Robotics Badges: *Designing Robots*

Robot Build Plan

Overview: Use the Design Thinking Process to build a working model of a social robot.

STEP ONE: Pick a challenge

The Sense-Think-Act definition of a robot is a machine that can detect and analyze its environment and respond by moving or making changes to the physical world around it.

Robotics also includes the study of **artificial intelligence** or **AI** programs that interact with people using ordinary conversation. AI helps **chatbots** like the Apple's Siri® or Amazon's Alexa® understand normal spoken language.

Social robots look and act in ways that seem friendly to humans. They use AI to recognize different members of a family and behave differently depending on whether it's an adult or a child.

Some social robots resemble humans or animals. This is called **biomimicry.** However, roboticists try to avoid making social robots look too real so they don't fall into the **Uncanny Valley.** That's the point where realistic robots seem creepy instead of life-like. For example, the Boston Dynamics Spot Mini has a body that looks and moves like a metallic dog, but its "head" consists of a claw at the end of a folding arm. To avoid the Uncanny Valley, social robots often have simple, cartoony designs, such as two big child-like eyes on an otherwise blank face.

Some social robots being used today are:

- **Robotic home assistants** that look like tabletop speakers. One example, Jibo, was designed by Cynthia Breazeal, head of the Personal Robots Group at the MIT Media Lab. Jibo can tilt and swivel its screen "face" to follow and recognize people as they move around a room.
- **Robotic pets** that keep seniors company when they are not able to take care of living cats or dogs. A robotic baby seal called Paro responds when you talk or stroke its fur.
- **Robotic therapists** that help autistic children practice communication and social skills, like making eye contact. One example, KeepOn, is a small yellow rubbery robot that is shaped like a miniature snowman and can bounce and swing its head in time to music.
- **Robot guides** that help customers and answer questions in multiple languages at airports or shopping malls.

A typical set of steps in the Design Thinking Process consists of:

- Pick a challenge or define a problem that is important and interesting.
- Research the problem by talking to the people affected by it and finding out what's already been done to address it.
- Brainstorm possible solutions—no matter how odd or unusual they may seem—and choose a solution to test.
- Design and build a prototype that shows how the solution might work.
- Test the prototype with the people who would be using it.
- Iterate, or repeat, the design and testing phase as many times as is needed.
- Share your project with the world.

(continued)

What are some problems your social robot could help to solve?

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You may want to consider:

- A need that robots might fill, like drilling students on their multiplication tables,
- Ideas about human-robot relations that you could test, such as how to change the design or programming of a social robot to make it seem friendlier.

A good challenge will:

- Be interesting to the members of your team
- Take place in a situation that is easy to demonstrate or make a model of
- Have one or more solutions that could be carried out by robots

What challenge will your robot solve?

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STEP TWO: Explore Possible Solutions

Now that you've chosen a challenge to work on, it's time to brainstorm ideas about what a robot might need to reach its goal. Write each idea down using just a few words. Test how well each solution might work by acting out the roles of robot and human, and note how well each solution worked.

POSSIBLE SOLUTION	TEST RESULTS

(continued)

STEP THREE: Plan Your Prototype

Building Robot Prototypes: When developing robot prototypes, researchers often go through several stages. For instance, to create a robotic arm that responds to thought commands, here are some of the prototypes that might be built:

- To start, they may just build a working mechanical version of a hand.
- Next, they may attach the hand to an arm.
- When those parts are working together, they may add remote control that shows how the hand opens and closes and how the arm moves around.
- Finally, when they have the kinks worked out of the other parts, they would add electronic sensors and programming that would make it respond to the user's thoughts.

Here are some details to consider as you plan:

- Where will the robot be used?
- What kinds of movement should it be able to make?
- How will it communicate?
- What will it look like?
- What protections will it need to be safe for humans and sturdy enough to be handled?
- Can it be reused or is it single-use?
- What sensors does it need, and what will they do?
- How is the robot controlled? Does it require human controllers or is it completely autonomous?

DON'T FORGET!

- Deadline – How much time do you have to produce a working model?
- Tools and materials – What supplies do you have access to? Which will you use in your protoype?
- Possible substitutions – If you can't build a complete working prototype, how can you show where electronic sensors, controllers, wheels, etc. will go on the finished robot?

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Write the plan for your robot prototype here.

MATERIALS:

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STEP FOUR: Build a Prototype

Before you begin to build, review your plan, and think about which team member(s) will be in charge of different tasks involved in building the prototype.

TASK	WHO'S RESPONSIBLE
DOCUMENTATION Take notes, make drawings, shoot photos or record video of the build.	
LOCOMOTION Help the robot move around, if that will be shown in your prototype.	
FUNCTION Make sure the robot does what it is supposed to.	
PACKAGING Make the robot look appealing.	
PROJECT MANAGER Keep track of time and materials and make sure all the parts are coming together on schedule.	

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STEP FIVE: Get Feedback on Your Robot

With any engineering project, it's vital to get feedback from people outside your team. These can be other engineers or experts, potential users or potential salespeople for your project.

The best feedback comes from letting your testers try out your project under conditions that are as close to real life as possible. While they are testing your project, watch what they say and do—and take notes. Notice where they have trouble using your project and where they are successful.

Afterwards, ask questions to gather feedback, such as:

- How well does the robot solve the problem it was designed for?
- What worked and what didn't?
- What would you add or improve?

OBSERVATIONS FROM TESTING	FEEDBACK FROM TESTERS

(continued)

After the test, go over the results to see how well the robot worked, and look over the feedback to see what people said about it.

What are three changes you could make to improve your robot?

1. _____

2. _____

3. _____

PLAN FOR IMPROVEMENT: