Design a Robotic Personal Assistant
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INTRODUCTION

Welcome to Lab-Volt’s Inventions and Innovations series.

The Lab-Volt Inventions and Innovations series builds both foundational knowledge and problem-solving skills.

This project is an example of problem-based learning. Problem-based learning involves students in active learning. You are presented with a problem, then work in teams to research and identify a solution to the problem. You will use your knowledge from English, science, and math class as well as this class to find a solution to your problem. You will also learn the cyclical nature of invention and innovation.

Keep in mind that there is more than one possible solution. If your solution works and you can explain why you chose it, you have a valid solution.

This Project Guide contains the Design Brief for your project. The Design Brief provides the details of the problem you will solve. The Project Guide also contains additional information to assist you in solving the problem. An explanation of the rubric assessments your instructor will use to grade your project are located in Lessons 7, 8, and 9 of this guide.

A list of supplies and equipment describes what is supplied to you to complete this project. Do not let this list limit your imagination. Ask your instructor how to obtain any additional materials you require to complete your solution to the problem.

Please do not write in this book. To keep records of your activities you may use the online worksheets or ask your instructor for hard copies of these worksheets. Your instructor will tell you what notebook requirements you will be responsible for.
RESOURCES

The Resources provide information and tools that you may access as you work through the lessons.

Click on the Resources button to find the following menu items:

1. **Calculator** – This brings up the *Windows* calculator.

2. **Lab-Volt Encyclopedia of Knowledge** – This resource has explanations of words and/or concepts that you may need to complete your projects. Entries can be searched by keyword. They are also linked by category. Many contain animations or video clips. Words included in this encyclopedia appear with green text in the multimedia presentation.

3. **Student Journal** – This tool allows you to create and maintain a journal. Ask your instructor how he/she would like you to use this resource.

4. **Math Help** – This resource provides help with math problems.

5. **Internet Link** – This resource allows you to access the Lab-Volt website. The website connects you to other Internet links related to the projects.
SAFETY

Safety is everyone’s responsibility. All must cooperate to create the safest possible working environment. Follow the common sense rules presented in the courseware and by your instructor.

Any environment can be hazardous when it is unfamiliar. The Inventions and Innovations environment may be new to you. Your instructor will provide you with the necessary introduction to the learning environment and to the equipment.

Here are some basic rules that you should make part of your everyday Inventions and Innovations classroom routine:

- Make sure your behavior is appropriate to the workplace. (No horseplay.)
- Report any injuries to the instructor.
- Keep areas clean and uncluttered.
- Familiarize yourself with proper equipment operation and procedures.
- Obey all other safety rules set forth by your school, instructor, and equipment manufacturers.
- Always follow the specific safety rules outlined in each activity.

WARNING

You will be using a variety of tools that you may not be familiar with. While some instruction is provided in the safe use of these tools, Lab-Volt does not assume any responsibility for inappropriate or unsafe use of these tools. Always ask your instructor for assistance when using a new tool.

You are also required to test your design solutions. Testing should occur in a safe, well-supervised environment. See your instructor for approval of all your testing procedures before they take place. Your instructor may ask you to modify these procedures for safety reasons.

Lab-Volt assumes no responsibility and offers no guarantees that the design solutions produced by students will be safe and without fault.
ROBOTIC PERSONAL ASSISTANT DESIGN BRIEF

A local technology center has partnered with your school to develop a robotic personal assistant (RPA). Both institutions are hoping to advance the concept of small robots that can assist people, particularly the elderly or disabled, in daily or preferred activities.

The technology center has provided you with the Robix™ Robot Construction Kit and Project Book which provides materials and information for creating any of 11 different projects. But you should not feel limited by these projects if you can come up with a different RPA design. However, you must consider several factors:

- Purpose and Benefit – There must be an obvious and practical purpose for your RPA. What does it do and how does it benefit the user?
- Safety – The robotic personal assistant must be safe for operation by all users.
- Ease – It must be easy to use for all ages.

To access supplemental information that may help you complete your project, use the Encyclopedia of Knowledge resource. Click on the Resources button and select Encyclopedia of Knowledge from the menu. If you need additional information, try the following websites:

- http://42explore.com/robots.htm 42Explore
- http://www.aapd-dc.org/ American Association of People with Disabilities
PROJECT EQUIPMENT & SUPPLIES

Supplied by Lab-Volt
Design a Robotic Personal Assistant multimedia presentation
Project Guide
Robix™ RCS-6 Robot Construction Set

Optional equipment
Word processing software
Presentation software
LESSON 1: TEAMWORK

Teamwork Rules

Access the worksheet titled "Teamwork Rules." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

1. Look at the Teamwork Rules worksheet. Then, take approximately 10 minutes to work on your own, answering the worksheet questions.

