# Requirement Analysis Lab Task

## Facial Expression Recognition System

Course: Software Engineering
Duration: 2 Hours
Topic: Requirement Analysis

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### Group Members

- Zainul Abideen (23pwbcs1019)
- Khkula Gul (23pwbcs1029)
- Eisha Shah (23pwbcs1034)
- Umaima Ali (23pwbcs0981)

**Instructor:** Ma'am Kanwal Aneeq

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## Part 1: Requirement Elicitation

**Stakeholder Roles:**

Healthcare Professional, Educator, Researcher, IT Administrator

**User Requirements (14 Requirements):**

1. System must capture live video from webcam at 30 FPS
2. System should automatically detect human faces in video stream
3. System must classify emotions into seven categories: happiness, sadness, anger, fear, surprise, disgust, neutral
4. System should achieve minimum 85% accuracy on standard datasets (FER-2013, CK+)
5. System must process emotions in real-time at minimum 15 FPS
6. System should display confidence scores for each emotion prediction
7. System must provide web-based interface using Streamlit framework
8. System should show emotion labels overlaid on live video feed
9. System must process all data locally without external transmission
10. System should initialize within 10 seconds of startup

11. System must provide start and stop controls for emotion detection

12. System should handle camera errors gracefully with clear error messages

13. System must run on standard hardware (Intel Core i5, 8GB RAM)

14. System should support Windows, macOS, and Linux operating systems

## Part 2: Requirement Categorization & Analysis

| ID | Requirement Description | Type (F/NF) | Source | Ambiguity/Conflict | Resolution |
|---|---|---|---|---|---|
| REQ-01 | Capture live video at 30 FPS | F | Healthcare, Educator | None | N/A |
| REQ-02 | Detect faces automatically | F | All Users | None | N/A |
| REQ-03 | Classify seven emotions | F | Healthcare, Researcher | None | N/A |
| REQ-04 | Achieve 85% accuracy | NF | Researcher | Dataset version unclear | Specify FER-2013 Kaggle, CK+ v1.0 |
| REQ-05 | Process at 15 FPS minimum | NF | All Users | Hardware specs vague | Define baseline: i5 5th gen, 8GB RAM |
| REQ-06 | Web-based interface | F | Educator | User-friendly subjective | Define: 5-min learning time |
| REQ-07 | Display emotion labels on video | F | All Users | Display format unclear | Specify: 18pt font, overlay on box |
| REQ-08 | Local data processing only | NF | Healthcare, IT | None | N/A |
| REQ-09 | Initialize within 10 seconds | NF | Educator | Startup conditions unclear | Include model loading time |
| REQ-10 | Start/stop controls | F | All Users | None | N/A |
| REQ-11 | Display confidence scores | F | Healthcare, Researcher | None | N/A |
| REQ-12 | Handle camera errors | F | IT Administrator | Recovery time not specified | Auto-recover within 5 seconds |
| REQ-13 | Standard hardware support | NF | IT, Educator | Standard is vague | Specify minimum requirements |

| ID | Requirement Description | Type (F/NF) | Source | Ambiguity/Conflict | Resolution |
|---|---|---|---|---|---|
| REQ-14 | Cross-platform support | NF | IT Administrator | OS versions unclear | Windows 10+, macOS 10.14+, Linux |

> **Key Ambiguities Identified:**
>
> - **Dataset Version (REQ-04):** Standard datasets mentioned but exact versions not specified - Resolution: Use FER-2013 Kaggle version and CK+ Extended v1.0
> - **Hardware Requirements (REQ-05, REQ-13):** "Standard hardware" is subjective - Resolution: Define minimum as Intel Core i5 5th gen, 8GB RAM, 50GB storage
> - **User-Friendly Interface (REQ-06):** Unclear what makes it "user-friendly" - Resolution: Measurable criteria - learnable in 5 minutes, minimal clicks
> - **Display Format (REQ-07):** Emotion label positioning and size not defined - Resolution: 18pt font, high contrast, overlay on bounding box

# Part 3: Requirement Modeling

*See Use Case Diagram in separate artifact below*

## Use Case Descriptions:

### Use Case 1: Detect and Classify Emotions

**Actor:** Healthcare Professional, Educator, Researcher
**Description:** User starts the system, webcam captures live video, system detects face, classifies emotion in real-time, and displays result with confidence score overlaid on video feed.

### Use Case 2: View Real-time Results

**Actor:** All Users
**Description:** User views live video feed with emotion labels, confidence scores, and bounding boxes displayed in real-time with smooth updates at minimum 15 FPS.

### Use Case 3: Control Recognition Process

**Actor:** All Users
**Description:** User controls emotion recognition by starting or stopping the detection process using interface buttons, allowing them to manage when emotion analysis is active.

