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Emotional Drift Analysis in Temporal Text Streams Using AI

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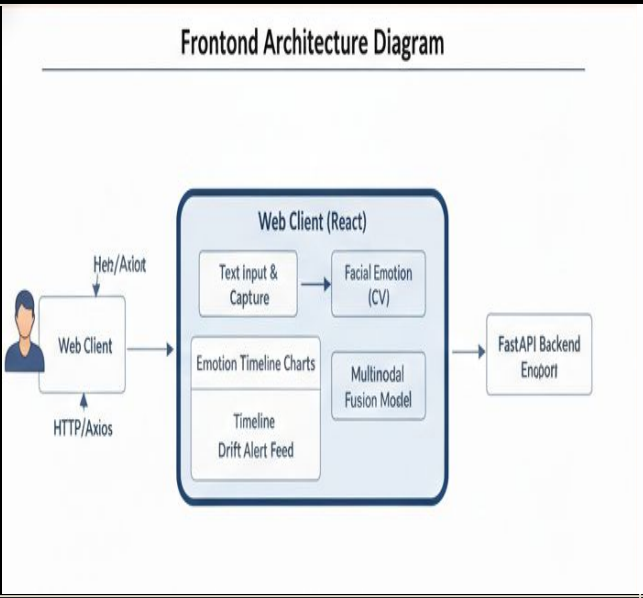
Single-modality emotion detection systems fail to accurately capture human emotions due to ambiguity in text, lack of contextual understanding in facial expressions, and absence of temporal emotional analysis.

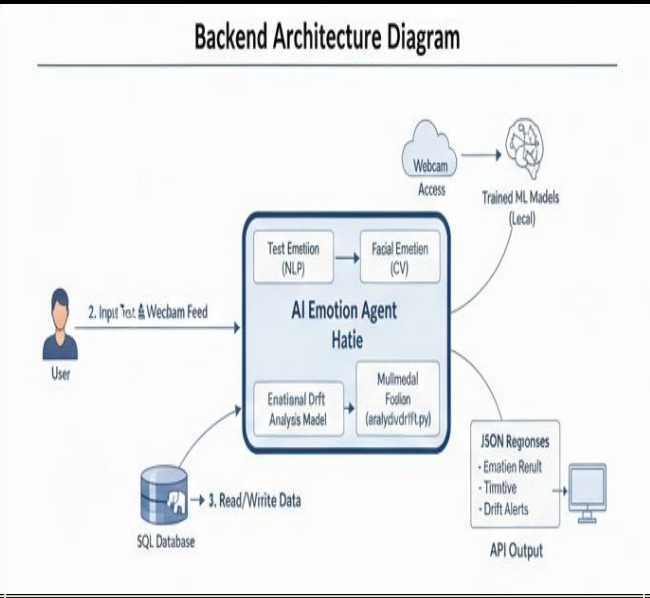
Goal: Build a multimodal emotion intelligence system combining text + facial emotion recognition + temporal drift analysis

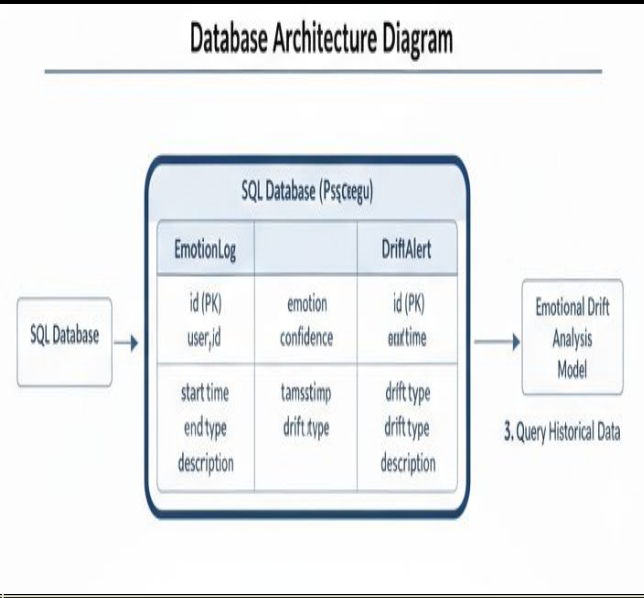
Value Proposition: Improved accuracy, interpretability, and longitudinal emotion tracking

