IOT-ENABLED REAL-TIME EMOTION MONITORING AND EMERGENCY ALERT SYSTEM FOR PARENTAL SUPPORT AND STRENGTHENING SOCIAL PROTECTION

Project Reference No.: *49S_BE_6480*

College : CHRIST Deemed to be University, Kengeri Campus, Bengaluru
Branch : Department of Computer Science and Engineering
Guide : Dr. Sandhiya B
Students : Mr. Sumeet Bafna
Mr. Marc Francis Pereira
Mr. Emil Joseph

Keywords:

Emotion Monitoring, Sentiment Analysis, DistilBERT, IoT Emergency Alert, Mental Health Intervention.

Introduction:

In today's highly connected digital world, young individuals increasingly turn to social media platforms like Twitter (X) to express their unvarnished thoughts, feelings, and frustrations. Often, these seemingly casual online expressions serve as early warning signs of deeper psychological distress, such as anxiety, depression, or severe emotional burnout. Unfortunately, traditional mental health support and parental intervention mechanisms are largely reactive—help usually arrives only after a severe emotional crisis has already occurred or the individual explicitly asks for it. This creates a dangerous gap where silent cries for help go entirely unnoticed. To address this critical vulnerability, this project introduces a proactive, holistic safety net. By seamlessly combining artificial intelligence with physical hardware, we have designed a system that passively monitors a user's digital environment for signs of emotional distress in real-time. It not only provides immediate digital resources to the user when they are vulnerable but also equips them with a tangible, physical "panic button" to instantly alert their parents or guardians when they are overwhelmed and need immediate human intervention.

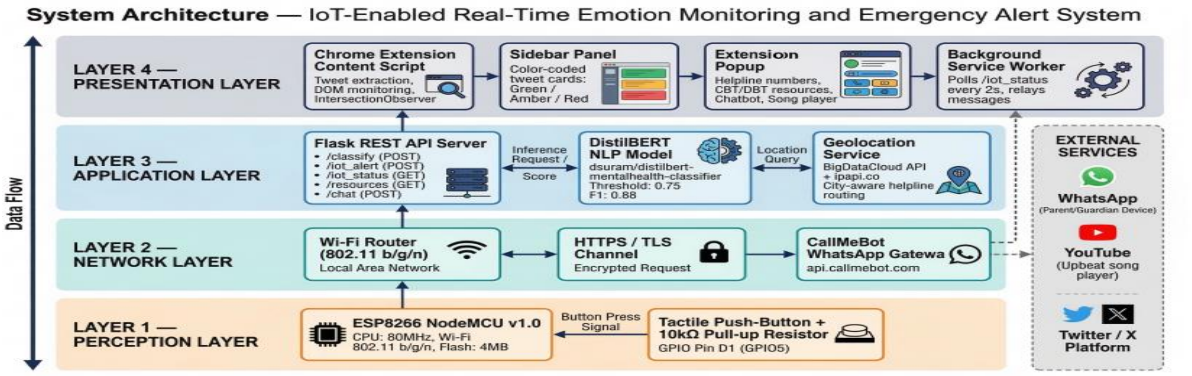

Figure 1: High-Level Architecture of the IoT-Enabled Emotion Monitoring System

Objectives:

1. Develop a real-time sentiment analysis system using a fine-tuned DistilBERT transformer model to accurately detect emotional distress signals from social media posts.
2. Implement a seamless Chrome browser extension (Manifest V3) that extracts tweet content, communicates with a backend server, and provides subtle visual feedback to the user without interrupting their browsing.
3. Design and build a reliable IoT-based emergency alert device using an ESP8266 NodeMCU microcontroller and a physical panic button.
4. Enable the physical IoT device to instantly trigger automated WhatsApp distress notifications to predefined parent or guardian contacts using an automated messaging API.

Methodology:

