

Robot Playing Tic-Tac-Toe

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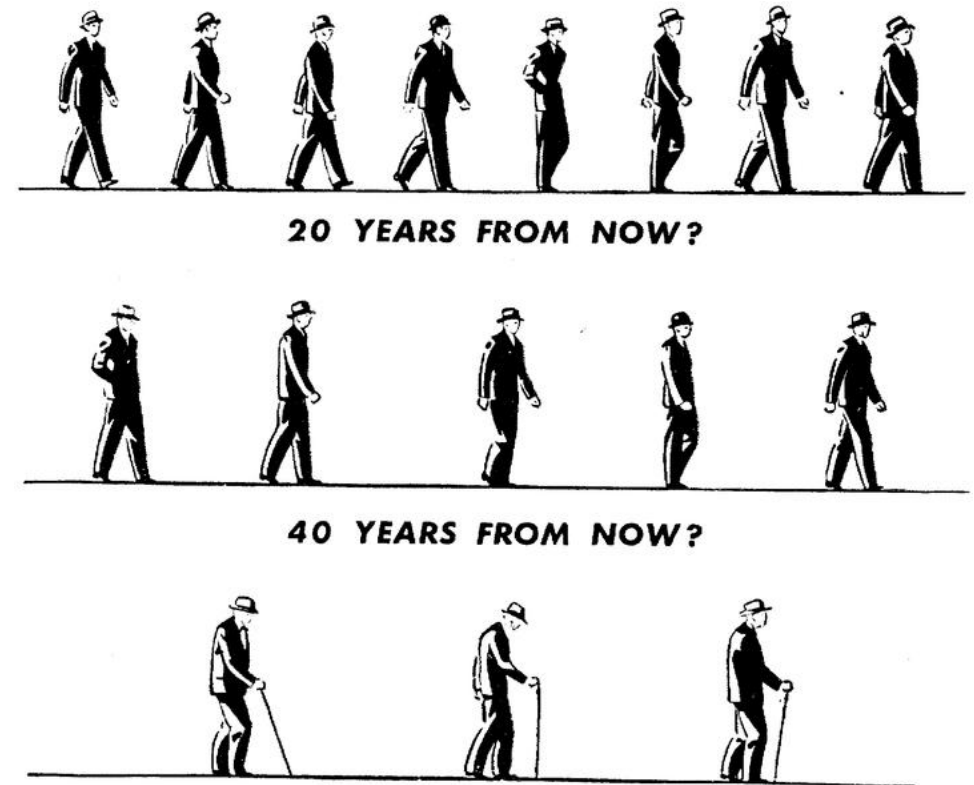
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Outline

- Motivation
- Introduction
- Tic-tac-toe robot system architecture
- Image processing
- Artificial intelligent game algorithm
- Experiment results
- Conclusions

