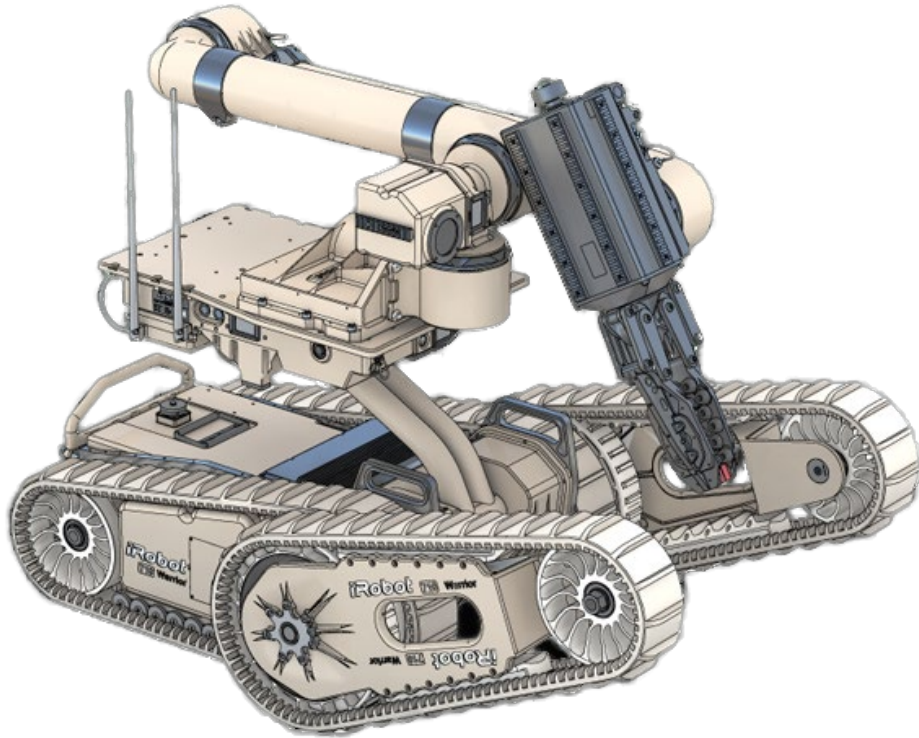# Warrior Tactical Robot
Capabilities Storyboard

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communications
D.P. Associates Inc.

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Introduction

Preview of Capabilities	
Template: Opening Video	
Audio or Text	**Media Treatment**
N/A	Show a 30-second video consisting of a series of scenes highlighting specific robot capabilities (see below). Pair the footage with an instrumental rock and roll music soundtrack. From our footage during customer site visit, include the following scenes of the robot in action as it: ■ Barrels down a gravel path ■ Makes its way over a mound of large rocks ■ Traverses through a dense forest ■ Hurdles a large tree stump ■ Climbs stairs ■ Rotates in a circle without overturning (end video with this scene) On page load, begin playing the video. Ten seconds after the video starts to play, slide in the lesson title, Warrior Tactical Robot Capabilities. Once the video ends, show text "Select the Next button to continue" in lower right corner of screen.

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Lesson Overview

Template: Section Overview

Audio	Media Treatment
Becoming a proficient robot operator requires an understanding of the capabilities and limitations specific to the model being used. Fundamentally, expert operators make the most of a robot's features and functionality. And because these professionals are keenly aware the robot is not a toy (and using it is not a game) they refrain from any maneuver or situation that could potentially jeopardize the vehicle. In the video earlier, you got a sneak peek of the Warrior in action. You witnessed a robust and rugged tactical robot, demonstrating some remarkable capabilities. ▪ But what about controlling the robot when it's out of sight? How can you see where it is, what it's doing, and what's going on around it? ▪ How well does the Warrior tolerate desert conditions: scorching heat in summer, below-freezing temperatures in winter, and blowing sand year-round? ▪ Can it be used at night? Or in the rain? … Coming up, you'll get answers to these questions, … and more.	Show a series of scenes in background synchronized with narration as avatar comes on stage (foreground) and speaks. Army soldier (avatar) entering from left side walks out onto screen and positions himself to the left of center stage, so the scenes to appear behind him will be fully visible to learners. Soldier avatar begins to narrate. Background scene ideas to collaborate on are as follows. Base model robot (without arm) travels through sand in Afghan desert. Warrior's manipulator arm picks up and carries away an explosive.

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Learning Objectives

Template: Objectives

Audio and Text	Media Treatment
By the end of this lesson, you should be able to: ▪ Identify the component used to plan and execute the Warrior's route. ▪ Name the sensor(s) used to avoid an object, given an example. ▪ Specify each terrain type the Warrior can traverse. ▪ Given the physical characteristics of a vertical obstacle, indicate whether the Warrior can surmount it. ▪ Given the physical characteristics of a horizontal obstacle, determine whether the Warrior can maneuver beyond it. ▪ Contrast the capabilities and limitations of the Manipulator payload. ▪ Distinguish between the natural environmental conditions the Warrior can and cannot withstand. ▪ Designate each hostile environment the Warrior can endure. The lesson will take approximately 30 minutes to complete. This includes a quiz at the end to assess your understanding of the material.	Faded background image or illustration of Afghan desert with text overlay

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Purpose and Functionality

Template: Section Introduction

Audio	Media Treatment
The Warrior is a remotely operated, robotic vehicle, whose envisioned capability is to assist in manpower-intensive and high-risk functions, such as: ▪ Explosive ordnance disposal (EOD) ▪ Urban intelligence, surveillance, and reconnaissance missions ▪ Minefield and obstacle reduction ▪ Toxic industrial chemicals and materials disposal - All without exposing operators directly to the hazard. The Warrior operates from a stationary position, on the move, and in all environments and conditions.	Faded background image or illustration of Afghan desert with text overlay

Operator Control Unit

Controlling the Robot	
Template: Section Overview	
Audio	**Media Treatment**
The main reason for sending a robot in your place is to keep you out of harm's way. To remain at a safe distance usually means you won't be able to *see* the vehicle. So how do you interact with the robot when it's out of sight? … The answer … is the operator control unit.	Show the Warrior out of sight from its operator.

Operator Control Unit	
Template: RTSC	
Audio	**Media Treatment**
The operator control unit, commonly referred to as the OCU, is the heart of the controls for the tactical Warrior robot. The OCU consists of a laptop with specialized software installed and a hand controller. Using the software, you can access real-time video streaming of the robot, its movements, and its surroundings. Of course, the software also provides access to many other system features and functionality as well. And that's where the hand controller comes in. The hand controller allows you to navigate through menu displays and perform robot actions.	Show OCU screen (main menu) in a Toughbook laptop with a handheld controller in front.

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OCU Connectivity

Template: CDIA

Audio	Media Treatment
You'll use this USB plug-and-play OCU to manage all robot functions via radio signal or fiber optic cable. The OCU can be paired with any Warrior DOD robot. By entering the robot's serial number during login, you establish dedicated communications between the OCU and the robot you're using. Then upon startup, the OCU smart interface automatically adapts to the configurations of that specific robot and detects the presence and type of installed payloads.	Show OCU comms module being plugged into USB port.