PROBLEM STATEMENT

SYSTEM ARCHITECTURE







Frontend

React SPA (Axios for API calls)

Backend

FastAPI (Modular services: Inference, Fusion, Drift, API Layer)

Database

SQL-based (EmotionLog, DriftAlert)

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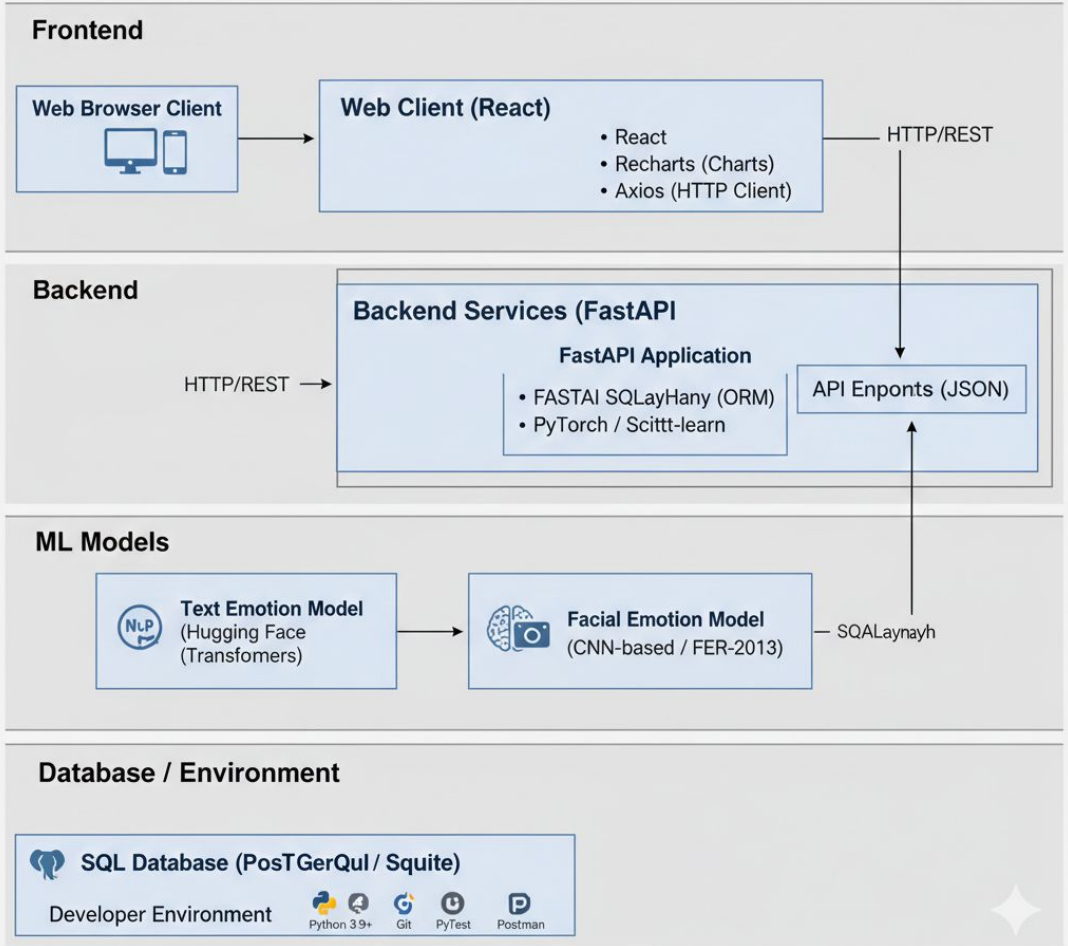
TECHNICAL STACK & COMPONENTS

- Frontend:
  - React
  - Recharts
  - Axios
- Backend:
  - FastAPI
  - PyTorch/Scikit-learn
  - SQLAlchemy
- ML Models:
  - Text Emotion: Hugging Face Transformers
  - Facial Emotion: CNN-based model (FER-2013)
- Database:
  - SQLite / PostgreSQL
- Environment:
  - Python 3.9+
  - Git
  - PyTest
  - Postman