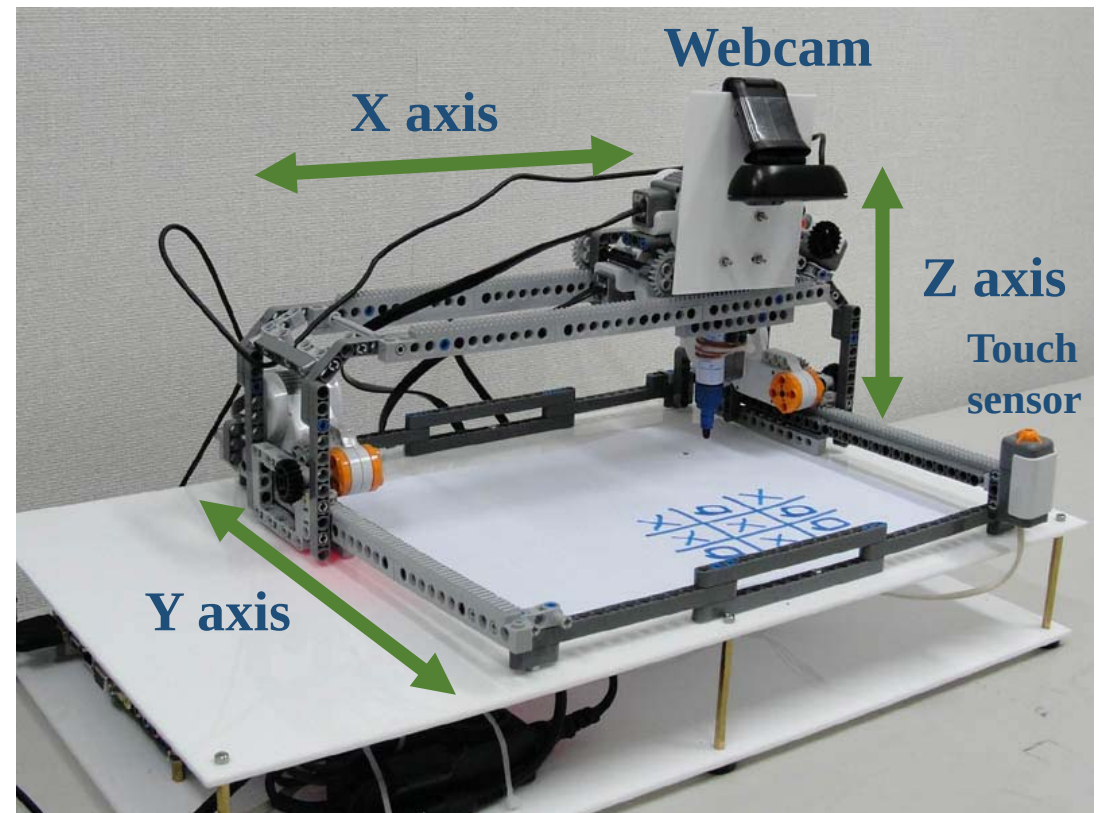
Motivation

- Recently, population ageing phenomenon had become more serious and the population of **dementia** patients grows at the same time.
- Dementia patients will cause degeneration of brain memory, judgment, language functions disability.



Introduction

