

LESSON PLAN 9: CREATE A COMPUTER-CONTROLLED ROBOT USING LEGO MINDSTORMS

Objective: design and create a computer-controlled robot

Age range: 14-18



Mercury Bay Area School's Max Ross sent us the details of robot competition he devised for his class (which counted towards the NZQA Standard 5967: Create a computer controlled robot using a kit set – based on an assessment from John Stonyer). Here we review how he successfully organised and staged the Mercury Bay Area School Robot Sumo competition.

YOU WILL NEED

- ▶ Lego Mindstorms kits
- ▶ Sumo ring

DEVELOPING SKILLS

Engineering, programming, communication, problem-solving and team-work.

METHOD

1. **Introduction** – talk to the class about the robot-building competition, how they will participate (individually and as a team) and explain the 'Rules of the game'.

2. **Design the robot** – as part of the process, ask the class to complete this questionnaire and then discuss the results as a group:

- What is the purpose of your robot?
- What are the most important rules that you will need to keep in mind during the design process?
- Draw the robot you want to construct. Indicate on the design any special features you hope to include to achieve the task.
- List three components of your robot.
- Briefly describe each component and its purpose.
- Briefly describe how your robot will fulfil this.
- The rules of the competition state the components required. Repeat these in your own words.

READ THE FOLLOWING STATEMENT:

Robotics is about building systems. Locomotion actuators, manipulators, control systems, sensor suites, efficient power supplies, well-engineered software – all of these subsystems have to be designed to fit together into an appropriate package suitable for carrying out the robot's task.

RULES OF THE GAME (compiled from various sources)

- A die will be rolled to determine which way to orient the robots (face to face, side to side, or back to back).
- At the signal, both players press their start buttons simultaneously then move back out of the way so spectators can see.
- Players cannot touch their robots or enter the ring.
- The robot must wait five seconds before moving. If it does not, it is disqualified.
- A robot wins a game when it pushes its opponent out of the ring or if the opponent moves out of the ring by itself. A robot is out of the ring when any part of it touches the floor, even if that part is no longer connected to the main body.
- The game will be restarted if both robots:
 - are locked together and stop movements for 30 seconds
 - are stuck in a repetitive pattern for 30 seconds
 - move or stop for 30 seconds without touching each other
 - touch the space outside the ring at the same moment

- Discuss how your design fulfills three of the requirements for good robot design.
- From the robot parts provided, list the main components that you will be using in your design.
- A robot should not be hazardous to humans. Discuss how your design could be hazardous and how you will minimise this.
- Assuming that the competition was in 10 periods of class time, identify the main stages of construction, programming and testing. Draw a flowchart demonstrating how these stages fit together and give a time allocation to each stage.

After completing the questionnaire, it should be handed in. As a group, ask the students to review the designs and ideas, and take the best from each to produce the team robot.

3. **Program a computer control system** – explain that the programming of the robot should be a team effort, but everyone should understand all sections as they will be tested by the assessor. Ask the team to draw a flow diagram detailing the main sections of the robot's control program. Then get them to describe how this allows it to compete and briefly explain their strategy.

4. **Keep a team blog or diary** – each team is required to keep a blog or diary that details all the work done on the robot, including testing and changes. It will be used to ensure that all team members have contributed, and also assess testing and correction of errors in both robot programming and construction.

5. **Stage the competition** – may the best robot win!

MORE INFORMATION

- Max Ross talks more about the competition on his blog: <http://blog.aoteatech.com/>
- Lego Mindstorms site: <http://mindstorms.lego.com>
- Lego education site: www.lego.com/education

 Lesson Plans can be downloaded in PDF format from www.nz-interface.co.nz

- If one robot stops its movement for 30 seconds, it shall be considered as not having the will to fight, and forfeit the game. This includes incapacitation.
- If neither robot moves outside the ring within seven minutes, the judge will decide the winner based on technical merit of the movements and operation, as well as players' attitudes.
- The robot may not send messages that interfere with the operation of the other.
- The robot cannot be designed to deliberately damage the other robot or the ring.

THE ROBOTS MUST BE:

- Totally autonomous (brains on board), meaning no: remote control; human intervention; or tethered, IR, or RF connection to a host computer.
- Constructed from the parts in the robot kit. No other parts or materials may be used.

STUDENT PHOTOS