System Architecture Diagram - Technology Stack



Multimodal Fusion Logic

Approach: Rule-based fusion of text + facial emotion outputs

Process:

- Text input → NLP model → Emotion label + confidence
- Webcam input → Facial recognition model → Emotion label + confidence
- Fusion logic → Weighted confidence → Final emotion label
- Fallback Mechanism: Text-only mode if webcam fails

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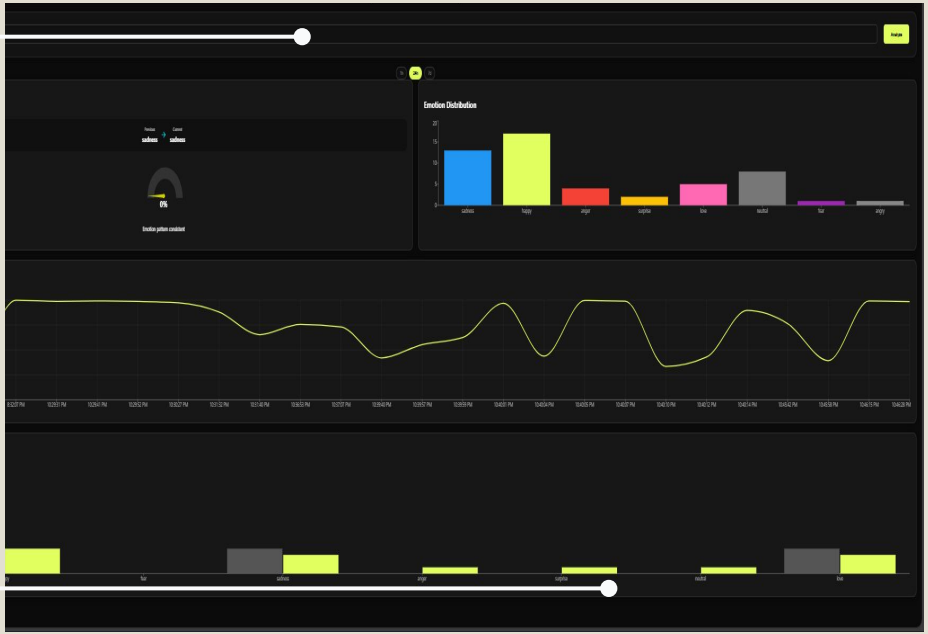
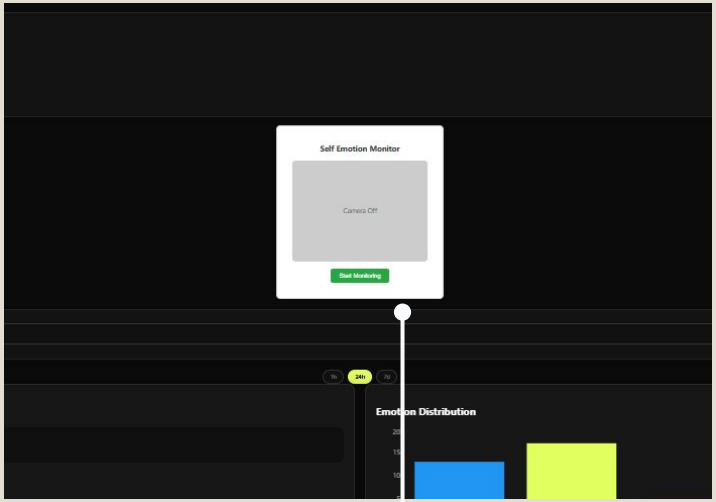
Text Analysis



History



Face Emotion Detection

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Emotion Drift Detection - Technical Deep Dive

- Definition : Significant change in emotional pattern over time
- Method :
  - Sliding window analysis on historical emotion logs
  - Statistical thresholds for drift detection (e.g., confidence drop, label change)
- Output: Drift alerts stored in DB, Visulaized in frontend