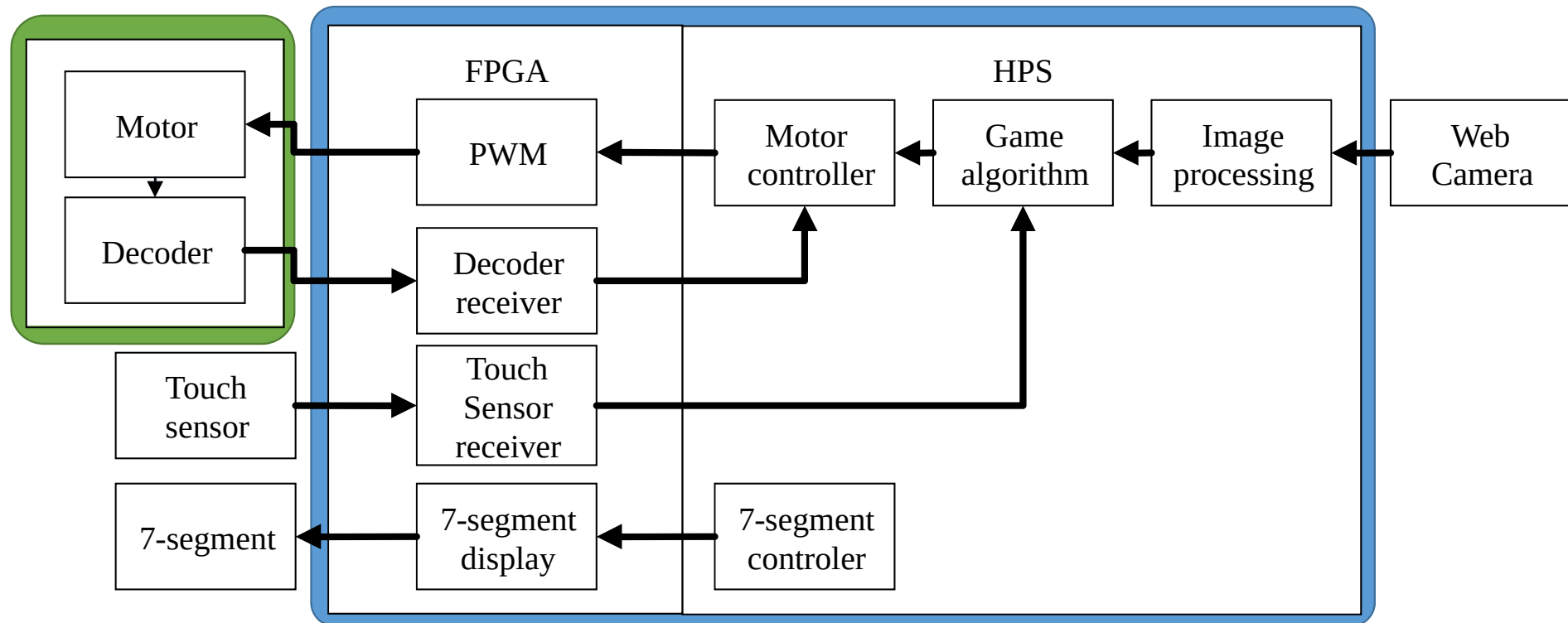
- ◆ The Tic-tac-toe robot is an interactive Robot, which can play the game with human.
- ◆ Use 4 Lego motors transmit the robot to draw cross and naught on the chessboard.
- ◆ Use a touch sensor for interaction and a webcam for catching image from the chessboard.