Communications

Template: CVTR

Audio	Media Treatment
This robot features two-way audio, using voice over IP, with listen-and-talk capability. There are two types of communication modes: radio and fiber optic. Radio – Multiple RF modules enable different frequencies. The radio obtains a range of 600-800 meters. Fiber optic is used in areas where communications are very poor. These include high radio traffic areas as well as jammed areas in which radio communications are disrupted by deliberate blocking or interference. They can also include heavily shielded areas and caves. The fiber optic spooler provides up to one kilometer of cable, which converts to a little more than half a mile.	Two side-by-side graphics: ▪ Left Side: Radio with different frequencies emitting from it ▪ Right Side: Cable being pulled from fiber optic spooler Note: Warrior should be shown in neutral position, with payload deck centered over flippers.

Navigational Capabilities

Navigation
Template: Section Overview

Audio	**Media Treatment**
The Warrior's navigation system provides a range of maneuvering capabilities and speed settings. And to help you negotiate under more challenging circumstances, the system also includes enhanced functionality such as GPS, obstacle avoidance sensors, and infrared illumination.	Show the Warrior returning to you after completing a mission.

Direction and Speed
Template: CVTR

Audio	**Media Treatment**
Basic driving techniques are executed as the Warrior moves forward and backward, and rotates clockwise and counter-clockwise in a 360-degree continuous rotation. Three maneuvering speeds are available: 1. Creep – To avoid obstacles, traverse difficult terrain, or fine-tune the position once you arrive at the target, driving at a maximum speed of 3 mph 2. Normal (default) – To reposition at the best economy speed of 12 mph 3. Fast – To drive at the maximum speed of 15 mph on flat terrain	Animation Superimpose a path onto a terrain map and include tree(s), hills, and a lake. Animate robot driving forward and backward as well as turning and rotating. In top right corner, show speed setting (creep, normal, or fast) synchronized with respective maneuver. Note: For all maneuvers, the front flippers should be up at 45° angle and the payload should be in neutral position.

GPS

Template: DVTR

Audio	Media Treatment
The robot's Global Positioning System (GPS) Sensor Module provides odometry waypoint navigation capability. Simply put, this means you can plan and execute a route from point to point, using GPS, onboard mapping, and digital terrain modeling. To track the vehicle's location, this sensor module uses longitude and latitude coordinates along with motion sensors to estimate the robot's change in position.	Show a close-up of GPS terrain map of a remote area in the Middle East in background. Include some longitude and latitude coordinates.

Obstacle Avoidance

Template: DVTR

Audio	Media Treatment
Earlier, you learned you'll be operating the vehicle remotely *most of the time*. And although that may *sound* challenging, the Warrior's Teleoperation Assist feature can help. Teleoperation Assist helps you prevent the robot from striking obstacles. It does so through the use of onboard obstacle detection and obstacle avoidance (ODOA) sensors, which in turn, use LiDAR, SONAR, and optical imaging.	Show Warrior driving along, while going around obstacles (trees, huge rocks, a barn, etc.). On both Warriors, show front flippers up at an angle of 45° and payload deck in neutral position, which is centered over the flippers.

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Night Vision and Operations

Template: RTSC

Audio	Media Treatment
The Warrior is equipped with a 300 times zoom camera with white light LEDs, low-light capabilities, and infrared illumination that facilitate night vision and operations. With these options, the robot can operate at night *without* being a beacon of light.	Show camera images (through perspective of OCU monitor) of Warrior operating at night using infrared lighting.

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Negotiating Terrain and Obstacles

Mobility	
Template: Section Overview	
Audio	**Media Treatment**

Designed to maneuver in all types of terrain, the Warrior can also:
 	
    ▪ negotiate vertical and horizontal obstacles,
    ▪ maintain balance to avoid tip-over, and
    ▪ recover from rollover, should it occur.
	Collage of images depicting some examples of robot in different types of terrain, negotiating vertical and horizontal obstacles, and recovering from a rollover.

Terrain	
Template: CVTR	
Audio	**Media Treatment**
With the ability to handle any type of terrain, this tactical robot can drive across a paved surface at a maximum speed of 15 miles per hour and traverse through sand and mud at five miles per hour. It can also ford a body of standing water (fresh water or sewage) 12 inches in depth.	Show graphic composed of four quadrants, each graphic portrays the Warrior driving in/on each of the following types of terrain: asphalt, sand, mud, and water.

Vertical Obstacles

Template: IxD

Audio and Text (see media treatment instructions)	Media Treatment
The Warrior can surmount vertical obstacles including stairs, slopes, curbs, logs, debris, and rocks. Select each obstacle type from above to watch a demonstration of the Warrior's corresponding capabilities. A description will also appear in the text box below. **Stairs** While ascending and descending a 10-foot high flight of stairs, the robot can approach a 40° pitch angle. **Surface Slopes** On a hard, dry surface, the Warrior can climb and descend a 60° slope. On a grass-covered surface, it can travel up and down a 35° slope. The robot can also travel laterally (sideways) on a 30° grade. All surface slope examples include stopping and starting. **Curbs and Other Obstacles** Reaching a height of 13 inches, the Warrior can negotiate curbs, steps, and other obstacles, such as logs, debris, and rocks.	Interactivity. At top of screen, include a row consisting of 3 animations, with each in its own box. Below this row, include instructions. Below instructions, include an empty text box. When learner selects an animation box, 5 things happen: 1. The animation box becomes highlighted to confirm it's been selected. Highlighted = a thick blue outline surrounding the box. 2. The 10-second animation begins playing. 3. The corresponding text description appears in the text box below the animation. 4. Once the animation finishes, its box remains highlighted, and the text description remains in text box until the next animation box is selected. Animations include the Warrior: ▪ Traversing a grass slope ▪ Traveling over curb or log ▪ Climbing stairs Narrator reads first 2 sentences only. Onscreen text starts with instructions and includes the 3 individual animation descriptions.

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Horizontal Obstacles

Template: DVTR

Audio	Media Treatment

You just saw the Warrior tackle some obstacles much taller than itself. Now we turn to its ability to maneuver beyond horizontal obstacles.
 	
Cross a:
  ▪ horizontal gap of 24 inches
  ▪ ditch or similar divide
 	
Enter or cross through:
  ▪ 32-inch standard exterior doorways
  ▪ 30-inch interior doors
  ▪ without modification
 	
These are all things the Warrior can do with relative ease.
	Show the Warrior going into or coming out of a shallow ditch.
	
	Also show the Warrior fitting through entrance to a building (in a battleground setting).
	
	Warrior front flippers to be at a 45° angle upwards, and payload deck in neutral position.

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Warrior Obstacle Course

Intro / Instruction Screen

Template: Custom

Text	Media Treatment
You just received word of a new mission requiring the Warrior. As its remote operator, you are tasked with safely maneuvering the vehicle along a challenging route. For each obstacle encountered, you must determine whether the robot should tackle it or take another path to get beyond it.	Include screen title: Warrior Obstacle Course. Show a graphic of an obstacle course. Include a BEGIN button at the bottom. Please refer to my sketch for layout of obstacle course. Then we can collaborate. In top right corner of every screen (following the Intro screen) please include a miniature progress bar in the shape of a curvy path, marked with milestones depicted as tiny, numbered obstacle icons. This feature will track the user's progress through the obstacle course and show the learner how far they've progressed through the exercise. Each icon will become grayed out once the user completes the corresponding multiple-choice question. Learner gets one attempt to answer question, then correct answer is provided. Once feedback for each screen is provided, activate the Next button.