The project utilizes a comprehensive four-layer Design Science Research (DSR) methodology to integrate software engineering with embedded IoT systems. 1. Perception Layer (Hardware): We assembled a physical IoT panic button using an ESP8266 NodeMCU development board and a tactile push-button. This acts as the physical trigger for immediate distress signaling. 2. Network Layer: The NodeMCU connects via local Wi-Fi, utilizing HTTPS protocols to communicate with the CallMeBot API (for WhatsApp routing) and our custom backend server. 3. Application Layer (Backend AI): The "brain" of the project is a Flask REST API server deployed with a fine-tuned DistilBERT NLP model (dsuram/distilbert-mentalhealth-classifier). This model evaluates incoming text against a finely tuned confidence threshold (0.75) to accurately classify whether the user's text indicates distress or neutral emotion. 4. Presentation Layer (Frontend): We engineered a custom Google Chrome Extension that actively monitors the user's Twitter/X feed. Using DOM selectors and the IntersectionObserver API, it silently extracts visible tweets and sends them to the Flask backend. The extension then actively modifies the webpage, applying a color-coded border (Green/Safe, Amber/Warning, Red/Distress) around the tweets based on the NLP model's findings. If extreme distress is detected—or if the physical IoT panic button is pressed—the extension automatically overrides the screen to display immediate CBT/DBT coping resources and local helpline numbers.

Result and Conclusion:

In conclusion, the system successfully bridges the gap between passive digital monitoring and active physical intervention. During our rigorous testing, the DistilBERT model achieved a highly impressive F1-score of 0.88, proving its ability to accurately detect mental distress signals while minimizing false positives to just 4%. In practical end-to-end integration tests, the browser extension successfully captured and accurately categorized 96% of the tested social media interactions in real-time. Crucially, the physical IoT hardware proved highly reliable; under normal Wi-Fi

conditions, the system consistently successfully dispatched emergency WhatsApp alerts to parents within a rapid 2.1 to 3.4 second window. By successfully unifying a sophisticated transformer-based AI model with an accessible, low-cost (under INR 500) physical IoT device, this project proves that everyday digital environments can be transformed into proactive safety nets that actively protect youth and empower parents.

Project Outcome & Industry Relevance:

The primary outcome of this project is a fully functional, hybrid physical-digital prototype that proactively safeguards emotional well-being. From an industry perspective, this solution holds massive relevance for the rapidly growing EdTech, Digital Wellness, and Parental Control sectors. Unlike traditional parental control apps that merely block content or track screen time, this system introduces "empathetic monitoring"—using AI to understand the *context* of a child's digital life and intervening only when genuine distress is detected. This technology could be readily adopted by mental health organizations, school counselling programs, and cybersecurity firms looking to build smarter, more humane digital safety tools.

Working Model vs. Simulation/Study:

This project is an active, fully developed **Working Model**, not merely a theoretical study or simulation. We successfully built and integrated the physical IoT panic button hardware (using the ESP8266 NodeMCU), the live machine learning backend server, and the active Chrome browser extension, running them collectively in real-world browsing environments on actual social media feeds.

Project Outcomes and Learnings:

Through the development of this system, we gained hands-on expertise in deploying heavy transformer NLP models (DistilBERT) for real-time, low-latency browser applications. We learned the intricacies of hardware-software communication, specifically how to bridge physical microcontrollers (ESP8266) with web APIs (WhatsApp/CallMeBot) and a dynamic web frontend. Most importantly, we learned that creating technology for mental health requires a delicate balance: maximizing user privacy and maintaining an unobtrusive user experience, while still ensuring that critical, life-saving alerts are delivered instantly.

References:

- M. De Choudhury, M. Gamon, S. Counts, and E. Horvitz, "Predicting depression via social media," in *Proceedings of ICWSM*, 2013, pp. 128-137.
- G. Coppersmith, M. Dredze, and C. Harman, "Depression and ptsd on twitter," in *CLPsych Workshop*, 2015, pp. 31-39.
- V. Sanh, L. Debut, J. Chaumond, and T. Wolf, "Distilbert: A distilled version of bert," *arXiv preprint arXiv:1910.01108*, 2019.

- B. Inkster, S. Sarda, and V. Subramanian, "Empathy-driven conversational ai agent (wysa) for digital mental well-being," *JMIR mHealth and uHealth*, vol. 6, no. 11, 2018.

Future Scope:

The future scope of this project includes:

1. **Multilingual NLP Support:** Upgrading the sentiment analysis model to understand local languages and code-mixed textual data (e.g., "Hinglish"), which is highly prevalent among Indian youth online.
2. **GPS Integration:** Enhancing the physical IoT panic button to include a GPS module, ensuring that the WhatsApp emergency alert also broadcasts the user's exact physical location to parents or first responders.
3. **Cross-Platform Expansion:** Adapting the browser extension's DOM monitoring to support other heavy text-and-messaging platforms, such as Instagram Web, Facebook, and Discord.
4. **Clinical Integration:** Conducting large-scale user studies in collaboration with certified mental health professionals to safely deploy the system as a prescribed digital intervention tool for high-risk patients.