2. Return to your group and review your answers.

3. Working as a team, create a list of ground rules to use as guidelines for your team. One person should be designated to write the list. Then, ask your instructor to make copies for each member of your team. (If your instructor does not have access to a copy machine, each team member should make a personal copy by writing the rules on a blank sheet of paper.)

Click on the Forward arrow to resume the lesson.
Role Assignment

Access the worksheet titled "Role Assignment." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

1. Meet with your team.

2. Review the Role Assignment worksheet and enter the appropriate information.

3. Since you know what your project is, you should be able to anticipate the roles that are required. Don't worry if you are unsure. You will probably need to modify this worksheet as you continue with your project.

Click on the Forward arrow to resume the lesson.
Project Plan Practice

Access the worksheet titled "Project Plan Practice." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

1. You will use the same type of Project Plan worksheet in Topic 5: Project Planning and Management. For now, practice working with this worksheet by considering the following scenario.

   Scenario: It is September. Your English teacher has assigned a team research project due at the end of the semester. You must research author Jane Austen using all available resources (encyclopedias, library books, the Internet, journals, etc.). Then, you must use the information to write a research essay. You must also create a presentation that highlights the main ideas of your research essay.

2. Use your team’s Project Plan worksheets to map out the tasks necessary to complete the project. (Don’t worry; this is only a scenario. You do not actually have to complete the tasks. This gives you practice breaking down assignments into tasks and mapping out a timeline toward completion.)

Click on the Forward arrow to resume the lesson.
LESSON 2: BRAINSTORMING

Brainstorming Team Rules

Ask your instructor for the worksheets titled "Preliminary Brainstorming Rules" and "Brainstorming Team Rules." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

This activity consists of establishing rules for conducting all brainstorming sessions your team may use to complete your project.

Before session 1, get together with your partner to come up with some brainstorming ground rules.

1. Work with your partner to come up with some ideas for your team brainstorming rules. Write down your ideas on the Preliminary Brainstorming Rules worksheet.

2. Meet with your team for session 1 and complete the Brainstorming Team Rules worksheet.

3. At the meeting, the team leader explains the purpose of the meeting. The leader designates someone to record the ideas and asks team members to contribute. The team leader tells team members to use the Preliminary Brainstorming Rules worksheet to contribute some ground rules for the brainstorming sessions.

4. The team leader determines when enough ideas have been presented. The group then discusses any and all rules, eliminating any unnecessary or repetitive items. The final rules are recorded on the Brainstorming Team Rules worksheet. All members should receive a copy of the Team Rules.

Click on the Forward arrow to resume the lesson.
LESSON 3: RESEARCH, DESIGN, AND SPECIFICATIONS

Researching on the Internet
The Internet should be on your screen. If it isn’t, click on the Internet button. Your team has been tasked by a local technology center to develop a safe, easy-to-use robotic personal assistant to be used mainly by the elderly and disabled. You must work with your partner to come up with a design solution to present to your team at the next brainstorming session.

Ask your instructor for the worksheets titled "Robotic Personal Assistant Research" and "Design Solution." You will record your answers on the worksheets, either on-screen or on a print-out, as you complete your research.

Research Topics
Your research topics may include:

• Robotics
• Automation
• People with disabilities
• Technology and the disabled

Design Considerations
Keep in mind several or all of the following considerations when thinking of design solutions.

• Purpose and Benefit – There must be an obvious and practical purpose for your RPA. What does it do and how does it benefit the user?
• Safety – The robotic personal assistant must be safe for operation by all users.
• Ease – It must be easy to use for all ages.

1. Begin your research. Use your research list to guide your search for information.

2. Fill out the Robotic Personal Assistant Research worksheet as information becomes available. Take notes, or if a printer is available, print out additional information as needed. Make sure to keep a record of any resources used.
Brainstorming Design Ideas

Ask your instructor for the worksheet titled "Comparing Design Solutions." You will need three copies of the worksheet (or one for each Design Solution presentation).

Record your brainstorming session on the worksheets, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

This brainstorming activity consists of two steps. The brainstorming session should begin with each group of partners presenting their design solution. As the partners are presenting their solution, they should give as much information as possible regarding their project.