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Warrior Obstacle Course

Obstacle 1

Scenario: Climb a Curb

Template: Custom

ELO: Given the physical characteristics of a vertical obstacle, indicate whether the Warrior can surmount it.	**Media Treatment**
The Warrior approaches a curb 8 inches in height. The curb's apron, a concrete approach ramp, is 50 yards away. Will you drive the robot over the curb directly in front of it or travel the extra distance to use the curb's apron? ○ Climb the curb. (correct answer) ○ Use the curb's apron.	Show graphic of a curb to get beyond. To show height of curb, superimpose a tape measure in front of the curb and extend it vertically. Have the curb reach 8 inches on the tape measure. Also, show curb's apron in the distance. On page load, the first obstacle icon should be bold – along the miniature progress bar at top right of screen. Answer choices are radio buttons. **Incorrect Feedback:** Incorrect. Because the Warrior can climb a curb up to 13 inches in height, traveling the extra distance to use the curb's apron is not an efficient option. **Correct Feedback:** Good job! Because the Warrior can climb a curb up to 13 inches in height, you saved the robot from making an extra trip to the curb's apron.

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Warrior Obstacle Course

Obstacle 2

Scenario: Cross a Ditch

Template: Custom

ELO: Given the physical characteristics of a horizontal obstacle, determine whether the Warrior can maneuver beyond it.	**Media Treatment**

The ditch up ahead is about 18 inches wide. Will you drive the Warrior through it or find a detour?

    o   Proceed.
    o   Detour. (correct answer) | Show a ditch 18 inches wide (place a tape measure across ditch to show 18 inches).

On page load, the first obstacle icon is grayed out and the second icon is bold.

Incorrect Feedback: No.
The ditch must be at least 2 feet wide for the Warrior to cross it. So, you'll need to find another way around the ditch

Correct Feedback: That's right. You'll need to find another way around the ditch, considering the robot cannot maneuver anything narrower than two feet. |

Warrior Obstacle Course

Obstacle 3

Scenario: Avoid a Tree

Template: Custom

ELO: Name the sensor(s) used to avoid an object, given an example.	**Media Treatment**

Next, the Warrior must get beyond a densely populated forest. Snaking through the woods is a dirt-covered trail, thought to be the most efficient route, provided the robot exit unscathed.
 	
If the robot strikes a tree, however, serious damage could occur. Given this information, would you proceed or find another way to reach the next waypoint?
 	
   o   Proceed through the forest. (correct answer)
   o   Find another way around.
	Show graphic of a tree directly in front of the Warrior.
	
	On page load, the first two obstacle icons are grayed out and the third icon is bold.
	
	Incorrect Feedback:
	Incorrect. The Warrior's Teleoperation Assist feature includes onboard obstacle detection and obstacle avoidance sensors, which use LiDAR, SONAR, and optical imaging.
	
	Correct Feedback:
	Good job! The Warrior's Teleoperation Assist feature includes onboard obstacle detection and obstacle avoidance sensors, which use LiDAR, SONAR, and optical imaging.

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Warrior Obstacle Course

Obstacle 4

Scenario: Descend a Hill

Template: Custom

ELO: Given the physical characteristics of a vertical obstacle, indicate whether the Warrior can surmount it.	**Media Treatment**
The robot sets atop a hill made of stony, parched ground (hard dirt) with minimal scattered brush. To get beyond the hill, will you have the vehicle forge ahead to tackle the 60° descent head on? Or weave the vehicle down the hillside along a footpath at a more gradual descent, which would take a bit longer? o Tackle the 60° descent head on. (correct answer) o Weave down the hillside at < 60° angle.	Show scene from the robot's point of view at the top of a small hill made of stony, parched ground (hard dirt) and scattered brush, looking downward. On page load, the first three obstacle icons are grayed out and the fourth icon is bold. **Incorrect Feedback:** Incorrect. On hard, dry ground, the Warrior can indeed travel downhill at a 60° angle. The scattered brush will not interfere with making headway. (Note: The robot can also travel up a 60° slope.) **Correct Feedback:** You've got it! On hard, dry ground, the Warrior can travel downhill at a 60° angle. The scattered brush will not interfere with making headway. (Note: The robot can also travel up a 60° slope.)

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Warrior Obstacle Course

Obstacle 5

Scenario: Traverse through a Culvert

Template: Custom

ELO: Given the physical characteristics of a horizonal obstacle, determine whether the Warrior can maneuver beyond it.	**Media Treatment**

The most direct route to the next location is a stream. Along the way, the current, at a depth of 1½ feet, flows downstream through an arch-shaped culvert made of corrugated metal with an opening 6 feet in diameter.
 	
Will you navigate the Warrior downstream and through the culvert or find another way?
 	
   o   Proceed downstream and through the culvert.
   o   Find another way. (correct answer)
	Show graphic of a stream running through an arch-shaped culvert.
	
	On page load, the first four obstacle icons are grayed out and the fifth icon is bold.
	
	Incorrect Feedback: Incorrect. Never attempt to navigate the Warrior through *moving* water (creeks, streams, rivers, etc.). Doing so will result in a loss of control over the robot.
	
	Correct Feedback: Correct. Never attempt to navigate the Warrior through *moving* water (creeks, streams, rivers, etc.). Doing so will result in a loss of control over the robot.

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Warrior Obstacle Course

Obstacle 6

Scenario: Ascend a Flight of Stairs

Template: Custom

ELO: Given the physical characteristics of a vertical obstacle, indicate whether the Warrior can surmount it.	**Media Treatment**

Just ahead lies a wall of boulders spanning 300 yards. Intersecting it is a passageway made of steps chiseled from stone. This stairway reaches a height of 10 feet and sets at a 40° angle.
 	
Would you drive the robot up the stairs or search for another way around the boulders?
 	
    o   Climb the stairs. (correct answer)
    o   Find another way around the boulders.
	Show a concrete set of stairs carving out a pathway up a smooth, sheer wall of rock. The set of stairs is 10 feet high and has a 40° slope.
	
	On page load, the first five obstacle icons are grayed out and the sixth icon is bold.
	
	Incorrect Feedback: Incorrect. The Warrior can climb a flight of stairs at a maximum height of 10 feet and up to a 40° angle.
	
	Correct Feedback: Nice job! The Warrior can climb a flight of stairs at a maximum height of 10 feet and up to a 40° angle.

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Obstacle 7

Scenario: Open a Gate

Template: Custom

ELO: Contrast the capabilities and limitations of the manipulator payload.	**Media Treatment**

A wooden fence stands between the Warrior and a stretch of land the robot must access. The gate is 7 feet wide and 4½ feet tall. Lifting the metal latch unlocks the gate and pushing on the frame makes it swing open as a single unit.
 	
Should the Warrior go through the gate? Or will you need to find another way past it?
 	
    ○   Go through the gate. (correct answer)
    ○   Find another way.
	Show a wooden fence with single-frame gate, based on the description in the text.
	
	On page load, the first six obstacle icons are grayed out and the seventh icon is bold.
	
	Incorrect Feedback: Incorrect. With the help of its camera and gripper, the manipulator can open gates, doors, and trash receptacles.
	
	Correct Feedback: Correct. With the help of its camera and gripper, the manipulator can open gates, doors, and trash receptacles.
	
	After feedback is provided:
	
	  ▪ Make the seventh obstacle icon bold.
	  ▪ Add the following text to the bottom of the screen. You made it through the Warrior Obstacle Course and are ready for a new exercise.
	  ▪ Activate the Next button.

