CI IA2 Hardware Project Report by

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Real-Time Emotion Detection Security System Using ESP32-CAM

Abstract:

This project implements a real-time emotion detection security system using the AI Thinker ESP32-CAM module. The system captures video using the ESP32-CAM and streams it to a Python-based server for emotion detection. The server processes the captured frames to detect faces and identify emotions using the FER (Facial Expression Recognition) library. The processed frames are then displayed on a monitor with emotion annotations. This project aims to create an efficient, low-cost emotion detection security system that can be used for various applications such as smart security and human-computer interaction.

Components:

1. **ESP32-CAM**: A small, low-cost camera module with Wi-Fi capability, used to capture and stream video.
2. **Python Server**: A Python-based server running on a laptop, responsible for receiving frames from the ESP32-CAM, processing them for emotion detection, and displaying the processed video stream.
3. **OpenCV**: A computer vision library used to process images and detect faces.
4. **FER Library**: A lightweight emotion detection library used to identify emotions from facial expressions.
5. **Wires**: Used for connecting components in the prototype setup.

Description:

The system operates by having the ESP32-CAM capture video frames and send them to a Python server using HTTP. The server processes the frames to detect faces using OpenCV's pre-trained Haar Cascade model and performs emotion detection using the FER library. The emotion with the highest likelihood is annotated on the video, and the annotated frame is displayed in real-time. The system can be used as a security solution, providing an additional layer of emotion-based analysis in environments that require human monitoring.

The process involves the following key steps:

1. **Capture Frame**: The ESP32-CAM captures the video feed in real-time.

2. **Frame Transmission**: The captured frames are sent over the network to the server.

3. **Emotion Detection**: The server processes the frames using the FER library to identify emotions.

4. **Frame Display**: The server annotates the frames with the detected emotion and displays them on a monitor in real-time.
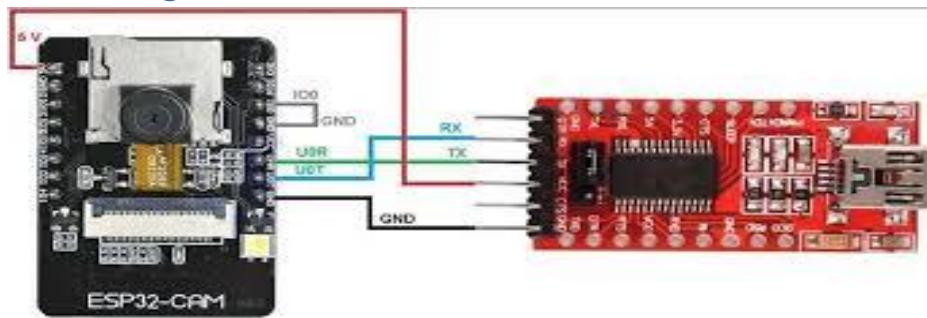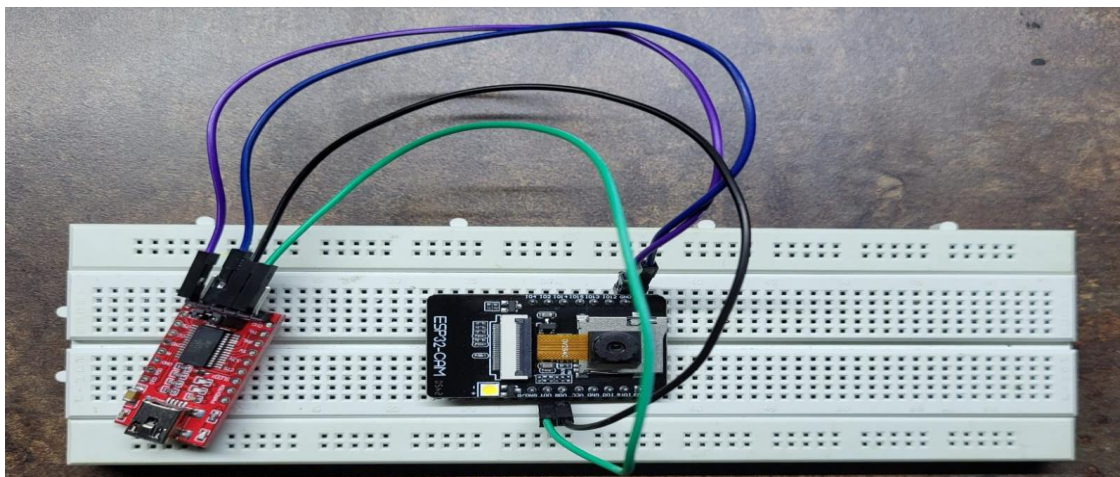
Output:

The system outputs a real-time video feed on a monitor with annotations of detected emotions on the faces in the video stream. For instance, if a person appears in front of the camera, the system may display "Happy," "Sad," or "Surprised" based on the detected facial expression.

Application of Project:

1. **Human-Computer Interaction**: Provides a platform for interactive systems where the user's emotional state can influence the system's responses.

2. **Smart Surveillance**: It can be integrated into surveillance cameras to enhance monitoring by adding emotional context to the video footage.

3. **Healthcare**: Can be applied to monitor patients in medical settings to assess their emotional well-being.

Conclusion:

The emotion detection security system using the ESP32-CAM offers an innovative solution to traditional surveillance systems. By adding emotion detection capabilities, it provides an additional layer of understanding and analysis, which can be useful in various applications like security, human-computer interaction, and healthcare. The system is cost-effective and can be further optimized by reducing latency and increasing detection accuracy. Future improvements can involve integrating more advanced emotion detection algorithms or adding additional sensors for better contextual awareness.