-3]: Third Scenario – categorization of the new products

At first, the robot is placed in the starting area where the black rectangle is 1.5 m long and 1 m wide. The three chambers are spaced apart, as shown in Fig. 3, and the entrance of each chamber faces towards the starting point. In each room, there exists three commodities, the vital information of which are categorized according to their color, shape and temperature. The storage temperature in the QR Code format, which is affixed to each item, is visible to the robot, as well. All goods inside a chamber share one similar characteristic. The similar characteristic for the storage temperature here refers to their temperature range. As mentioned before, all these goods in each chamber shares a common feature or characteristic which is characterized and named as the characteristic features of the very specific chamber or room, but at the same time they differ from each other, in other features.

Each of the three chambers in the warehouse has a specific characteristic feature and in fact shares different modes of the feature, as well. In the first step, the robot must enter each of the chambers and, after checking the goods in the chamber, make a list of them. Then it has to exit the room and show the list on the operator's display and then go to the next room and make the next list of goods in the new chamber and follow the suit as it has done in previous chamber and once more display them on operator' display.

This process is continued for all three chambers (the list of goods in each chamber must be made and displayed before entering the next chamber) and at the end of this rotation, the robot returns to the starting area and a list of goods for all three chambers will be displayed differently on the operator's screen.

On the fourth side in the starting area, there is a commodity. The robot must review the item, categorize it and see to which chamber it belongs (e.g. in which chamber the product should be classified), then move to the relevant room and enter into it and stop there, and display the characteristics of the product in front of it, along with other previously displayed goods in the chamber (according to the list which was previously provided), along with a new message as the completion of the operation on the operator's display.

In the example below, the characteristic feature of the chambers is determined by the shape of the goods inside. As shown in the example, all goods inside a chamber are similar to each other based on their "shape", but different from each other in other features.

3.1 Example

Suppose the chambers and commodities are similar to the figure. In fact, the robot makes a list of the following commodities after checking all the goods:

1- Chamber no 1: Cube, yellow - 80 / rectangular cube, red - 5 / cube, blue, 25

2- Chamber no 2: Pyramid, blue - 5 / Pyramid, yellow - 80 / Pyramid, red, 26

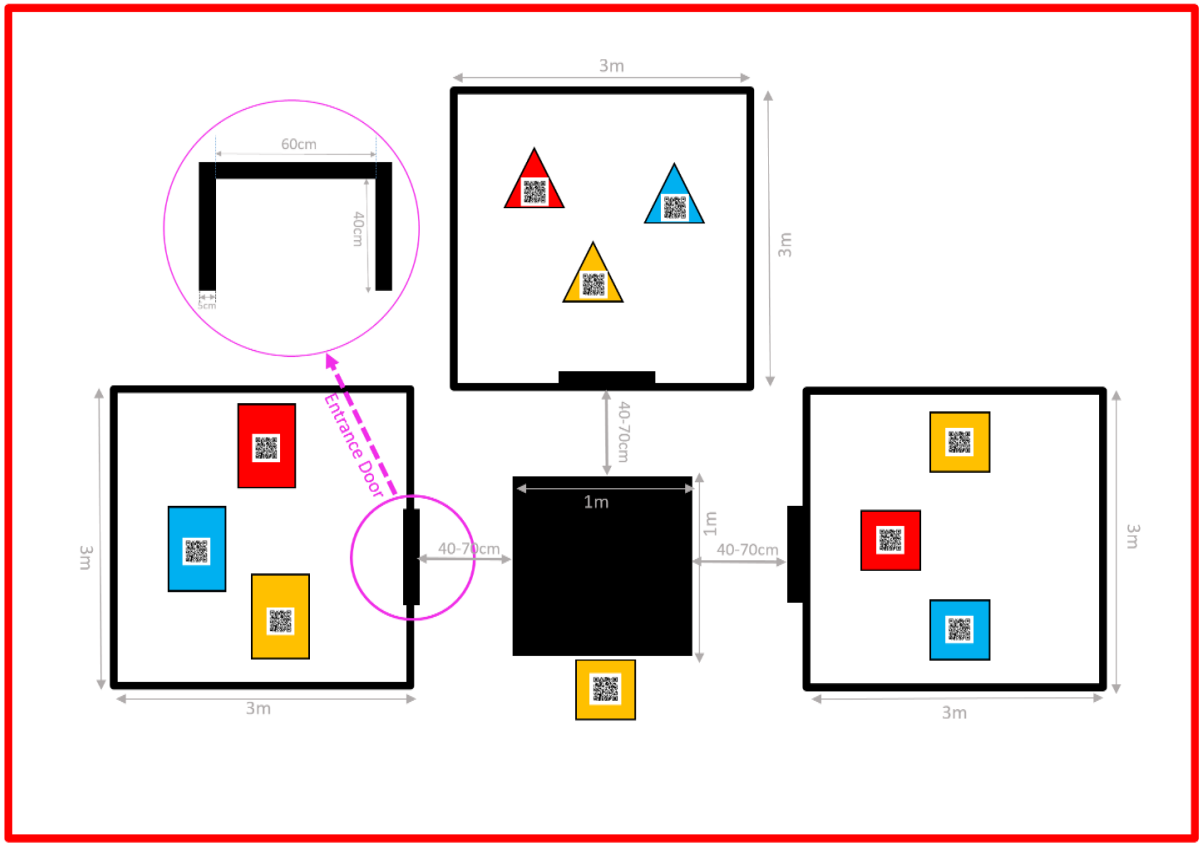
3- Chamber no 3: Cube Rectangle, red - 5 / Rectangle Cube, blue - 81 / Rectangle Cube, yellow, 25