The second step in the session allows all team members to consider the advantages and disadvantages of each design solution. The team will use this session to decide on a final system to be built. The final idea will be presented to your instructor in the next lesson.

1. Meet with your team for a brainstorming session and bring your Design Solution worksheet, any additional research items and the Comparing Design Solution worksheets.

2. Each group of partners should present their design solution. (When describing your project, be as specific as possible.)

3. Working as a team, apply brainstorming techniques to determine your team’s final design solutions. Remember not to criticize or in any way eliminate any ideas at this point. You will be eliminating ideas later.

4. Write the name of each design solution presented on a separate worksheet: "Comparing Design Solutions" in the box provided.

5. Brainstorm (and discuss if necessary) the advantages and disadvantages of each design solution. Record this information in the columns provided.

   NOTE: In narrowing your selections, you can use some of the same questions, comments, ideas, or justifications listed in the Design Considerations section of your last activity. You can also come up with your own comments.

6. As a team, examine and compare the advantages and disadvantages of the items on each worksheet, eliminating less desirable selections until you have a final project.
NOTE: It is possible that during the brainstorming session, the team may find additional design solutions. The final project may turn out to be a combination of some of the presentations.

7. Save the worksheets describing your project. You will take these with you to your next lesson.

Click on the Forward arrow to resume the lesson.
LESSON 4: PROJECT PROPOSAL

Writing a Proposal

Access the worksheets titled "Proposal Forms." Record your answers on the worksheets, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

Your team will now use the pyramid method to write an internal proposal. The objective of this proposal is to present the design of your project. Your proposal details your plan of action to accomplish this objective.

Use the following four parts for your team's proposal:

Project Overview
Stresses the strongest points of the proposal in a clear and precise manner.

Body
Background

States the objectives of the proposal.

States the need for the requested action.

Proposal Details
Explains how the requested action can be accomplished.

Lists the methods used to accomplish the action.

Specifies the time and resources required to accomplish the requested action.

Conclusion
Stresses why the reader should choose the proposed course of action.

Appendix
The appendix contains all the data (drawings, research, data sheets, etc.) that support the action statement. If you did research on the Internet, then be sure to include the Web addresses for the sites you consulted.

Once your proposal is written, click on the Forward arrow to resume the lesson.
LESSON 5: PROJECT PLANNING AND MANAGEMENT

Project Plan

Access the worksheet titled "Project Plan." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

1. Meet with your instructor for project specifications.

2. Gather with your team members. Discuss your project and make a list of all the separate tasks that are necessary for completing your project.

3. Determine which tasks are milestones in your project. Remember, milestones are the major goals within your project that will enable you to complete the project. You must set specific dates for the completion of each milestone. This helps to keep your project on track and on schedule. For example, product specifications would be an early milestone. Other milestones might include completion of the product design, internal proposal, and completion of project plan.

4. Once you have determined your milestones, number them in the order in which they must be completed.

5. Create enough electronic or paper copies of the worksheet so that each team member has one. Use one worksheet for each milestone, and write the milestone next to "Objective" on the worksheet. Then, indicate the chronological milestone number next to Milestone #.

6. In the Task column, list all the tasks necessary for completing the milestone.

7. Tasks also need to be assigned owners and deadlines. In the Task Owner column, list the team member(s) responsible for completing a particular task.

8. In the Start Date column, indicate the date that a task will be started. In the End Date column, indicate the deadline for completion of that task.

9. Repeat steps 1 – 8 for each milestone.

Click on the Forward arrow to resume the lesson.
Gantt Chart

Access the electronic worksheet titled "Project Plan." Record your answers on the worksheet, either on-screen or on a print-out, as you complete this procedure. (If you are completing the worksheet on-screen, ask your instructor for directions on where to save your file.)

1. The first step in developing a Gantt chart is to break down your team’s project into tasks. You learned about this earlier. For this project, try not to over-categorize your tasks. For example, “research three companies” is one task rather than three. List all your tasks, including those that are NOT milestones, in the column labeled “Tasks,” and number the tasks in the column labeled “ID.” Your worksheet should look similar to the partial list in Figure 5-A.

2. Once you’ve accomplished the task breakdown, the team must figure out the duration of each task. For your project, the duration of each task should be broken down into days or class periods. For example, the team may reason that researching three companies will take two class periods to complete; therefore, the duration of this task is two class periods. Enter this information in the columns labeled “Start” and “End.” Refer to Figure 5-B for an example.
3. As a team, you must decide which team members are suited for a particular task. In some cases, the whole team may be involved in a task. In other cases, one or two team members may be all that is necessary. Indicate team members in the column labeled “Resource.” See Figure 5-C for an example.

