

Research Plan for CSE3000 Research Project

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Research Questions

Can domain adaptation improve
AI-based (*Google's) hand landmark prediction
from RGB to infrared (IR) images?

Qualitative Comparison

Quantitative Comparison

Data

Qualitative Comparison

- Availability of data
- Shallow vs Deep models
- Scalability

Quantitative Comparison

- Comparative metrics
- Real-time inference maintenance

Data

- Data augmentation
- Google's model limitations

Methodology (1/2): Setup and Core Components

```
1 # 1. Data Collection and Initial Setup
2 DATA = Upload_and_clean_infrared_videos()
3 DETECTOR = GoogleMediaPipe.HandLandmarkDetector()
4
5 # 2. Domain Adaptation Methods to Explore
6 ADAPTATION_METHODS = [
7     "Feature Alignment", # Start with simpler approach
8     "Adaptive Batch Norm", # Gradually increase complexity
9     "DANN", # Deep adversarial learning
10    "Correlation Alignment" # Advanced feature matching
11    # And maybe more based on other methods limitations
12 ]
13
14 # 3. Core Evaluation Pipeline
15 def EVALUATE(Data, Detector, Annotations):
16     """Measures performance using:
17     - Landmark accuracy
18     - Inference speed
19     - Resource usage"""
20     return EvalResults
21
22 def DATA_PREP(Data, Method):
23     """Prepares data specific to each adaptation method:
24     - Data augmentation
25     - Feature extraction
26     - Domain-specific preprocessing"""
27     return (ProcessedData, Annotations)
```

Methodology (2/2): Iterative Research Process

```
1 # 4. Iterative Experimentation Loop
2 DEADLINE = datetime(2025, 1, 31)
3 while datetime.now() < DEADLINE:
4     # Phase 1: Setup and Data Preparation
5     current_method = select_next_method(ADAPTATION_METHODS)
6     prepared_data = DATA_PREP(DATA, current_method)
7
8     # Phase 2: Model Adaptation and Testing
9     adapted_model = apply_adaptation(DETECTOR, current_method)
10    results = EVALUATE(prepared_data, adapted_model)
11
12    # Phase 3: Analysis and Improvement
13    Reflect(results)
14
15 def Reflect(results):
16     """Research Documentation and Analysis:
17     1. Compare with previous iterations
18     2. Document time/resource costs
19     3. Identify improvement areas
20     4. Plan next adaptation strategy"""
21     update_research_findings()
22     optimize_pipeline()
```

Key Milestones:

- **Nov 2024:** Literature Review & Evaluation Framework
- **Dec 2024:** Method Implementation & Midterm Presentation
- **Jan 2025:** Model Optimization & Comparison Analysis & Final Documentation