PROJECT LOGBOOK

Computer-Vision-based-approach-to-detect-fatigue-driving

Course: CS-477 Computer Vision (Fall 2025)

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Project Duration: 14 Weeks (3 Phases)
Phase 1: Literature Review & Proposal (Weeks 1–6)
Phase 2: Model Training & Deployment (Weeks 7–13)
Phase 3: Final Report & Presentation (Weeks 14–16)

National University of Sciences and Technology (NUST)
School of Electrical Engineering and Computer Science

Contents

1 PHASE 1: Literature Review & Proposal

Weeks 1–6

1.1 WEEK 1

Progress:

1. Team formed (Haida Asif, Aleesha Waqar, Ayesha Nahman)
2. Project topic finalized: Computer-Vision-based-approach-to-detect-fatigue-driving
3. Initial brainstorming on dataset availability, problem scope, NVIDIA Jetson Nano feasibility
4. Discussed driver fatigue detection methodologies and embedded platform requirements

Meeting Minutes Detail:

1. Meeting Duration: 45 minutes
2. Agenda: Project topic selection and initial planning
3. Discussion Points: Dataset choices, Jetson Nano computational constraints, real-time processing requirements
4. Action Items: Collect research papers on fatigue detection methods, finalize system pipeline architecture

Key Decisions:

1. Selected computer vision-based approach for non-invasive fatigue detection
2. Decided to target NVIDIA Jetson Nano platform for embedded deployment

1.2 WEEK 2

Progress:

1. Collected initial set of research papers on driver fatigue detection
2. Identified key papers on MTCNN and embedded deep learning
3. Repository structure planned on GitHub
4. GitHub project board created with task categorization

Meeting Minutes Detail:

1. Meeting Duration: 25 minutes
2. Agenda: Pipeline architecture planning
3. Discussion Points: Finalized algorithm pipeline (face detection $\rightarrow$ feature extraction $\rightarrow$ fatigue classification)
4. Action Items: Continue comprehensive literature collection, document findings

Key Decisions:

1. Multi-index fusion strategy adopted as baseline approach
2. Proposal will include feasibility analysis for Jetson Nano deployment
3. Focus on real-time processing with minimal latency requirements

1.3 WEEK 3

Progress:

1. Literature review expanded with focus on embedded fatigue detection systems
2. Analyzed state-of-the-art methods: MTCNN, CNNs, multi-parameter fusion
3. Identified dataset sources for training and validation
4. Reviewed papers on eye closure detection, and yawning recognition

Meeting Minutes Detail:

1. Meeting Duration: 30 minutes
2. Agenda: Literature review progress update
3. Discussion Points: Data sourcing challenges
4. Action Items: Complete comprehensive literature review summary

Key Decisions:

1. Focus on publicly available facial datasets
2. Target multiple fatigue indicators: eye closure, mouth opening, headpose

1.4 WEEK 4

Progress:

1. Completed comprehensive literature review document
2. Analyzed techniques: improved MTCNN, convolutional networks
3. Finalized project proposal structure with technical specifications
4. Created initial timeline with phase-wise milestones
5. Documented comparison of fatigue detection methodologies

Meeting Minutes Detail:

1. Meeting Duration: 40 minutes
2. Agenda: Proposal finalization and scope definition
3. Discussion Points: Project scope and deliverables, technical feasibility assessment
4. Action Items: Complete proposal draft, prepare for supervisor review

Key Decisions:

1. Submit proposal to supervisor by end of week 5
2. Literature review will serve as foundation for methodology selection
3. Begin preliminary dataset exploration simultaneously

1.5 WEEK 5

Progress:

1. Project proposal submitted to course instructor
2. Documented system architecture: face detection, landmark localization, feature classification
3. Created data preprocessing pipeline outline
4. Identified hardware requirements for Jetson Nano deployment

Meeting Minutes Detail:

1. Meeting Duration: 35 minutes
2. Agenda: Supervisor feedback incorporation
3. Discussion Points: Technical feasibility concerns, computational constraints, real-time performance targets
4. Action Items: Address supervisor feedback, refine methodology

Key Decisions:

1. Modify approach based on supervisor suggestions regarding model optimization
2. Plan to begin implementation phase in week 6
3. Establish clear performance metrics: accuracy, inference time, resource utilization

1.6 WEEK 6

Progress:

1. Finalized proposal incorporating supervisor feedback
2. Setup development environment: VS code, Jetson Nano SDK installation
3. Created initial code repository structure with organized directories
4. Documented system requirements and dependencies

Meeting Minutes Detail:

1. Meeting Duration: 25 minutes
2. Agenda: Phase 2 implementation planning
3. Discussion Points: Resource allocation, timeline for model development
4. Action Items: Prepare development environment, begin dataset collection

Key Decisions:

1. Start model training and implementation in week 7
2. Establish weekly progress review meetings

2 PHASE 2: Model Training & Deployment

2.1 WEEK 7

Progress:

1. Initiated facial detection and landmark localization using Multi-Task Cascaded Convolutional Neural Network (MTCNN)
2. Implemented MTCNN (standard three-stage model: P-Net, R-Net, O-Net) for face detection and landmark extraction.
3. Extracted 5 keypoints (eye and mouth corners), validated their stability, and integrated them into the preprocessing pipeline
4. Tested face detection pipeline on data
5. Documented MTCNN performance metrics on varied lighting conditions