Stability

Payload Effect on Vehicle Stability

Template: Section Overview

Audio	Media Treatment
To tailor the robot's configurations for specific mission requirements, operators can install specialized gear (otherwise known as payloads) onto the payload deck. The Warrior's software supports the manufacturer's plug-and-play payloads and provides operators access to enhanced functionality. It is important to mention, however, that gear other than those for which the payload deck was intended should not be placed on, carried by, or installed onto this platform. Otherwise, the vehicle's stability could be negatively impacted.	Point out and label the payload deck on the Warrior. Do not include any payloads, including the manipulator arm.

Center of Gravity and Balance

Template: RTSC

Audio	Media Treatment
The payload deck has a weight capacity of 150 pounds of payload.	Point out the two-bar linkage that supports the payload deck.
This weight and the location of the payload deck can significantly affect the robot's center of gravity and balance, *especially* when the robot climbs a set of stairs or ascends a slope.	Show payload deck's position change from centered overtop the robot to where it moves when the robot:
Taking this into account, the Warrior was designed with a self-adjusting payload deck that contains two-bar linkage to control the center of gravity for enhanced mobility.	▪ climbs a set of stairs ▪ crosses a ditch
If necessary, the payload deck can be manually manipulated. And you may need to do this for the robot to cross a gap, for instance.	

Rollover Recovery

Template: CVTR

Audio	Media Treatment
If the Warrior rolls over, its flippers can be used to return the vehicle to its upright position.	Show transition of Warrior:
How that's done is covered in a later course.	▪ Turned on its side after a rollover ▪ Righting itself / returning to an upright position
	Include arrows of Warrior going from rollover position to upright.

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Manipulator Capabilities

Available Modes of Operation

Template: Section Overview

Audio	Media Treatment
The Warrior has one primary mode of operation: Drive. Additional modes are available when certain payloads are installed. Each mode of operation offers a unique set of commands and displays that facilitate completing certain tasks. So when might you need a mode of operation *other than* Drive? … Well *remember*, the robot does *a lot more* than just *drive*. During an Explosive Ordnance Disposal (EOD) mission, for example, *numerous* modes of operation are required. … But there are a few things you need to understand before the other modes of operation make sense.	Show menu for modes of operation. Show Drive mode in focus and the other modes out of focus and illegible.

Manipulator Payload

Template: CDIA

Audio	Media Treatment
A successful EOD mission means the robot must be able to approach, inspect, and remove an ordnance. For this to happen, the robot needs an arm and a hand with fingers—all parts included in the manipulator payload. Once the manipulator payload is installed, several modes of operation become available, providing the functionality necessary to carry out these tasks. And that brings us to those other modes of operation, … next.	Show the robot (without the manipulator) driving up to an IED in Afghan desert. In synch with narration, show manipulator arm with gripper and label them. Also include camera above the gripper and label it generically.

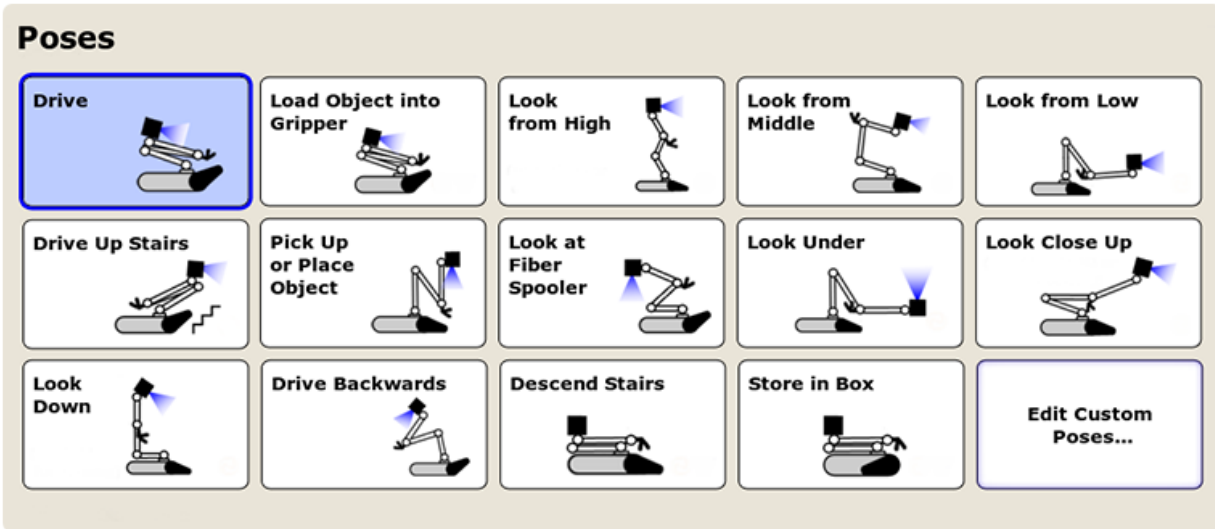|	L-3 Com / D.P. Associates	
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Manipulator and EOD Modes of Operation

Template: CDIA

Audio	Media Treatment
With the manipulator installed, you'll have access to these semi-autonomous modes of operation. They are especially useful for EOD missions, as they enable the robot to approach, inspect, and remove an ordnance. ▪ **Drive** (default) – Navigate the vehicle. ▪ **Search** – Conduct a wide area search using the attack camera. ▪ **Joint** – Manually control the vehicle's arm movements and attack camera. ▪ **Gripper** – Operate the gripper. ▪ **Target** – Fly the attack camera and navigate the Warrior to aim and target the explosive ordnance. May also move arm joints. ▪ **Manipulate** – Grasp, move, and release items using the gripper fingers. May also move arm joints.	Show still images side-by-side of the Warrior performing the following three functions: ▪ Approach an ordnance (IED) ▪ Inspect an ordnance (camera at end of manipulator arm moves closer to get a better look) ▪ Remove an ordnance (use gripper)

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Manipulator Capabilities

Template: IxD

Audio and Text	Media Treatment
Set to the appropriate mode of operation, the manipulator—with the help of its camera and gripper—can perform the tasks listed below. **Inspect** Inspect under cars, over walls, through windows. **Open** Open doors, gates, and trash receptacles. **Grasp** Grasp objects as large as 8 inches in circumference. **Carry** Carry an object weighing up to 150 pounds within a one-meter radius of the robot.	Collage with images or illustrations of Warrior using manipulator to inspect, open, grasp, and carry an object, IED, or other type of ordnance.

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Arm Preset Poses

Template: CDIA

Audio	Media Treatment
The manipulator was designed with semi-autonomous arm presets, used to position the arm where it can best be utilized for a specific task. Examples are illustrated in the graphic above.	Put text at bottom of screen, and have background image faded, so text is visible. Above the text, show image in focus of arm presets submenu. Label arm positions.

Durability

Environmental Ruggedness

Template: Section Overview

Audio	Media Treatment
The Warrior's long lasting power source and rugged design enable it to endure natural and hostile environments in operational and non-operational modes.	In background, show static photo of Warrior coming toward you, a photo that emphasizes its rugged design.

