DETECTING STRESS BASED ON SOCIAL INTERACTIONS IN SOCIAL MEDIA A HYBRID CNN-FACTOR GRAPH MODEL FOR PSYCHOLOGICAL STRESS DETECTION

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Abstract

Psychological stress is a growing threat to human health, yet timely detection remains challenging. With the widespread use of social networking platforms such as Twitter, Facebook, and Instagram, users increasingly express their emotions and daily experiences through posts, comments, and interactions. This paper presents an intelligent framework for detecting users' psychological stress states by leveraging both tweet content and social interaction patterns. We define a comprehensive set of stress-related textual, visual, and social attributes at tweet-level and user-level. We propose a novel hybrid model that combines a Convolutional Neural Network (CNN) for extracting user-level content features with a Factor Graph Model (FGM) to incorporate social interaction information and model correlations between a user's stress state and that of their friends. The system is implemented as a web-based Java/J2EE application that supports real-time data collection, analysis, and stress-level reporting. Experiments on a large-scale real-world social media dataset demonstrate high accuracy and reveal interesting phenomena, such as stressed users having sparser social connections. The proposed framework provides an effective, proactive, and scalable solution for early stress detection and mental health support.

Keywords:

Stress Detection, Social Media Analysis, Natural Language Processing, Machine Learning, Deep Learning, Convolutional Neural Network, Factor Graph Model, Hybrid Model.

I.Introduction

Psychological stress has become a major health concern in modern society.

Traditional stress detection methods rely on self-reported questionnaires, interviews, or wearable sensors, which are reactive, time-consuming, and difficult to scale. Social media platforms now offer a rich, real-time source of behavioral and emotional data. Users' posts, comments, likes, and interaction patterns can reveal early signs of stress that may not be explicitly stated.

This paper introduces an intelligent stress detection system that analyzes both content and social interactions. The system extracts tweet-level and user-level attributes and employs a hybrid CNN-Factor Graph Model to classify stress states (low, medium, high). By studying correlations between a user's stress and their friends' stress states, the framework provides proactive insights for mental health support.

II.LiteratureSurvey

Previous research has explored stress detection from social media using various approaches:

- Text-based NLP methods for sentiment and emotion analysis
- Machine learning classifiers (SVM, Random Forest) for stress prediction
- Deep learning models (LSTM, CNN) for contextual understanding
- Social interaction analysis showing that stressed users tend to have reduced activity and sparser connections

While these works demonstrate the feasibility of social media-based stress detection, most focus only on textual content and ignore the rich information present in social interactions. Our hybrid model addresses this gap by jointly modeling content and social relationships.

III. Existing System & Proposed System

A. Existing System

Current systems primarily rely on tweet content analysis using NLP or basic machine learning. They suffer from:

1. Limited character length and indirect expression of stress
2. Failure to capture behavioral changes in social interactions
3. Lack of modeling correlation between users and their friends
4. Poor handling of noisy, sarcastic, or informal language
5. No proactive, real-time detection capability

B. Proposed System

The proposed system is a hybrid intelligent framework that combines a Convolutional Neural Network (CNN) for extracting deep content features with a Factor Graph Model (FGM) to incorporate social interaction information. It processes weekly social media data, computes tweet-level and user-level attributes (content, posting behavior, and social interactions), and outputs a stress state classification. The system supports user registration, data upload/analysis, stress reporting, and alerts.

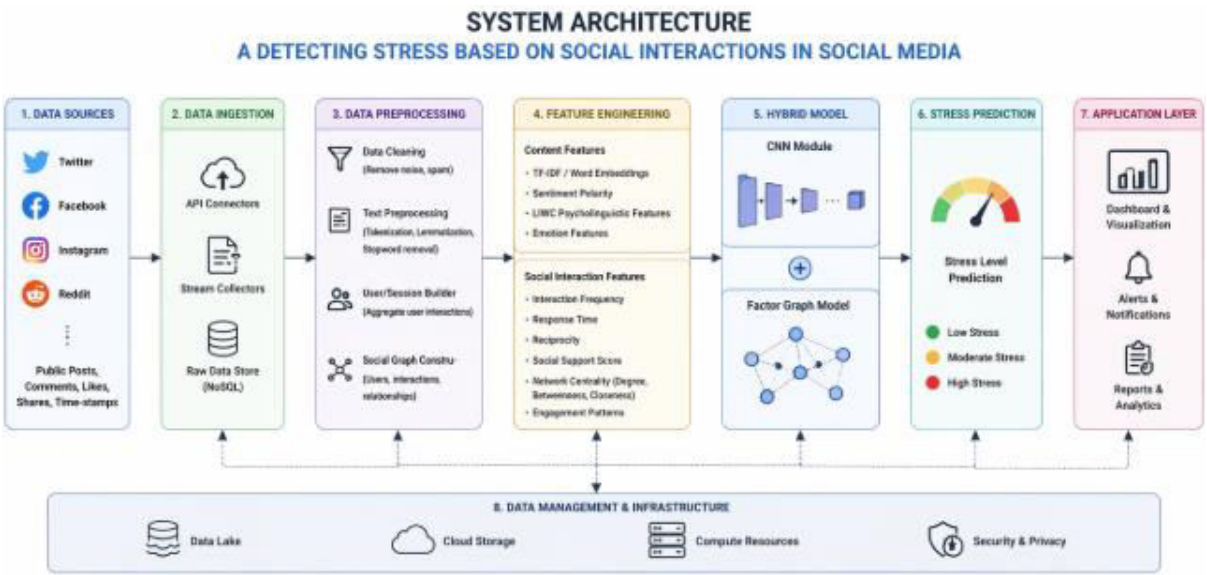
Advantages of the Proposed System:

1. Joint modeling of content and social interactions
2. Higher accuracy through hybrid CNN-FGM architecture
3. Real-time proactive stress detection
4. Reveals correlation between user stress and friends' stress
5. Scalable web-based implementation with user-friendly interface
6. Better handling of indirect and behavioral stress indicators

IV. System Design & Architecture

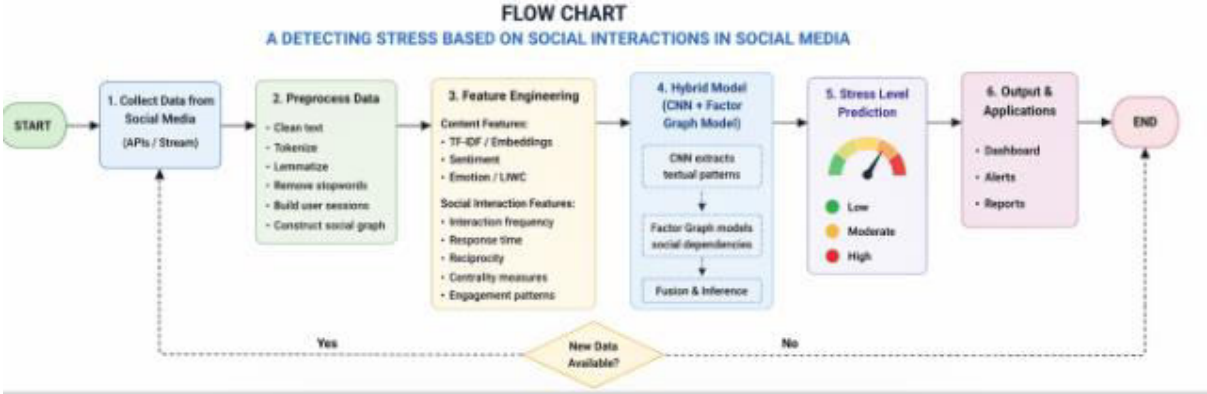
A. System Architecture

The architecture consists of a user-friendly web interface, data collection module, NLP preprocessing layer, CNN feature extractor, Factor Graph Model for stress inference, and reporting module. Data flows from social media input → attribute extraction → hybrid model processing → stress classification and visualization.



B. System Flowchart

User login → social media data upload → preprocessing (textual + social attributes) → CNN feature learning → FGM inference (incorporating friend correlations) → stress level output (low/medium/high) → report generation and alerts.