Meeting Minutes Detail:

1. Meeting Duration: 20 minutes
2. Agenda: Facial detection implementation and validation
3. Discussion Points: MTCNN architecture optimization, detection accuracy under different scenarios
4. Action Items: Complete MTCNN implementation, prepare for feature extraction phase

Key Decisions:

1. Use improved MTCNN for robust face detection
2. Implement facial landmark localization for eye and mouth region identification
3. Target detection accuracy suitable for real-time embedded processing

2.2 WEEK 8

Progress:

1. Implemented convolutional neural network for eye and mouth state recognition
2. Collected and preprocessed training data for eye closure and mouth opening detection
3. Configured training parameters for initial model training

Meeting Minutes Detail:

1. Meeting Duration: 20 minutes
2. Agenda: Feature extraction network implementation
3. Action Items: Continue network training, evaluate preliminary classification results

Key Decisions:

1. Adopt depth-separable convolutions for computational efficiency on Jetson Nano
2. Focus on Eye Closure Rate (ECR) and Mouth Opening Rate (MOR) as primary fatigue indicators

2.3 WEEK 9

Progress:

1. Completed implementation of multi-index fusion strategy
2. Integrated Eye Closure Rate (ECR) and Mouth Opening Rate (MOR)
3. Configured fusion thresholds for ECR and MOR
4. Developed fatigue assessment algorithm combining multiple indicators

Meeting Minutes Detail:

1. Meeting Duration: 25 minutes
2. Agenda: Multi-index fusion implementation
3. Discussion Points: Threshold selection rationale, fusion algorithm design
4. Action Items: Validate fusion strategy on diverse test cases, document performance metrics

Key Decisions:

1. Select multi-index fusion strategy over single-parameter methods for robust detection
2. Configure thresholds based on fatigue indicators
3. Implement analysis for sustained fatigue state identification

2.4 WEEK 10

Progress:

1. Completed facial landmark coordinate extraction
2. Extracted facial landmarks for eye and mouth feature computation
3. Implemented feature parameter computation for ECR and MOR
4. Validated landmark extraction accuracy on test dataset
5. Optimized feature extraction pipeline for real-time processing

Meeting Minutes Detail:

1. Meeting Duration: 30 minutes
2. Agenda: Facial landmark extraction validation
3. Discussion Points: Integration, coordinate accuracy
4. Action Items: Complete feature extraction pipeline, prepare for model optimization

Key Decisions:

1. Use library for reliable facial landmark detection
2. Validate landmark accuracy before proceeding to full system integration

2.5 WEEK 11

Progress:

1. Setup NVIDIA Jetson Nano development environment
2. Installed JetPack SDK with CUDA, cuDNN, and TensorRT libraries
3. Configured development tools and dependencies
4. Tested initial deployment pipeline
5. Documented Jetson Nano setup procedure and dependency installation

Meeting Minutes Detail:

1. Meeting Duration: 25 minutes
2. Agenda: Jetson Nano platform preparation
3. Discussion Points: SDK installation, performance benchmarking
4. Action Items: Complete environment setup, prepare for model deployment

Key Decisions:

1. Configure Jetson Nano for optimal performance with power mode settings
2. Enable TensorRT optimization for model acceleration
3. Establish baseline inference performance metrics

2.6 WEEK 12

Progress:

1. Conducted architecture selection analysis: Improved MTCNN
2. Evaluated model performance on ECR and MOR detection
3. Documented architecture comparison based on accuracy and computational efficiency
4. Prepared training configuration for selected architecture
5. Optimized model parameters for embedded deployment

Meeting Minutes Detail:

1. Meeting Duration: 30 minutes
2. Agenda: Architecture selection and justification
3. Discussion Points: Model complexity vs accuracy trade-offs
4. Action Items: Finalize architecture selection, document design rationale

Key Decisions:

1. Select Improved MTCNN for optimal balance
2. Prioritize computational efficiency for real-time embedded processing
3. Document architecture selection rationale for final report

2.7 WEEK 13 (In Progress)

Progress:

1. Ongoing: Camera interfacing implementation on Jetson Nano platform
2. Ongoing: Drowsiness detection accuracy improvement through hyperparameter tuning
3. Testing real-time capture from camera module
4. Optimizing frame preprocessing pipeline for minimal latency
5. Evaluating detection accuracy on live camera feed
6. Implementing head pose estimation for additional fatigue indicator
7. Integrating Head Non-Positive Face Rate (HNFR) into fusion strategy

Meeting Minutes Detail:

1. Meeting Duration: 30 minutes
2. Agenda: Real-time implementation progress review
3. Discussion Points: Camera integration challenges, optimization strategies, accuracy refinement
4. Action Items: Complete camera interfacing, improve detection accuracy, integrate head pose estimation

Key Decisions:

1. Focus on camera interfacing and real-time performance optimization
2. Implement accuracy improvement techniques: model fine-tuning, threshold adjustment
3. Add head pose estimation as third fatigue indicator alongside ECR and MOR