4. You must also determine the linkage between tasks. This means that you must know which tasks are dependent upon the completion of previous tasks before they can be started. For example, selecting a product(s) must be completed before a business proposal can be made. As you complete the Gantt chart, indicate linked tasks with an arrow.

5. At this point, you should double-check your task start and end dates to make sure that no task is scheduled before its linked predecessor is completed. (In this instance, predecessor refers to the previous task.) Some tasks in your list might overlap. This is fine except in the case of linked tasks. Remember, tasks are only linked if one task must be completed before the next one can begin. So, if any linked tasks overlap, be sure to adjust your dates to correct the overlap.

6. Your team should have already completed some of the first tasks on your list. Fill in the grid for the tasks that have been completed, and indicate linked tasks. Your team leader should keep the Gantt chart up-to-date. The team leader may also want to post it in an area accessible to all team members.

Click on the Forward arrow to resume the lesson.
LESSON 6: MODELING THE PROTOTYPE

Building Your Robotic Personal Assistant

1. Follow your design brief guidelines and build a robotic personal assistant according to the design your team agreed on.

   NOTE: Before you build your robot, please read the safety precautions in the Robix™ User Guide and Project Book. If you do not understand the safety rules, ask your instructor to explain them to you.

2. When your class period ends, be sure to put the tools and parts away so that nothing is misplaced.

3. Put your robot assembly, tools, and parts in an area designated by your instructor.

Click on the Forward arrow to resume the lesson.
LESSON 7: TESTING AND OPTIMIZING THE PROTOTYPE

Rubric Assessment: Testing and Optimizing the Prototype

A rubric represents an opportunity for you to show your instructor what you have learned in this lesson. Notify your instructor when you have completed it. He or she will use this rubric checklist to review your work.

For this rubric, you will be asked to do the following for your instructor:

1) Present three design solutions for the robot project.
2) Justify your choice of a final robot design.
3) Demonstrate how the prototype meets the requirements of the design brief.

This authentic assessment activity will receive a grade. It will also help your instructor determine whether you need additional practice before continuing with the project.

NOTE TO INSTRUCTOR: Refer to the Instructor Guide for the student handout containing detailed scenario information.

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Testing the Robotic Personal Assistant

Before you test your robot, please read the safety precautions outlined in the Robix™ User Guide and Project Book. Keep in mind that your robot may move suddenly and without warning. Always wear the safety goggles when operating the robot.

Depending on the type of robotic personal assistant that you built, you may need additional equipment in order to carry out the testing. For example, if you designed a robot that can draw, then you would need a ball-point pen and a rubber band to attach to the robot arm.

As you test your robot, try to keep the work area as clean as possible. Consider using substitute material that is less messy. For instance, if you are testing the coffeemaker robot, use dried beans and uncooked rice instead of coffee and sugar.

After you have determined what materials you need to test the robot, see your instructor for help in obtaining them.

**NOTE:** When testing the robot, please keep out of the work envelope. The work envelope is the maximum distance a robot can move in all directions. This area must be kept clear of all obstructions unless they are a necessary part of the robotic system. You can mark the safety boundaries using the brightly colored tape included in the robot kit.

In order to complete this activity, you will need the "Robotic Personal Assistant Testing" and "Robotic Personal Assistant Adjustments" worksheets. See your instructor for directions on how you can access them.

Before testing the robot, complete the "Specification," "Criteria," and "Procedure" sections of the worksheet. The specifications for your particular project can be obtained from the design solution you completed in Lesson 3. Work with your team to establish the criteria and the procedure that you will use. After testing is complete, record the results.
LESSON 8: MODIFYING AND IMPROVING THE PROTOTYPE

Rubric Assessment: Modifying the Prototype

A rubric represents an opportunity for you to show your instructor what you have learned in this lesson. Notify your instructor when you have completed it. He or she will use this rubric checklist to review your work.

For this rubric, you will be asked to do the following for your instructor:

1) Identify the modification made to the original design and explain the reason for making the modification.

2) Describe how the modification meets the requirements of the design brief.

3) Test the new design and make adjustments as needed.

This authentic assessment activity will receive a grade. It will also help your instructor determine whether you need additional practice before continuing with the project.

NOTE TO INSTRUCTOR: Refer to the Instructor Guide for the student handout containing detailed scenario information.