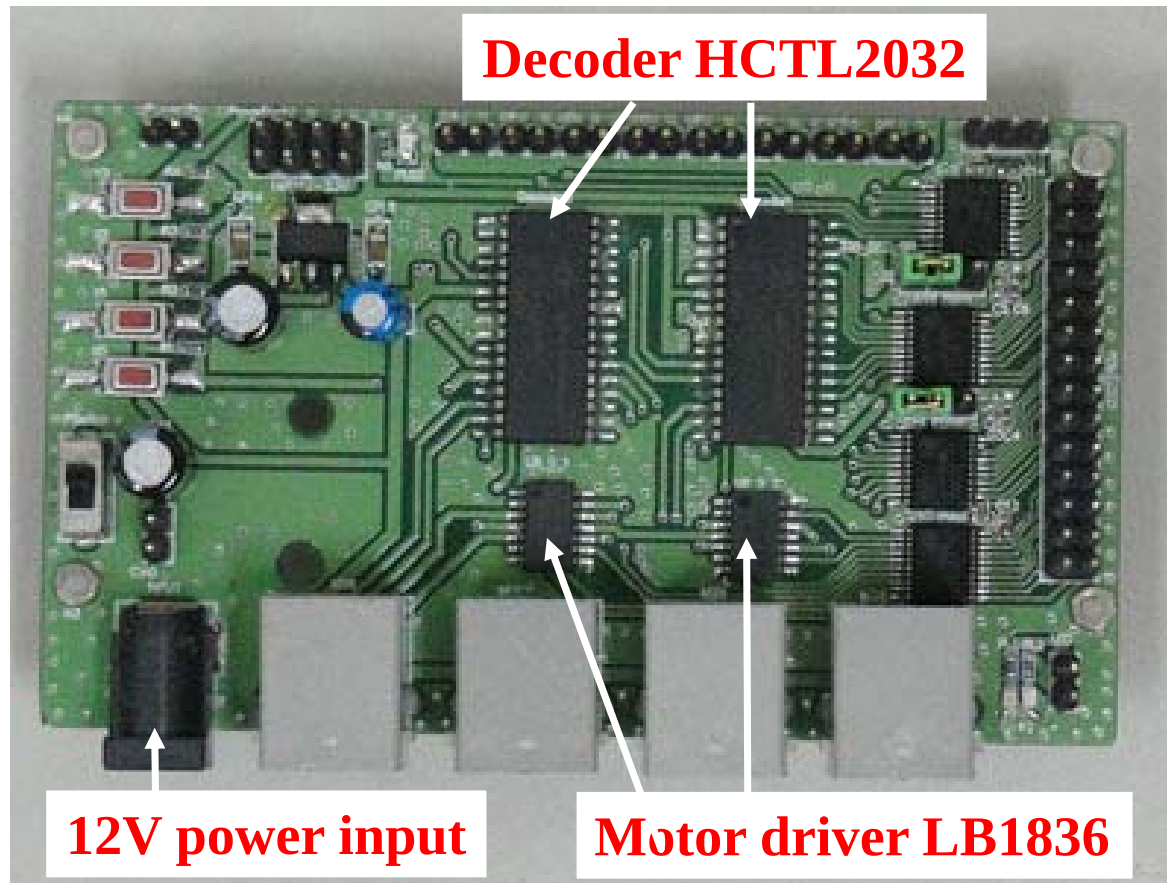
Tic-tac-toe Robot System Architecture

Motor control board

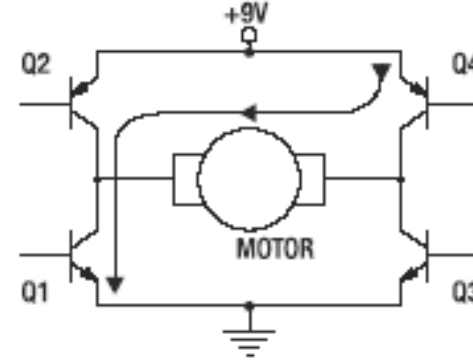
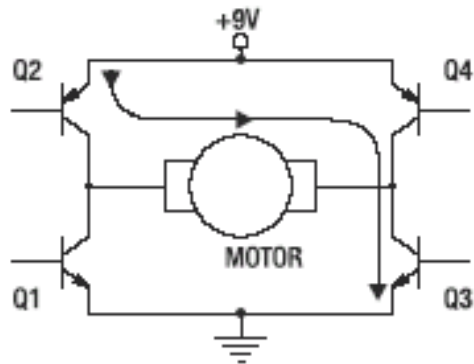
DE1_SoC



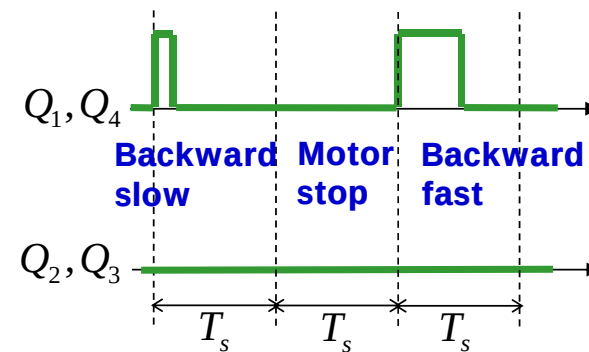
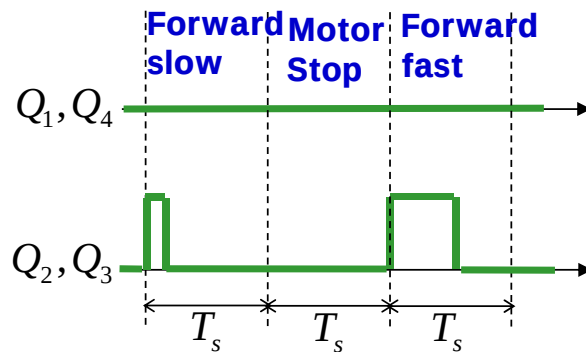
Self-made Motor Control Board