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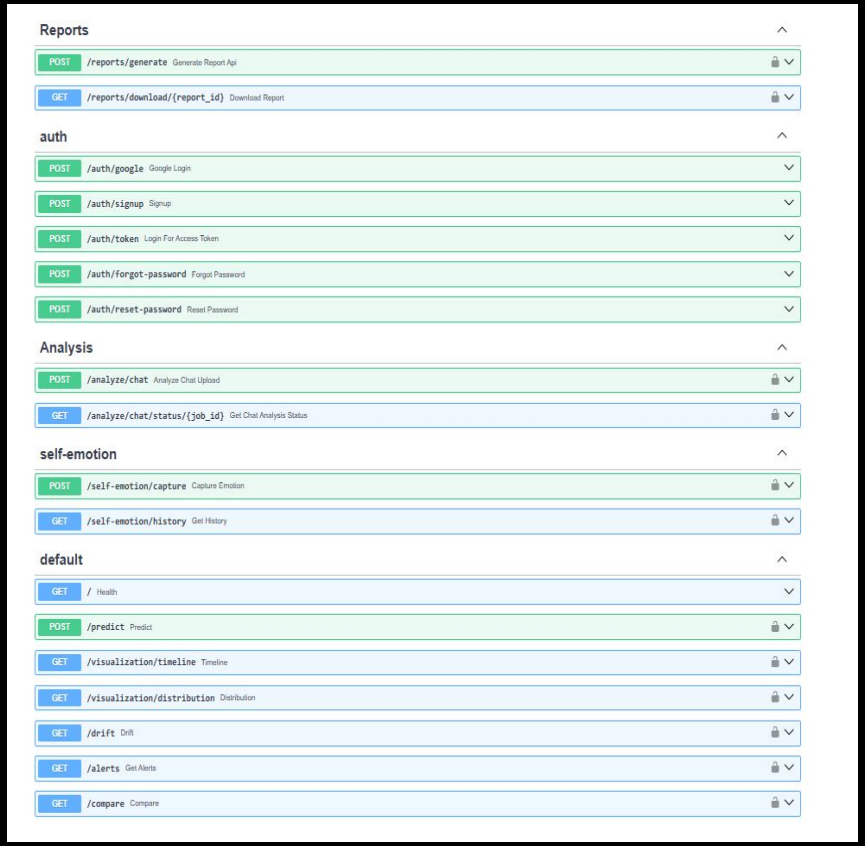

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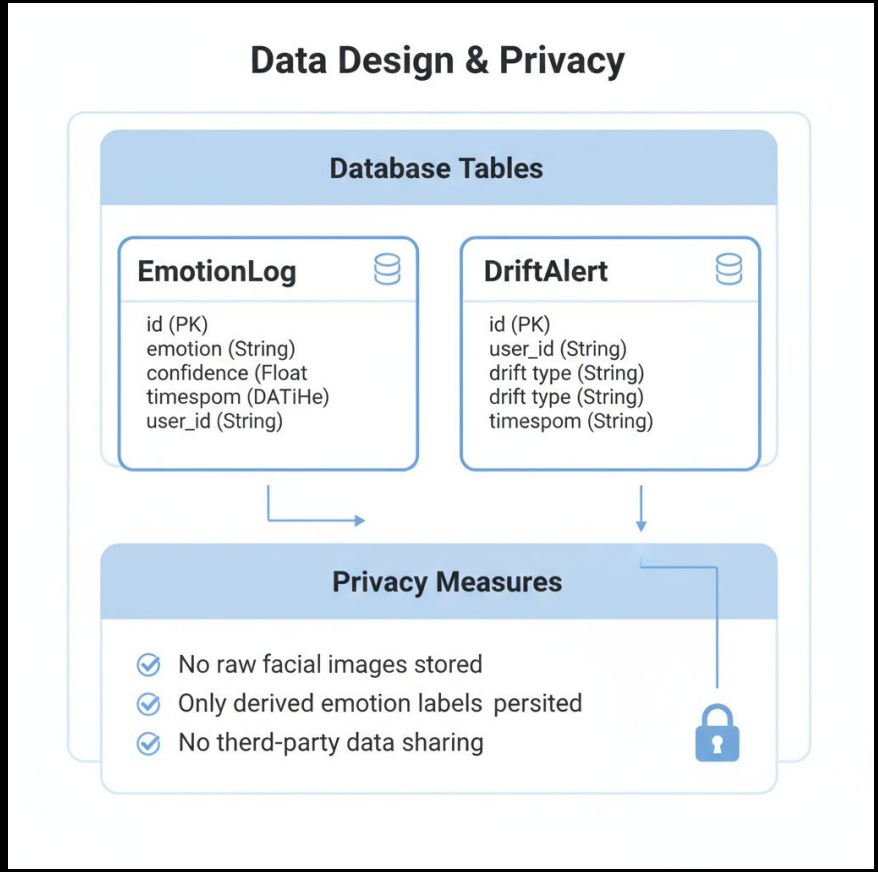
API Design & Endpoints