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Modifying the Prototype

Work with the members of your team to determine the change(s) you will make to the robotic personal assistant. Remember, you must make at least one modification to your project.

For each modification, consider the reason for making the change and how the change will improve the product.

Your modification must meet the following requirements as explained in the design brief:

- **Purpose and Benefit** – There must be an obvious and practical purpose for your robotic personal assistant. What does the robot do and how does it benefit the user?
- **Safety** – The robotic personal assistant must be safe for operation by all users.
- **Ease** – The robot must be easy to use for all ages.

When you have completed modifying and testing the prototype, you will record the results in the worksheets. Ask your instructor for the worksheets titled "Modifying the Robotic Personal Assistant" and "Testing the New Design." When you are finished completing the worksheet, notify your instructor. He or she will use the rubric checklist to review your work.

Click on the **Forward** arrow to resume the lesson.
LESSON 9: PRESENTATIONS

Rubric Assessment: Evaluate a Presentation

A rubric represents an opportunity for you to show your instructor what you have learned in this lesson. Notify your instructor when you have completed it. He or she will use this rubric checklist to review your work.

For this rubric, you will be asked to fairly evaluate a presentation. You will consider both the content and delivery of the presentation, and make suggestions for improvement.
You will be asked to do the following for your instructor:

1) Consider the content of the presentation. Was the content clear, informative, and persuasive? Suggest ways the presentation can be improved.

2) Critique the delivery of the presentation. Did the presenters speak loudly and clearly, and did they interact confidently with their audience? Suggest ways the delivery can be improved.

This authentic assessment activity will receive a grade. It will also help your instructor determine whether you need additional practice before continuing with the project.

NOTE TO INSTRUCTOR: Refer to the Instructor Guide for the student handout containing detailed scenario information.

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Designing a Presentation

In this activity, you will create a presentation for your project. If you are using presentation software, you will select a layout for your presentation, add text and graphics, apply a design template, and write notes to help remind you of what you'd like to discuss. Keep in mind that your presentation should be short. Try to keep it between five to seven slides.

You may also create your presentation using poster board or any other tools you have at your disposal.

Regardless of the type of presentation you choose to create, be sure to keep the following points in mind. They will help you design a presentation that is precise, interesting, and informative.

• Create a title for your presentation.

• Write or type five to seven main ideas that you would like to discuss in your presentation.

• Support each main idea with a few facts or bulleted points. For example, if you plan to discuss how your project is beneficial to the elderly, give your audience a few reasons why this is true.

• Use graphics to support your main ideas. Graphics may include clip art, charts, tables, scanned images, digital photos, or any other image you have access to. If you have access to a scanner or digital camera and you would like to use it for this project, be sure to ask your instructor for permission.

• Write notes to yourself about what you would like to discuss during your presentation. If you are using presentation software, write your notes in the Notes section of your presentation. If you are using a poster board or other tools for your presentation, write your notes in the order in which you plan to discuss them on note cards.

• If you are using presentation software, feel free to enhance it with sound, animations, slide transitions, and any other effects that are available to you.

• Remember to proofread your work.

Click on the Forward arrow to resume the lesson.
Rehearse a Presentation

Whether you have designed a presentation using poster board, presentation software, or some other presentation tools, it is a good idea to rehearse a presentation before taking it in front of your audience.

In this activity, you will pair with another team and rehearse your presentation. The team you rehearse with will evaluate your presentation and suggest ways to improve it.

Then, you will switch places and watch the other team rehearse their presentation. You will evaluate their work and offer suggestions about how they can improve it.

1. Select a team you’d like to work with if your instructor has not already done so.

2. Decide whether your team or the team you paired with will deliver their presentation first.

3. After the other team has delivered their presentation, complete the worksheet titled “Evaluation Sheet.” Remember to be fair, compliment the points you found most interesting, and make suggestions for areas that could use some fine-tuning.

4. Once you have given your presentation and the other team has evaluated it, go back and make any changes that may have been suggested.

Click on the **Forward** arrow to resume the lesson.
Evaluate a Presentation

Work with the members of your team to evaluate your classmates' presentation. Remember to be fair, use constructive criticism, and use the questions on your evaluation sheet as a guide.

You will evaluate your classmates' presentation according to the following criteria:
- Content – How clear, informative, and persuasive was the presentation?
- Delivery – Did the presenters speak loudly and clearly? Did they interact well with the audience and appear confident?

When you have completed the evaluation sheet, notify your instructor. He or she will use the rubric checklist to review your work.

Click on the **Forward** arrow to resume the lesson.