Self-made Motor Control Card - PWM



PWM to control motor



Software Flow Diagram

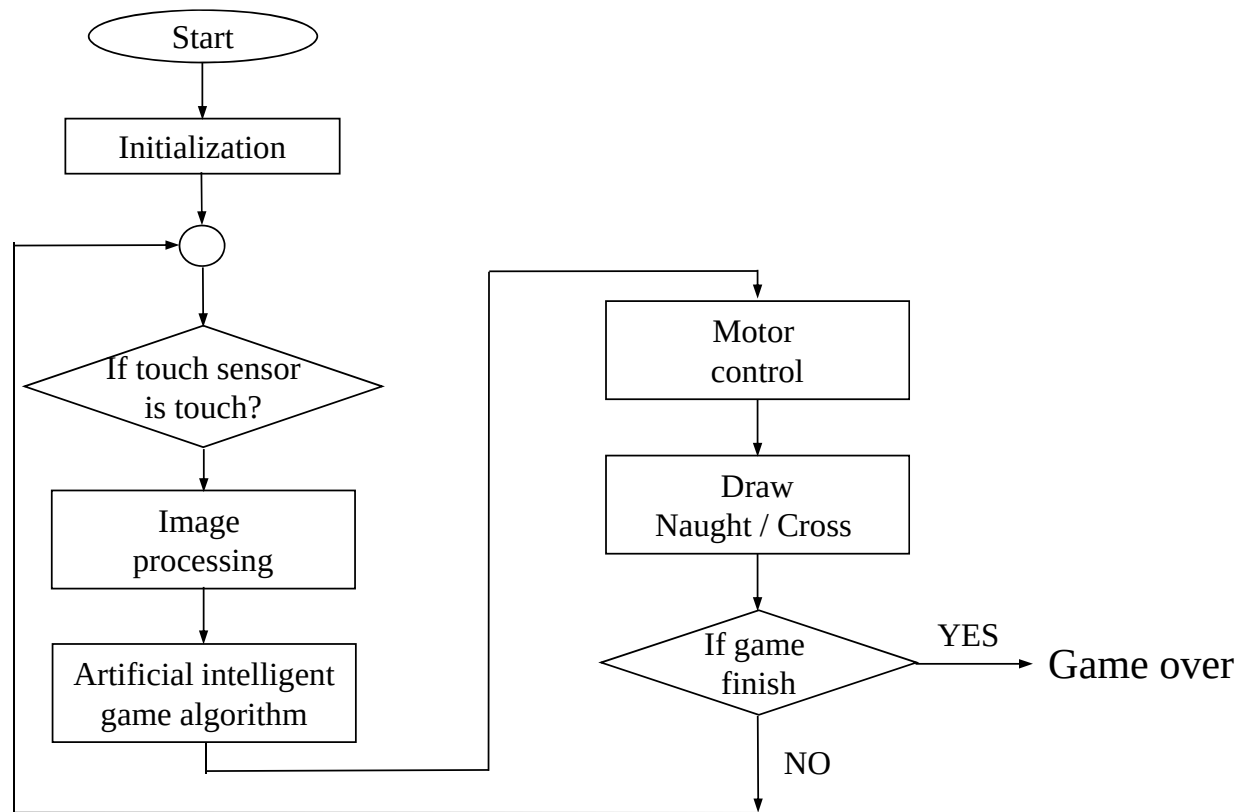
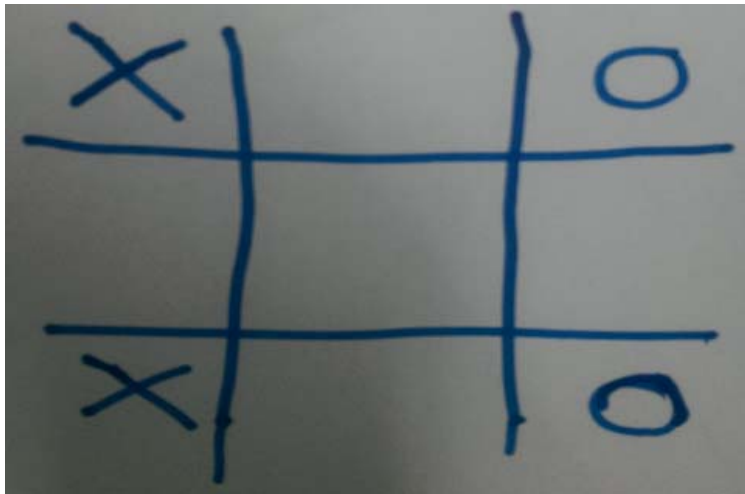
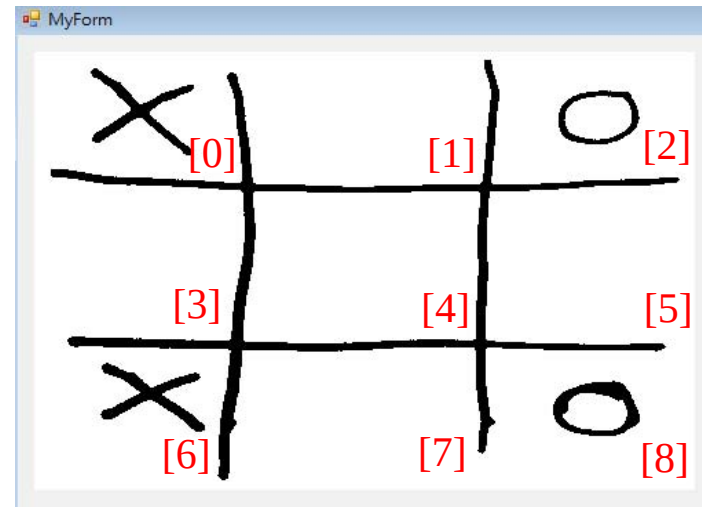


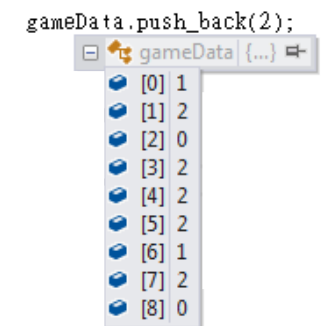
Image Processing



Chessboard image took by webcam



After image processing



Chessboard data

Artificial Intelligent Game Algorithm

$$F = F_{Attack} + F_{Defense}$$

If robot plays the “X”, player plays the “O” then

F_{Attack} = (the quantity of the **blank grid** in the horizontal, vertical, and diagonal row) x 1 +
(the quantity of “X” in the horizontal, vertical, and diagonal row) x 2