Now, based on the obtained list, the robot returns to the starting area and reviews the goods which is placed next to the fourth side of the starting area. It also specifies to see in which chamber it should be categorized. For example, it faces the following product:

Cube, yellow, 5

In this case, the robot must declare that the goods must be transferred to the first chamber, then, it goes into the chamber 1, make a stop there and display the corresponding message.

As another example, if the product in the front of robot was "pyramid, red, 80", the robot should have declared it to be categorized in the chamber 2, and then go into the chamber 2, stop there and display the relevant message.



(Fig.3)

3.2 The dimensions of each room are 2×2 m and the walls are 40 cm high.

3.3 The colors of the walls of the room are white and the field has checkered effect that each square is50 x50 cm.

3.4 The entrance door is completely black with a thickness of 5cm and the interior dimensions are 60×40.

3.5 The dimensions of the cubes are 15×15×15 cm.

3.6 The dimensions of the rectangular cube are 15×15×30 cm.

3.7 The dimensions of the pyramids are 20×20 cm.

3.8 The dimensions of the QR codes are 6×6 cm.

3.9 The start zone is 1×1 m.

[FW-4]: Operator's room

4.1 The operator has no right to give any command to the robot, except to order to start the mission at the beginning of each run, and only by one key.

4.2 If the monitor inside the operator's room is a laptop, it should be quarantined with the start of every working day along with the robot itself.

4.3 Displaying the information to the operator can be done in a graphical or command line environment.

[FW-5]: Route specification

5.1 It should be noted that the colors to be used in the contest are completely distinct (as green, blue, red, etc.) with an unspecified range (such as light green, dark green, light blue or dark blue, dark re or light red and so forth). For better understanding of the spectrum of the colors at the day of "set up", you will be provided with sample them.

5.2 The width of the streets is 60 cm and the height of the walls is 40 cm

5.3 The dimensions of the square cube are 15×15×15 cm and for the rectangle are 15×15×30 cm and the sides size of the pyramid is 20 cm.

5.4 Standard QR Codes

The expiration dates on different scenarios are not necessarily the same and can vary in each rounds.

The participating teams will see an example of these codes in order to exemplify and better understand how to code out the expiry dates in the QR code.

