PAINT TRAINING SIMULATOR TECHNICAL SPECIFICATION

1. Technical Specifications

1.1. Paint Simulator Instructor and User Station

Paint Simulation Station shall consist of the components listed in the technical specification table below, including 1 System Computer with Power Cable, 1 Touchscreen Display, 1 Virtual Reality Headset, 1 Combo Keyboard, and 1 Spray Gun.
The Instructor Station is operated through software running on the same hardware configuration.

Physical Characteristics,
Overall Dimensions (L-W-H) : 0.37 m - 0.47 m - 0.57 m
Net Weight (Product Only): 95 kg

Station Hardware Components:

Simulation Computer (1 Unit)	Processor	Min. Intel Core i5-11600K
	Main Memory (RAM)	Min. 16 GB DDR4 RAM
	Storage (Hard Drive / SSD)	Min. 256 GB SSD
	Graphics Card	Min. NVIDIA RTX 5070
	Chassis / Case	Min. 750 Watt
	Operating System	Min. Windows 11 Pro 64-bit
Monitor(TV) (1 Unit)	Display Size	Min. 32”
	Video Format	Full HD
	Image / Video Resolution	Min. 1920 x 1080 Pixel
	Refresh Rate	Min. 60 Hz
	HDMI Inputs	1 Unit
Touchscreen Display (1 Unit)	Display Type	Touchscreen LED LCD
	Screen Size	Min. 13.3”
	Aspect Ratio	16:9
	Resolution	Min. 1920 x 1080 Pixel
	Refresh Rate	Min. 60 Hz
	Response Time	8 ms

1.2. Physics and Realism Fidelity

1.2.1 Computer and Display Unit

- The system shall operate through a high-performance Computer Control Unit.
- The display unit shall be a touchscreen with a minimum resolution of 1920 × 1080.
- The computer shall communicate with peripheral devices via USB

1.2.2. VR Unit and Spray Gun Hardware

- The system shall use a Meta Quest 3 VR headset for tracking the user’s head position and orientation.
- A custom “Paint Gun” shall replicate the ergonomics and balance of a real paint gun and shall be integrated into the VR controller.
- The following physical inputs shall be provided via an adapter:

  Trigger Mechanism: Analog trigger pressure value ranging from 0.0 to 1.0, controlling the paint flow rate (min – max).

  Air Pressure Adjustment: Rotational mechanism for controlling air output pressure.

  Paint Flow Adjustment: Physical control of the paint flow rate.

  Spray Fan Angle Adjustment: Physical determination of spray pattern height.

  Aircap Rotation: Spray direction selection with two fixed positions (vertical and horizontal).

1.2.3. Chassis and Connectivity Components

1. All hardware components shall be housed within a portable, impact-resistant, industrial-grade chassis unit.
2. The chassis unit shall include cable management elements and an internal air circulation system.

1.2.4. Software Components

1. Simulation Engine: Shall operate on Unreal Engine 5.0+ and support high-quality physics and graphical interactions.
2. Data Input Interpretation (Input Interpreter) Layer: Middleware software that processes analog and digital inputs from the hardware and transmits them in a format compatible with the simulation engine.
3. Spray Particle Behavior Modeling Layer:

No	Module	Technical Specification Description
1	Particle Ballistic Motion Model	The 3D ballistic motion of particles is physically calculated based on velocity, direction, and air resistance.
2	Atomization Behavior Model	Droplet size and spray cone are modeled physically according to nozzle type, pressure, and viscosity parameters.
3	Spray Distribution Geometry Model	Spray density profile and spray geometry are calculated based on the type of spray gun.
4	Surface Adhesion Calculation Module	The retention rate of particles on the surface is determined based on the angle and velocity of impact.
5	Evaporation Calculation Module	The amount and timing of solvent evaporation are calculated according to environmental conditions.
6	Transfer Efficiency Calculation Module	The efficiency ratio between sprayed paint and paint adhered to the surface is calculated.
7	Paint Thickness Modeling Module	Film thickness formed on the surface is physically calculated based on the number and pattern of spray passes.

4. Simulation Module Software;
    - Shall include the Instructor Login Screen, Student Selection Screen, Operation Selection Screen (Spray Painting, Powder Coating, Sandblasting), Gun Selection Screen, Industry Selection Screen, Workpiece Selection Screen, Pre-Operation Gun Settings, Paint Selection Screen, and Environment Selection Screens.
    - Shall also include the Analysis Screen and Real-Time Practical Training Monitoring Screens.