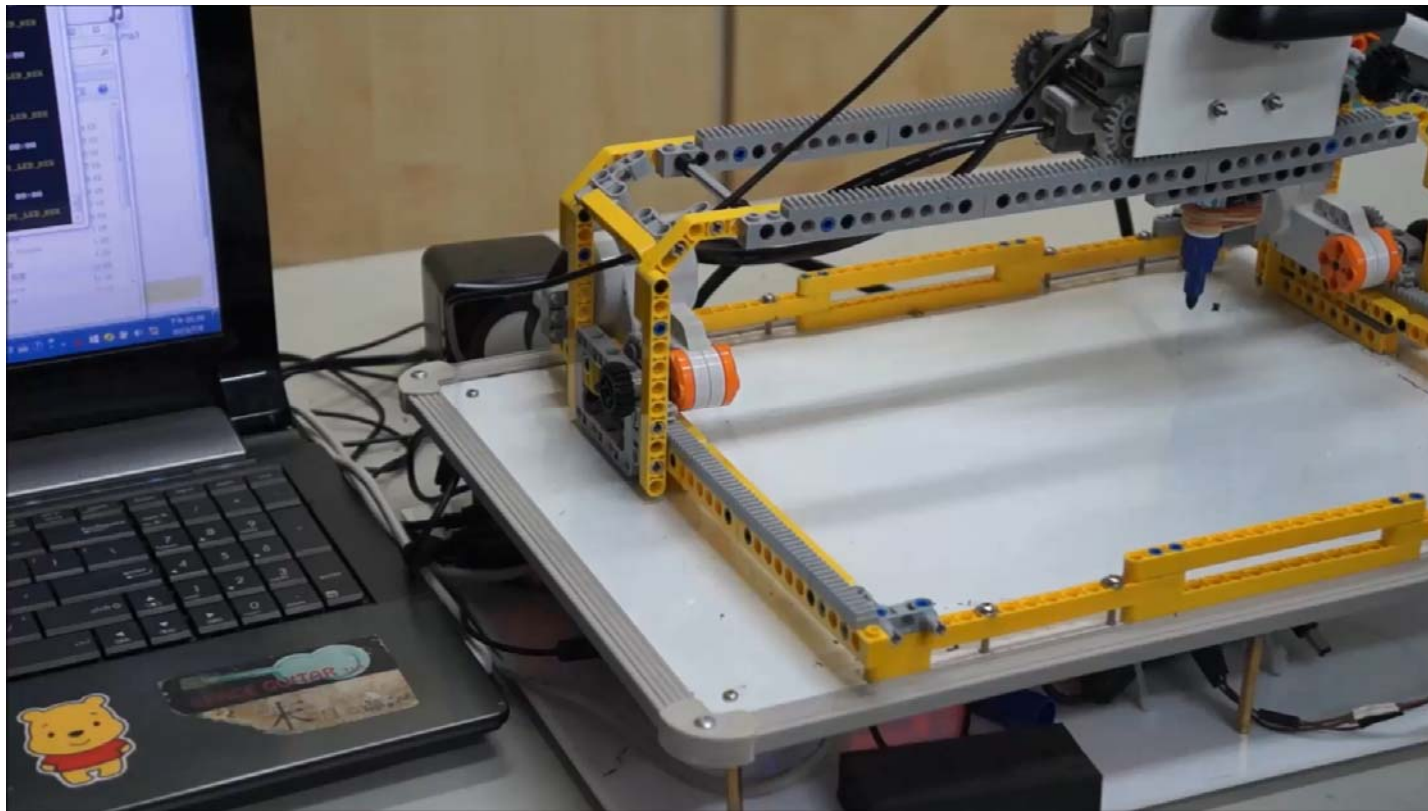
$F_{Defense}$ = 0, when there is **none** “O” in any the horizontal, vertical, and diagonal row.

$F_{Defense}$ = -1, when there is **one** “O” in any the horizontal, vertical, and diagonal row.

$F_{Defense}$ = 4, when there is **two** “O” in any the horizontal, vertical, and diagonal row.

The grid, which has the highest F, represented high priority and where the robot should play.

Experiment Result



Conclusions

- By using the SOC Linux environment, can reduce developing time of game algorithm and image processing.
- The sound function is also subjoined, which makes the game more fun.
- The Tic-tac-toe robot system can easily extend to four in a row or other interaction board game.

Thanks for your attention

Q&A