RESTful APIs (FastAPI):
POST/ predict : Emotional inference
GET/ timeline : Historical emotion logs
GET/ drift : Drift detection results
Response Time: <2 seconds
Authentication: User ID- based data mapping

Data Design & Privacy
Tables:
EmotionLog
DriftAlert

Privacy Measures
No facial images
Only derived emotions
No third-parthy data sharing



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Research & Market Analysis

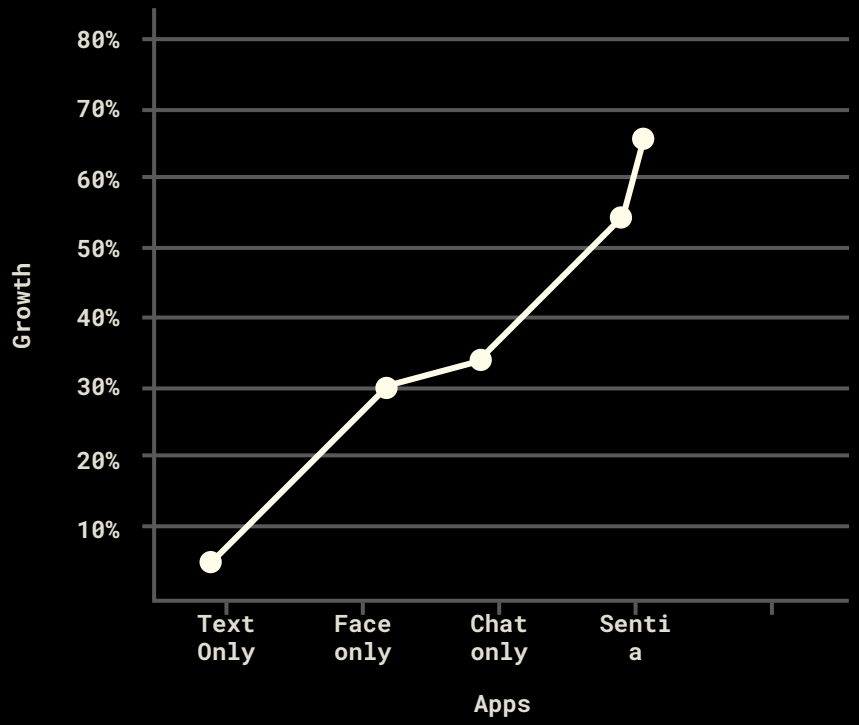
Literature Review :

- Ekman's Basic Emotion
- Multimodal Sentiment Analysis
- CNN-based Facial emotion Recognition

Competitor Analysis:

- Text-only tools (No facial cues)
- Facial-Only tools (No context)
- Chatbots (no drift analysis)

Our Edge : Multimodal + temporal drift detection



Testing & Quality Assurance

Non-Functional Requirements:

1. Latency <= 2 Sec
2. Uptime >= 99%
3. Error rate <= 1%

Testing Strategy

1. Unit tests (PyTest)
2. Integration tests (Postman)
3. UI tests (Manual)

Environments: Local - test - Demo

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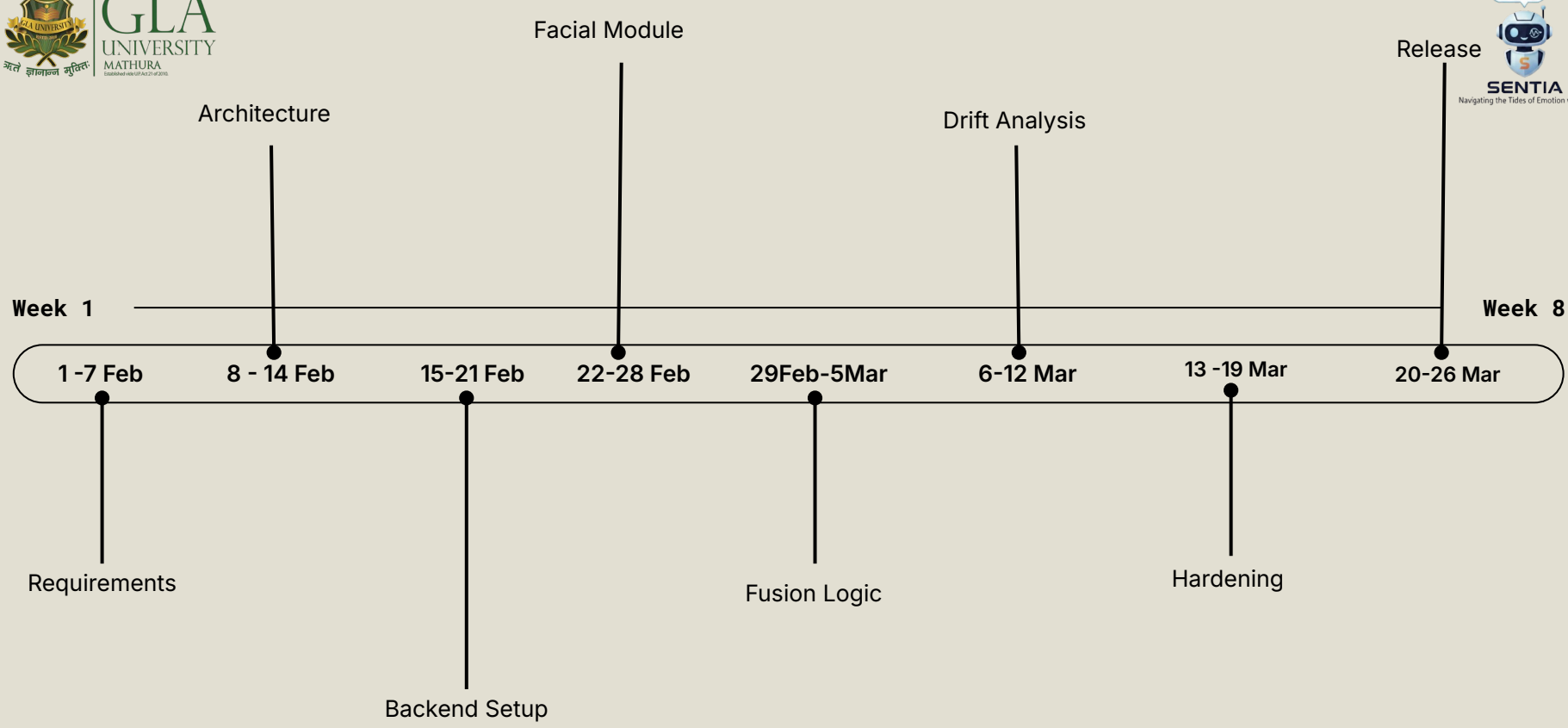
Risk Mitigation & Challenges

Risks :

1. Low detection accuracy:
   a. Model training
   b. validation
2. Webcam failure
   a. Fallback to text-only mode
3. Time constraints :
   a. Scope Prioritization

Mitigation :

1. Modular Design
2. Incremental Development
3. Continuous Validation



Week-wise Timeline

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- Achievements :
  - Built a working multimodal emotion detection system
  - Implemented drift detection and visualization
  - Ensured Privacy-aware design
- Future Work :
  - Speech Emotion Integration
  - Cloud deployment
  - Mobile app deployment

Conclusion and Future Scope

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