5. Instructor Module:
    - Management Panel Interface for registering institutions, classes, instructors, and students.
    - User Session Records and Training Evaluation Reports Interface.

The Paint Simulator Software shall be modular, allowing the addition of new parts or scenes/environments for painting based on customer requests. Part and scene integration shall include 3D model import, workpiece definition, simulation parameter configuration, and making them selectable in the user interface. These additions shall be performed exclusively by the manufacturer, and once completed, they shall be directly usable by the customer.

1.2.5. Performance and Evaluation System

- The system shall record user interactions (distance, angle, speed, trigger pressure, etc.) with time-stamped data.
- Automatic metric analyses and graphical reports shall be generated based on the recorded data.

The simulation software shall include the information fields listed in the table below and shall be capable of generating PDF outputs.

No	Field Name	Description
1	Institution Name	Name of the institution receiving the training
2	Instructor Name	Name of the instructor delivering the training
3	Class	Name of the class or group
4	Student / Participant	Information of the participant attending the training
5	Training Start Date	Date when the training begins
6	Training End Date	Date when the training ends
7	Performed Operation	Type of painting operation performed
8	Selected Industry	Industry selection in the simulation
9	Workpiece	Name/model of the painted part
10	Equipment Used	Selected gun/equipment information
11	Air Pressure Setting	Value of the air pressure used
12	Paint Flow Rate	Amount of paint flow
13	Nozzle Size	Size of the nozzle used
14	Spray Fan Width	Selected spray fan width
15	Total Score	Overall performance score
16	Distance Score	Accuracy of spray distance
17	Angle Score	Accuracy of gun angle
18	Speed Score	Accuracy of painting speed
19	Paint Thickness Distribution Map	Visual representation of paint distribution on the part
20	Final Part Image	Output image of the part after the operation
21	Orange Peel Defect Map	Representation of surface orange peel defects
22	Sagging Defect Map	Representation of paint sagging defects

1.2.6. Simulation Behavior Model and Realism Fidelity Requirements

- The trigger and other physical adjustments shall directly affect simulation parameters according to real-world equivalents.
- Spray behavior (atomization, distribution, surface coating) shall be simulated realistically, closely modeling real-world physics.
- The design of the VR cable protection hose and adapter shall provide the user with a realistic feel of using an actual spray gun.

1.3. 3D Model and Simulation Environment

No	Simulation Area	Description
1	Painting Workshop Environment	Simulation of the environment in a real painting facility
2	User Painting Speed Graph	Analysis of the user's applied speed and performance evaluation
3	User Painting Angle Graph	Accuracy and appropriateness of the gun angle during painting
4	User Painting Distance Graph	Optimization and measurement of the gun-to-workpiece distance
5	Workpieces to be Painted	Selection of physical parts to be painted in the simulation
6	3D Spray Gun Model	3D modeling of the gun design to provide a realistic usage feel in the simulation

2. Warranty Conditions

The contractor shall provide, as part of the tender, a capacity report demonstrating that it produces simulation software and construction machinery simulators, issued by the professional chamber of which it is a member, as well as an industrial registration certificate showing the same. The training simulator, including both hardware and software, shall be covered by a 24-month warranty. During this period, the contractor shall provide free-of-charge spare parts, transportation, and installation services required for warranty repairs. The repair time for any malfunction shall not exceed 14 days. If the repair exceeds 14 days, the contractor shall ensure continuity of training by providing a replacement simulator.

3. Transportation, Installation, and Maintenance Services

The contractor shall personally perform the transportation and installation of the training simulator equipment at the location designated by the Administration using its own personnel. The Administration shall prepare the electrical and IT infrastructure at the installation site. The contractor shall bring all technical materials required for installation based on the condition of the installation environment.

4. User Manual and Instructor Training

All interfaces, explanatory texts, and content within the simulation shall be in Turkish. The contractor shall deliver the user and maintenance manuals as well as training booklets in Turkish. For personnel assigned as instructors in courses organized by the Administration, the contractor shall provide a two-day Instructor Training on simulator operation and maintenance free of charge.

5. Other Considerations

Bids shall be submitted in EUR. The products shall be delivered within 15 business days from the project start date. The payment for the delivered products shall be made to the contractor no later than 15 business days after delivery.