Battery Longevity

Template: RTSC

Audio	Media Treatment
With 1600 watt hours of energy available from a fully charged Lithium-Ion battery pack, the Warrior can go without recharging or resupplying its power sources for quite some time. Endurance varies depending on the specific mission. A typical EOD mission may be four to five hours, whereas a recon ops mission may be longer. The robot's power sources can be fully recharged in eight hours. And its field-replaceable power sources take one minute to change.	Photo of the Warrior's battery pack

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Natural Environments

Template: CDIA

Audio	Media Treatment
In natural environments, the Warrior can withstand a wide temperature range, inclement weather, and other adverse conditions.	Warrior superimposed on a weather map of an ambiguous country or large region. Include the weather icons described below.
Temperature It can handle temperatures from -40°F to 160°F in non-operating mode … and from -26°F to 140°F in operating mode.	Weather: Show small icons that represent different weather conditions (sun, rain, snow, ice) and a thermometer with mercury reading to represent extreme temperature.
Inclement Weather This tactical robot also operates during and after exposure to: - Relative humidity up to 100%, in all weather conditions - Blowing sand and dust - Rain - Freezing rain and ice and - Snow up to 4 inches deep	Blowing sand or dust can be represented by wind.
Other Adverse Conditions The Warrior is immune to the vibration from its own locomotion or induced by the aircraft, train, ship, or truck upon which it is being transported. It can also withstand the shock from a drop of 4 feet, when secured in its shipping container.	Vibration can be represented by Hz and an aircraft and train?

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Natural Environments Interactivity

Template: Custom

ELO: Distinguish between the natural environmental conditions the Warrior can and cannot withstand.

Instructions

Include an Info button to reveal instructions.

Game Functionality
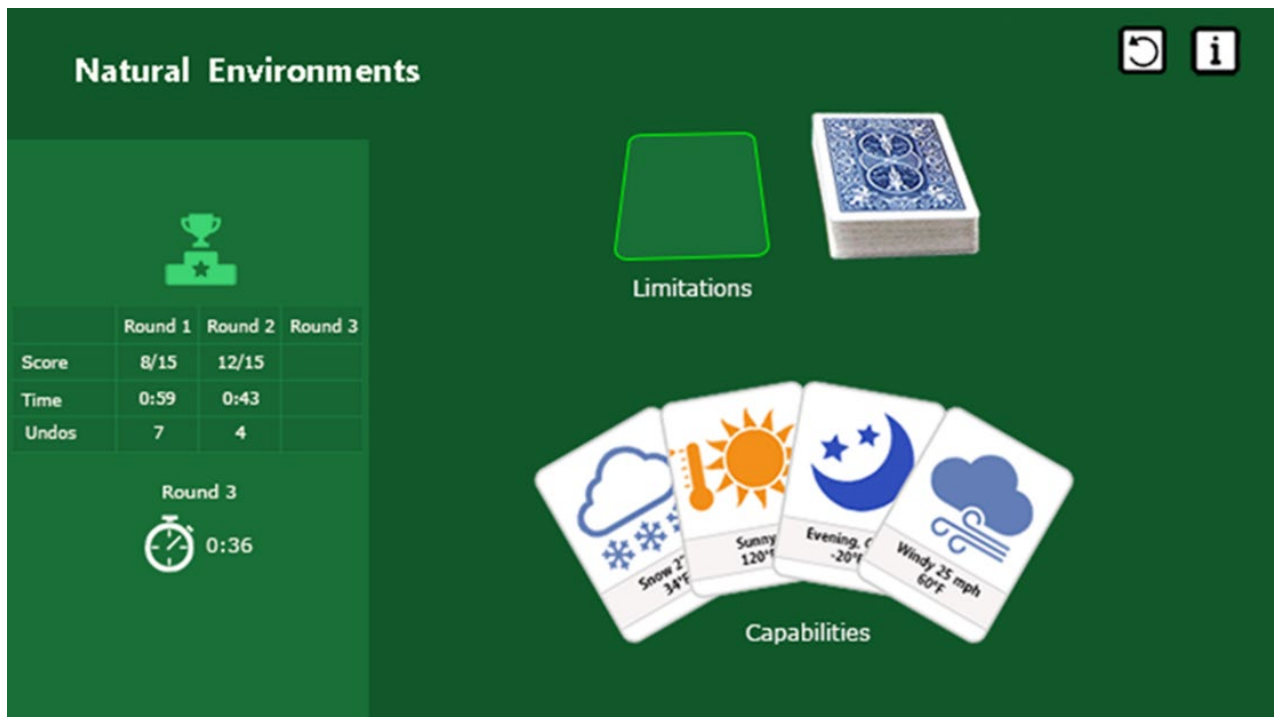
Card Game via Drag and Drop

Object of game
Sort all cards from the deck into groups: limitations or capabilities of the Warrior. Game ends when all cards from the deck have been sorted.
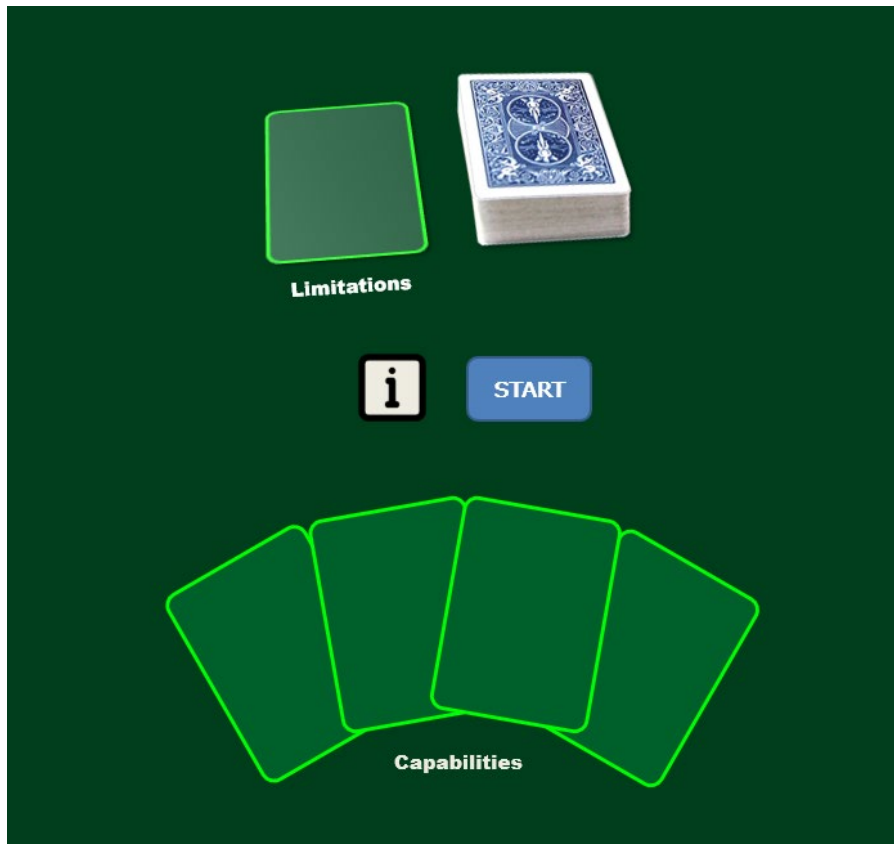
Feedback
A bang icon (starburst) and feedback text appear when the learner drags a card to the incorrect category. Then that card moves to the bottom of the deck for another attempt. See subsequent pages for additional details in feedback handling.

Visual Components and Page Layout
See my concept sketches below for each state of the game.