### Use Case 4: Monitor System Performance

**Actor:** All Users, IT Administrator
**Description:** User views system status indicators including FPS counter, processing state, and face detection status to ensure system is operating correctly and meeting performance requirements.

# Part 4: Reflection

## Challenges During Requirement Elicitation

The main challenge was balancing technical specifications with user-friendly language. Healthcare professionals and educators wanted simple, clear functionality while researchers needed detailed technical requirements like accuracy percentages and processing speeds. We also faced difficulty in defining "real-time" performance - different stakeholders had different expectations ranging from smooth video (30 FPS) to acceptable emotion updates (15 FPS).

Another challenge was privacy concerns from healthcare professionals who needed assurance that patient data would not be stored or transmitted. This required careful elicitation to understand their specific privacy needs versus technical capabilities.
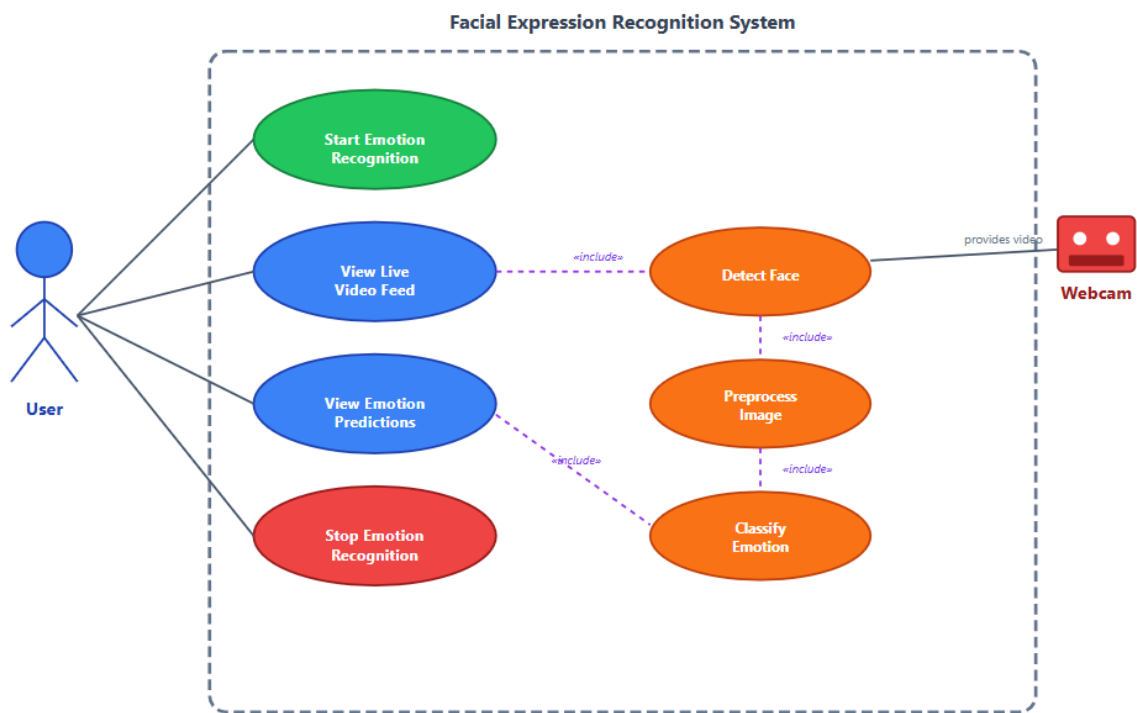
## Insights Gained

We learned that clear, measurable requirements are essential for avoiding ambiguity. Instead of saying "user-friendly," we specified "learnable within 5 minutes." Instead of "standard hardware," we defined exact specifications (Intel Core i5 5th gen, 8GB RAM). This precision eliminates confusion during development and testing phases.

We also discovered the importance of involving diverse stakeholders early. Each group (healthcare, education, research, IT) brought unique perspectives that shaped requirements we wouldn't have considered otherwise, such as the need for local processing due to patient privacy concerns.

## Improvements for Future Projects

In future projects, we would conduct more structured interviews with each stakeholder group separately before combining requirements. This would help identify conflicts earlier. We would also create a requirement

**Facial Expression Recognition System**

Start Emotion Recognition

View Live Video Feed

«include»

Detect Face

provides video

Webcam

User

«include»

View Emotion Predictions

Preprocess Image

«include»

«include»

Stop Emotion Recognition

Classify Emotion

Primary Use Cases    Internal Functions    Start Action    Stop Action

template with mandatory fields like "measurable criteria," "verification method," and "acceptance criteria" to force clarity from the start.

Additionally, we would prototype key features early (such as the interface) to get concrete feedback rather than abstract descriptions. Showing stakeholders a mock-up would have resolved many ambiguities about display formats and user experience expectations more efficiently than verbal descriptions.