PORTABLE AIR CONDITIONING JACKET (PACJ)

Proof of Concept - CAD Modeling & Design Visualization Project Report

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PROJECT IDENTIFICATION

Project Title: Portable Air Conditioning Jacket - 3D Modeling & Visualization
Project Type: Proof of Concept (PoC) Design Study
Date: June, 2020

EXECUTIVE SUMMARY

This project report documents the development of a proof-of-concept 3D model for a Portable Air Conditioning Jacket (PACJ) system. The work involved creating visual representations of system components based on reference images, with the primary objective of demonstrating spatial packaging feasibility within a wearable jacket form factor.

Key Project Outcomes:

- **Visual Concept Development:** Successfully created 3D representations of all identified components
- **Packaging Feasibility Study:** Demonstrated potential component arrangement within jacket constraints
- **Design Visualization:** Provided clear visual documentation for stakeholder review
- **Multi-Format Deliverables:** Delivered CAD files in industry-standard formats

Project Scope & Limitations:

This project represents a conceptual design study focused on visualization and spatial arrangement. No detailed engineering analysis, performance calculations, or technical specifications were developed as part of this proof-of-concept phase.

PROJECT BACKGROUND & OBJECTIVES

Problem Statement

The project required a visual representation of a portable air conditioning system integrated into a wearable jacket format. The challenge was to interpret reference images and create a cohesive 3D model that demonstrates the feasibility of packaging all necessary components within the constraints of a wearable garment.

Project Objectives

1. **Visual Interpretation:** Create accurate 3D representations of components shown in reference materials
2. **Spatial Study:** Explore packaging possibilities within jacket dimensional constraints
3. **Design Documentation:** Provide comprehensive visual documentation for review and approval
4. **Concept Validation:** Demonstrate feasibility of the overall design concept
5. **Stakeholder Communication:** Enable effective design discussions through visual aids

Design Philosophy

The project adopted a "form-follows-function" approach, prioritizing: - **Visual Clarity:** Clear representation of system components and their relationships - **Spatial Efficiency:** Optimal use of available space within jacket constraints - **Design Flexibility:** Adaptable component arrangements for future development - **Professional Presentation:** Industry-standard documentation and deliverables

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METHODOLOGY & DESIGN APPROACH

Design Process Overview

The project followed a systematic approach from concept interpretation through final deliverable preparation:

1. **Reference Analysis Phase**
2. Detailed study of reference images
3. Component identification and classification
4. Functional relationship mapping
5. Spatial constraint analysis
6. **3D Modeling Phase**
7. Component-by-component modeling approach
8. Non-parametric design methodology
9. Iterative refinement process
10. Visual validation at each stage
11. **Integration Phase**
12. Component assembly and arrangement
13. Spatial optimization studies
14. Interference checking
15. Visual documentation preparation
16. **Documentation Phase**

17. Multi-format file preparation
18. Screenshot generation and organization
19. Project report compilation
20. Presentation material preparation

Technical Methodology

Non-Parametric Design Approach

- **Dimensional Freedom:** Sizes based on visual proportions and judgment
- **Flexible Architecture:** Easily modifiable designs for future refinement
- **Proportional Scaling:** Maintaining realistic component relationships
- **Iterative Development:** Continuous refinement through visual feedback

CAD Modeling Techniques

- **Solid Modeling:** Primary technique for all component creation
- **Assembly Modeling:** Component integration and relationship management
- **Visual Rendering:** Presentation-quality outputs
- **File Management:** Organized structure for multi-format deliverables

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COMPONENT ANALYSIS & IDENTIFICATION

Proposed Subsystems and Components

1. **Cooling Subsystem**
2. Proposed Parts: Thermoelectric modules, compact heat sinks, axial cooling fans, thermal interface pads
3. Process Insight: Integrated solid-state modules for cooling, passive heat dissipation components, and air circulation units
4. **Power Management System**
5. Proposed Parts: Rechargeable battery module, DC-DC power regulator, basic BMS board, control switches
6. Process Insight: Modular battery housing, efficient voltage conversion, and safe user-side controls
7. **Fluid Circulation Network**
8. Proposed Parts: Micro pump, silicone tubing, compact fluid reservoir, inlet-outlet manifolds
9. Process Insight: Closed-loop design for targeted cooling, routed through jacket seams, basic pump fitment features
10. **Control & Monitoring System**

11. Proposed Parts: Embedded microcontroller board, onboard sensors, small display unit, user input knob or buttons
12. Process Insight: Conceptual layout for system status monitoring and manual override inputs

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DESIGN DEVELOPMENT PROCESS

Phase 1: Conceptual Design

Duration: 3–5 days
Activities: - Reference image analysis and interpretation
- Component functional analysis
- Initial sketching and concept development
- Spatial constraint evaluation

Deliverables: - Concept sketches
- Component matrix
- Spatial studies
- Documentation strategy

Phase 2: 3D Modeling & Development

Duration: 7–10 days
Activities: - 3D modeling of each component
- Assembly creation and integration
- Refinement and optimization
- Visual validation

Specifications: - **Software Used:** SolidWorks
- **Modeling Approach:** Non-parametric
- **File Organization:** By component and subsystem
- **Modeling Features:** Extrusions, revolutions, Boolean operations, mating features

Phase 3: Integration & Optimization

Duration: 2–3 days
Activities: - Assembly creation and constraint application
- Interference and clearance resolution
- Visual documentation generation

DELIVERABLES & FILES

CAD Model Files

- **PACJ_Assembly_v1.sldasm (SolidWorks Assembly)**

- PACJ_CoolingUnit.sldprt
- PACJ_BatteryPack.sldprt
- PACJ_PumpHousing.sldprt
- PACJ_ControlModule.sldprt
- PACJ_TubingNetwork.sldprt
- PACJ_Reservoir.sldprt
- PACJ_MountBracket.sldprt
- **PACJ_Assembly_v1.step**
- **PACJ_Assembly_v1.iges**
- **PACJ_Assembly_v1.pdf (3D PDF)**

Visual Documentation Package

- Multi-angle assembly views
- Exploded views
- Cross-sections
- High-resolution renders (1920x1080)
- Annotations and visual labeling

Project Status: Successfully Completed
Readiness Level: Proof of Concept (TRL 3)
Next Phase Recommended: Engineering Analysis & Prototype Development