**Intro Screen**

Before the game starts, the learner has the option of selecting the info button to view the game rules and instructions.

Once the START button is selected, the game play screen appears, which means:

- The info button moves to the top right corner of screen.
- A leaderboard appears in the left panel of the screen.
- A timer starts counting the seconds or minutes to completion.
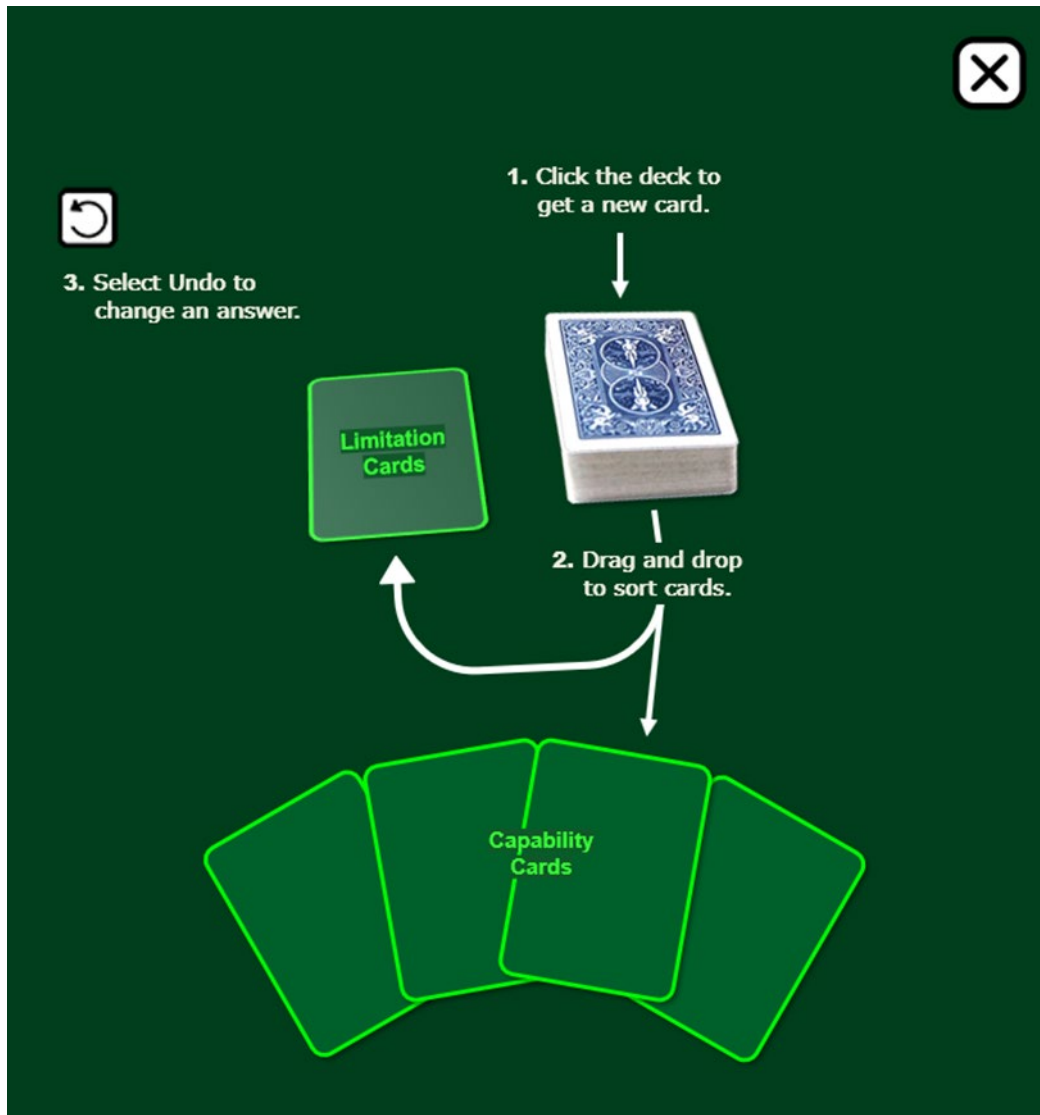
Instruction Screen

Selecting the info button opens the instruction screen shown above. (The info button is accessible from the start screen and the game play screen.) Selecting the X button closes the instruction screen and returns the learner to the source screen.

In addition to displaying the instructions, this screen also indicates the object of the game – to sort the cards into groups: limitations or capabilities of the Warrior.

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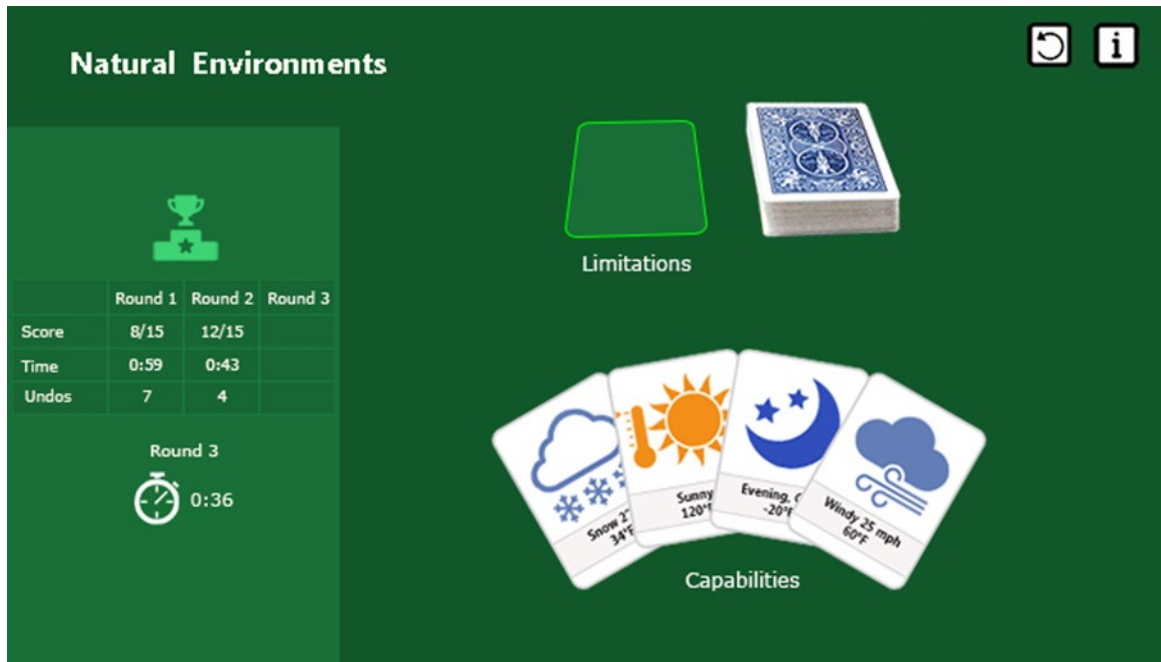
Game Play Screen (during the game)

Leaderboard
A leaderboard displays in the left panel of the screen. A timer is located at the bottom of the panel and starts counting the seconds to completion. The leaderboard also contains the score, duration, and "Undo" – the number of times the learner has changed his or her mind about an answer, indicating uncertainty.