For example, the QR code, which is considered to be for August 12, 1397, is coded as an 8-digit number of 13971209.

For the temperature, the QR code that is indicated is 30 ° C, which is coded as 30 ° C

Note: The whole size of the field is 7×7 m that all around marked with red line.

[FW-6]: Fail to advance

Fail to advance is said to be a quality that the robot does not move in a certain location for more than 20 seconds, alternately goes back and forth, or is locked at the corner of a locked door and there is no movement or it faces difficulty to identify the QR codes and leave the path or route (This is happening when the advance of the robot is possible only by the captain of the team).

The field at the beginning of each round is classified or divided with a number of check points. This check points in each scenario will be the first point after the declaration of robot state on operators' display when there is a failure to progress, so after 20 seconds the captain of the robot transfer it to the last check point where the robot has crossed it. Also after the third attempt, if the robots still fail to reach next check point, the team captain can decide to put the robot at the beginning of next check point. He can also put the robot for subsequent attempts again at the beginning of the same check point to work on the robot to earn points if there is still a score. Only if the robot has failed in one place, the captain can give the

referee a request for the robot's reset. In this case, with the approval of the referee only the program will be reset and any additional operations on the robot will make the team quickly leave the race. To this end, teams must use a separate key to use the law, and the referee will review the function of the key before the match.

It should be noted that, the robot operates automatically at all stages and no operator has the right to interfere with the robot's motion.

A team captain may request that the match be terminated solely because of the repetition of the lack of progression by the robot. Due to the repeated lack of progress mode, some teams may ask for the termination of the competition (Because of the fault in the robot). In this case, the match will be over by checking the accuracy of the claim and the approval of the referee after registering the obtained points and the writing down the unfinished match time.

[FW-7]: Environmental conditions

Teams must be ready to adapt their robot to the lighting conditions of the tournament venue, because the light and magnetic conditions may change during the tournament. The field of tournament may be affected by the magnetic field (for example, by wiring or metal objects below or around the ground (main field). It is also possible for spectators to take photos of the competition and cause a visible light or infrared light be emitted on the field and the robot, itself. Although the technical committee will try to control such unexpected conditions during the competition, but team must make robots in a way that do not suffer from such incidents as camera flash lights.

[FW-8]: Dimensions of the robot

Robots must be dimensionally constraints to match the field conditions and situations. For this purpose, on the first day of the competition, the dimensions of the robots will be checked by the Referee Committee and the robots should be placed in a cylinder of 40 cm diameter. If dimensions of robots are larger than the dimensions mentioned above, the robot will be deleted or removed from the competition (Although there is no limitation for the height of the robots, but attention must be paid to the dimensions of the entrance for the second day of the competition).

[FW-9]: Transparency of problems

Under any circumstances, it is only the referee who decides about the final decision during the competition. In certain circumstances of such an unpredicted situations or for possible inability of a robot, the referee may make some slight changes in the rules or regulations of the competition. These changes will be made under the approval of the majority of the technical committee members. It must also be

noted that, the technical committee will have **no responsibility**, if any member team fails to participate the meetings held by the committee.

It is only with the referees who have the right to acknowledge the cases eligible to be scored and finally be decided on during the various courses of the competition. Also, in the event of unforeseen circumstances, the committee of the jury decides and no objection will be accepted.

[FW-10]: Evaluation before the competition

In order to select teams participating in the tournament, teams need to submit a team presentation file (the official site of the tournament, containing the following information and submit to the committee at the time specified)

• Team introduction and its members

• A summary of relevant records

• A summary of the activities carried out in relation to the sections of the competition and forecasting how to do it

• A summary of the technical specifications of the robot include operators, control boards and software used

Note 1: All numbers in the filed specification may have 15% error.

Note 2: The rules of competition may be subject to minor modifications before the official schedule of tournament. Therefore, all participants are required to continuously review the site and notify changes.

Note 3: Participating teams can only share their questions with the League Technical Committee through the league mail (warehouse.fira@gmail.com).