Instructions
The Info button stays onscreen at all times. Any time the learner selects the info button while on the game play screen, the timer pauses. Note: The info button was intentionally chosen in lieu of instructional text because:

- Instructions are needed for a limited period of time. Persistent onscreen instructional text would take up valuable real estate better spent on game play and would also clutter the screen during the game. Access to instructions is one click away.
- The visual components were designed to provide clues to the object of the game and how it is played.
- Many prefer to learn by doing. They start the game and figure it out based on how the system responds to their interactions.

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Media Treatment

Labels are listed below. Graphic suggestions are in parentheses.

- **Evening, Clear, -20°F** (a crescent moon and a few stars over a dark background)
- **Sunny, 120°F** (sun next to a thermometer with a high mercury level)
- **Hazy, 140°F** (wavy, horizontal lines intersecting and blurring the sun)
- **Windy 25 mph, 60°F:** (clouds with swirling wind current)
- **Gale, Winds 54 mph** (clouds with intersecting bold/strong wind current)
- **Sand Storm, Winds 15 mph:** (strong wind current traveling through sand dunes)
- **Partly Cloudy, 95°F** (sun partially hidden behind a cloud)
- **Fog, Visibility 1 mile** (a cloud with wavy, horizontal lines intersecting it intermittently)
- **Rain 2", 54°F** (rain drops falling from clouds)
- **Thunderstorms, 84°F** (lightning bolt stemming from a cloud)
- **Flash Flood, 6"** (house tipping as it rides the waves)
- **Hail, 63°F** (irregularly shaped balls at the end of each line stemming from a cloud)
- **Snow 2", 34∘F** (snowflakes stemming from a cloud)
- **Snow 5", 26∘F** (numerous snowflakes stemming from several clouds; thermometer with low mercury level)
- **Freezing Rain, 32°F** (alternating raindrops and ice crystals stemming from a cloud)
- **Ice, -5∘F** (ice pellets on the ground)
- **Vibration (Hz)** (cascading of icons of an airplane, a train, and a ship; zig-zag lines overlaying the bottom of the vehicles)
- **Robot Falling 6 ft:** (icon of robot falling from the trailer of a stationary truck.)

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Feedback and Rounds

A bang icon (starburst) and feedback text appear when the learner drags a card to the incorrect category. Then that card moves to the bottom of the deck and reappears later for another attempt. When the learner places a card in the correct category, the card sticks in that location and points are added to the learner's score in the leaderboard. Note: There are 12 capability cards and 6 limitation cards.

- **Evening, Clear, -20°F:** Operates in temps from -26°F and uses infrared illumination [Capability]
- **Sunny, 120°F:** Handles temps ≤140°F [Capability]
- **Hazy, 140°F:** Handles temps ≤140°F [Capability]
- **Windy 25 mph, 60°F:** Handles mild to moderate wind gusts. [Capability]
- **Gale, Winds 54 mph:** Difficult to control with strong wind gusts [Limitation]
- **Sand Storm, Winds 15 mph:** Withstands blowing sand and dust [Capability]
- **Partly Cloudy, 95°F:** No issues [Capability]
- **Fog, Visibility 1 mile:** No issues [Capability]
- **Rain 2", 54°F:** Operates in the rain and in standing water ≤ 12" [Capability]
- **Thunderstorms, 84°F:** Risk of lightning strike poses hazard [Limitation]
- **Flash Flood, 6":** Loses control in moving water [Limitation]
- **Hail, 63°F:** Hazardous due to risk of serious damage [Limitation]
- **Snow 2", 34◦F:** Operates in snow ≤ 4" [Capability]
- **Snow 5", -10°F:** Traverses in snow ≤ 4" and temps from -26°F [Limitation]
- **Freezing Rain, 20°F:** Operates in freezing rain [Capability]
- **Ice, -5◦F:** Maneuvers on ice and in temps from -26°F [Capability]
- **Vibration (Hz):** Immune to vibration from own locomotion or from being transported [Capability]
- **Robot Falling 6 ft:** Withstands shock from a drop of ≤4 ft [Limitation]

Hostile Environments

Template: CVTR

Audio	Media Treatment
In hostile environments, the Warrior operates during and after exposure to: ▪ Chemical, biological, radiological, and nuclear (CBRN) effects ▪ High-Altitude Electromagnetic Pulse (HEMP) ▪ External Electromagnetic Environment (EME) Free Field Strength Now it's time to gauge your understanding of the material.	Show collage of chemical, biological, radiological materials: agricultural aircraft spraying biological warfare agents, pen and ink drawings of beakers full of chemicals, and nuclear explosion (cloud).

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Lesson Summary

Summary	
Template: Lesson Summary	
Audio and Text	**Media Treatment**
For your reference, here's a summary of the Warrior tactical robot's capabilities. The list is in alphabetical order to more easily locate specific information. ▪ **Balance** – center of gravity on payload deck ▪ **Carry** – 150 pounds of payload ▪ **Change** – field-replaceable power sources in 1 minute ▪ **Climb** – up to a 60° angle ▪ **Communicate** – two-way audio, using radio (600-800 meters) or fiber optic (1 KM) ▪ **Grasp** – objects as large as 8 inches in circumference ▪ **Illuminate** – visible and infrared ▪ **Inspect** – under cars, over walls, through windows ▪ **Move** – up to 15 mph ▪ **Manipulate** – grab, move, and release items ▪ **Navigate** – using GPS, onboard mapping, digital terrain modeling, and obstacle detection and avoidance sensors ▪ **Negotiate** – all terrain types, vertical and horizontal obstacles, and natural and hostile environments ▪ **Observe** – using a 300X zoom camera ▪ **Open** – doors, gates, and trash receptacles ▪ **Operate** – from a stationary position, on the move, and in all environments and conditions ▪ **Recharge** – battery in less than 8 hours ▪ **Record** – digital video	Watermark background of a military nature, with text overlay. Audio of first paragraph, then show text of the list.

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Assessment

Question 1	
Template: Multiple Choice	
ELO: Identify the component used to plan and execute the Warrior's route.	**Media Treatment**

What system feature should be used to plan and execute the Warrior's route?
 	
    A. Autonomous Guidance Management System
    B. Long Range Navigation Technology Software
    C. Routing and Logistics Optimization System
    D. Global Positioning System Sensor Module
       (correct answer)
	Show Warrior navigating a path on a generic topographic map of Afghanistan. Include features such as desert, mountains, hills, forest, and rivers. Please do not include any text labels; i.e., names of cities, bodies of water, etc.
	
	Incorrect Feedback: Incorrect. The Warrior's Global Positioning System sensor module allows you to plan and execute a route using GPS, onboard mapping, and digital terrain modeling.
	
	Correct Feedback: Correct. The Warrior's Global Positioning System sensor module allows you to plan and execute a route using GPS, onboard mapping, and digital terrain modeling.
	
	Once feedback is provided, activate the Next button.

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Question 2

Template: Custom

ELO: Specify each terrain type the Warrior can traverse.	**Media Treatment**
Place a checkmark next to each terrain type the Warrior can traverse. Select the SUBMIT button to view the results.	Checkbox Multiple-Select: Refer to my sketch for page layout. Place instruction text at top. Then show two rows of four thumbnail-sized boxes, each showing a terrain type (see labels below). Place the bolded label under the thumbnail and a checkbox to the left of each box.

Place thumbnail boxes in the following order:

  ▪ First row: Grass, Metal Grid, Water, Concrete
  ▪ Second Row: Sand, Mud, Rock, Gravel

Bold the SUBMIT button and center it under thumbnails. Center the feedback textbox under SUBMIT button. *Note: The thumbnail for "water" should show standing (still) water, not anything with a current.

User gets one attempt at answering correctly. Then feedback text appears. All choices are correct answers.

Incorrect Feedback: Incorrect. The Warrior is capable of handling all types of terrain, including water (standing water 12 inches in depth) and rocks (13 inches in height).

Correct Feedback: Correct. The Warrior is capable of handling all types of terrain, including water (standing water 12 inches in depth) and rocks (13 inches in height).

Once feedback is provided, activate the Next button. |

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Question 3

Template: Multiple Choice

ELO: Distinguish between the natural environmental conditions the Warrior can and cannot withstand.	**Media Treatment**

What temperature range can the Warrior withstand in operating mode?
 	
    A. -60°F to 120°F
    B. -40°F to 160°F
    C. -26°F to 140°F (correct answer)
    D. -10°F to 120°F
	Show a generic weather forecast image.
	
	Incorrect Feedback: Incorrect. In operating mode, the Warrior can handle temperatures ranging from -26°F to 140°F.
	
	Correct Feedback: Correct.
	In operating mode, the Warrior can handle temperatures ranging from -26°F to 140°F.
	
	Once feedback is provided, activate the Next button.

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Question 4

Template: True or False

ELO: Distinguish between the natural environmental conditions the Warrior can and cannot withstand.	**Media Treatment**

During transport, vibration from aircraft locomotion can negatively impact the Warrior. True or false?
 	
     A. True
     B. False (correct answer)
	Show a shipping box, labeled Warrior Robot, in the cargo area of a plane.
	
	 Incorrect Feedback: Incorrect. The Warrior is immune to vibration induced from the aircraft, train, ship, or truck upon which it is being transported.
	
	 Correct Feedback: Correct. The Warrior is immune to vibration induced from the aircraft, train, ship, or truck upon which it is being transported.
	
	 Once feedback is provided, activate the Next button.

Question 5

Template: Fill in the Blank

ELO: Given the physical characteristics of a vertical obstacle, indicate whether the Warrior can surmount it.	**Media Treatment**

The Warrior can surmount curbs, steps, logs, rocks, and debris as long as they are no more than ___ inches in height.
 	
    A. 9
    B. 13 (correct answer)
    C. 17
    D. 21
	Show a collage of curbs, steps, rocks, and debris.
	
	Incorrect Feedback: Incorrect. The Warrior can surmount curbs, steps, logs, rocks, and debris up to a maximum of 13 inches in height.
	
	Correct Feedback: Correct. The Warrior can surmount curbs, steps, logs, rocks, and debris up to a maximum of 13 inches in height.
	
	Once feedback is provided, activate the Next button.

Question 6

Template: Multiple Select

ELO: Name the sensor(s) used to avoid an object, given an example.	**Media Treatment**

Which feature(s) does the Warrior use to avoid striking an object? Select all that apply.
 	
    A. Light Detection and Ranging (LIDAR) Sensor (correct answer)
    B. Sound Navigation and Ranging (SONAR) Sensor (correct answer)
    C. Teleoperation Assist (correct answer)
    D. Obstacle Detection And Obstacle Avoidance (ODOA) Sensor (correct answer)
	Show an object in the Warrior's path that it should not attempt to overcome.
	
	Incorrect Feedback: Incorrect. The Warrior's Teleoperation Assist feature uses ODOA sensors, which use LIDAR and SONAR.
	
	Correct Feedback: Correct. The Warrior's Teleoperation Assist feature uses ODOA sensors, which use LIDAR and SONAR.
	
	Once feedback is provided, activate the Next button.

Question 7

Template: Fill in the Blank

ELO: Given the physical characteristics of a horizontal obstacle, determine whether the Warrior can maneuver beyond it.	**Media Treatment**

The Warrior fit through an exterior doorway up to _____ inches wide, without modification.
 	
    A. 24
    B. 28
    C. 32 (correct answer)
    D. 36
	Show the Manipulator approaching an exterior doorway to a building.
	
	Incorrect Feedback: Incorrect. The Warrior can cross through 32-inch standard exterior doorways, without modification.
	
	Correct Feedback: Correct. The Warrior can cross through 32-inch standard exterior doorways, without modification.
	
	Once feedback is provided, activate the Next button.

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Question 8

Template: Multiple Select

ELO: Specify each terrain type the Warrior can traverse.	**Media Treatment**
Which bodies of water can the Warrior safely traverse? **A.** Puddle 4 inches in depth (correct answer) **B.** Wastewater runoff 8 inches in depth **C.** Stream 10 inches in depth **D.** Marsh 12 inches in depth (correct answer)	Show a collage of the bodies of water mentioned in the distractors. **Incorrect Feedback:** Incorrect. Standing water up to 12 inches in depth is safe. But moving water is dangerous, as the robot can easily get swept away, even when it's shallow. **Correct Feedback:** Correct. Standing water up to 12 inches in depth is safe. But moving water is dangerous, as the robot can easily get swept away, even when it's shallow. Once feedback is provided, activate the Next button.

Question 9

Template: Custom

ELO: Designate each hostile environment the Warrior can endure.	**Media Treatment**
Place a checkmark next to each hostile environment the Warrior is capable of withstanding. Select SUBMIT to view the results.	Refer to my sketch of page layout. Show title of exercise at the top of screen: Hostile Environments Interactivity, followed by instructions. On the next line, include four image boxes with a checkbox to the left of each and the box's label below it. (See list below for labels.) Each image box will contain an image of a particular hostile environment. (See me; I have examples to include for image boxes.) Image Labels: ▪ External Electromagnetic Environment (EME) Free Field Strength (correct answer) ▪ Chemical, Biological, Radiological, and Nuclear (CBRN) Materials (correct answer) ▪ High-Altitude Electromagnetic Pulse (HEMP) (correct answer) ▪ Free Range Dielectric Fields Place a feedback text box below a centered SUBMIT button. Learner is allowed one attempt to answer correctly. **Incorrect Feedback:** Incorrect. The Warrior can operate during and after exposure to External EME Free Field Strength, CBRN, and HEMP environments. **Correct Feedback:** Correct. The Warrior can operate during and after exposure to External EME Free Field Strength, CBRN, and HEMP environments. Once feedback is provided, activate the Next button.

Question 10

Template: Multiple Choice

ELO: Contrast the capabilities and limitations of the Manipulator payload.	**Media Treatment**

With the help of its camera and gripper, the Manipulator arm enables the Warrior to do what?
 	
    A. Grasp and carry some objects.
    B. Poke, strike, or break open an object.
    C. Look over walls, under cars, and through windows.
    D. Both A and C. (correct answer)
	Show the Manipulator with its camera and gripper. But do not show this payload functioning or in context.
	
	Incorrect Feedback: Incorrect. The Warrior is able to look over walls, through windows, and under cars.
	
	Correct Feedback: Correct. The Warrior is able to look over walls, through windows, and under cars.
	
	Once feedback is provided, activate the Next button.

Conclusion

Conclusion

Template: Conclusion

Audio or Text	Media Treatment
Congratulations! You have completed the Warrior Tactical Robot Capabilities lesson. Select the Exit button to end your session.	Show a graphic of a certificate of completion as background for the Avatar. Include text overlay. Center the text.