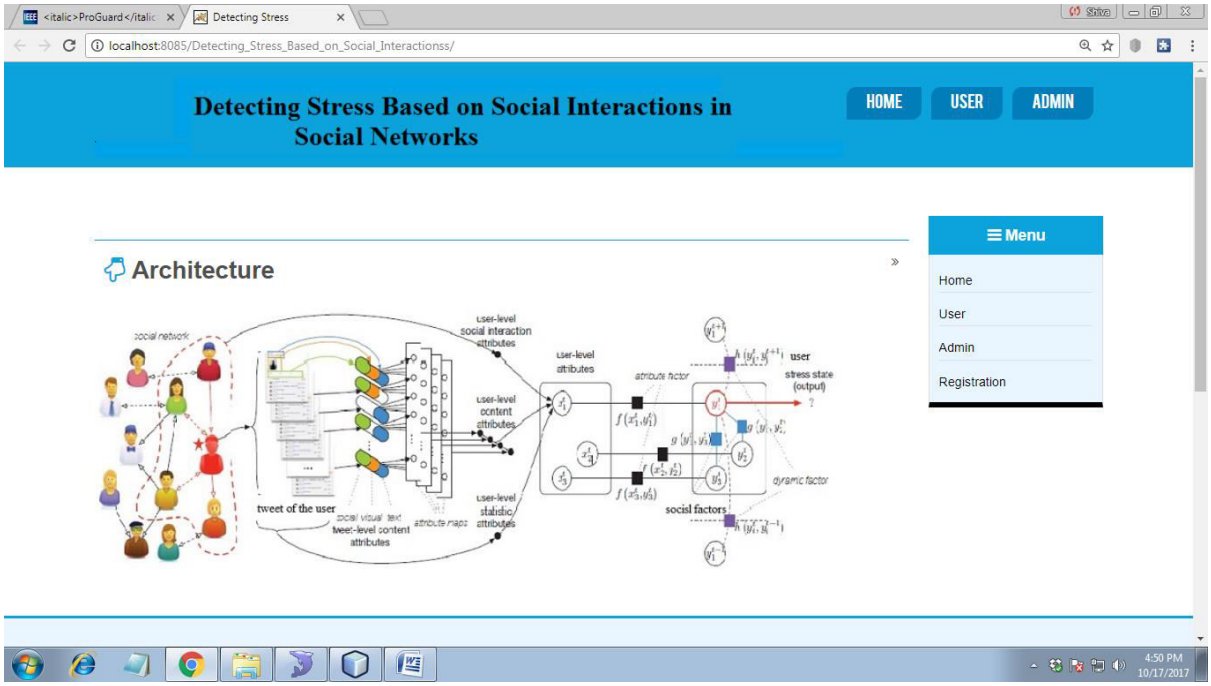
C. Modules Overview

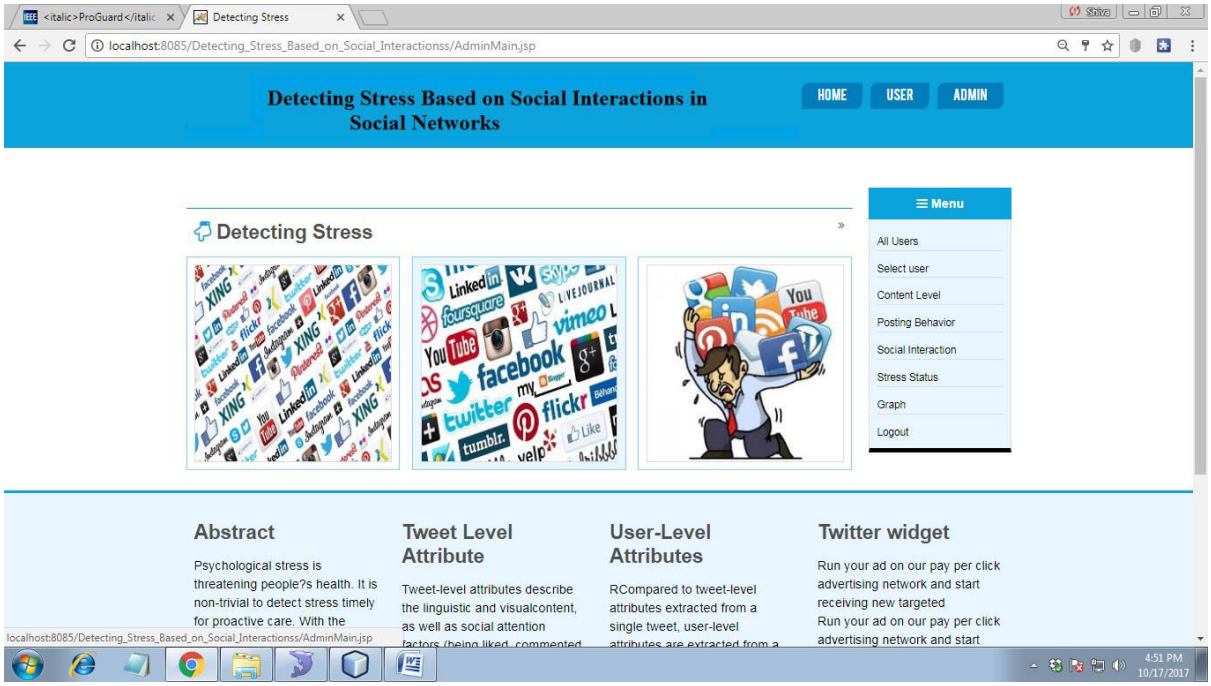
1. User Authentication Module: Secure login and role-based access
2. Data Collection Module: Upload or fetch social media posts and interactions
3. Feature Extraction Module: Computes textual, behavioral, and social attributes
4. Hybrid Model Module: CNN for content features + FGM for social inference
5. Stress Classification & Reporting Module: Generates stress levels and visualizations
6. Alert & Notification Module: Sends early warnings for high stress

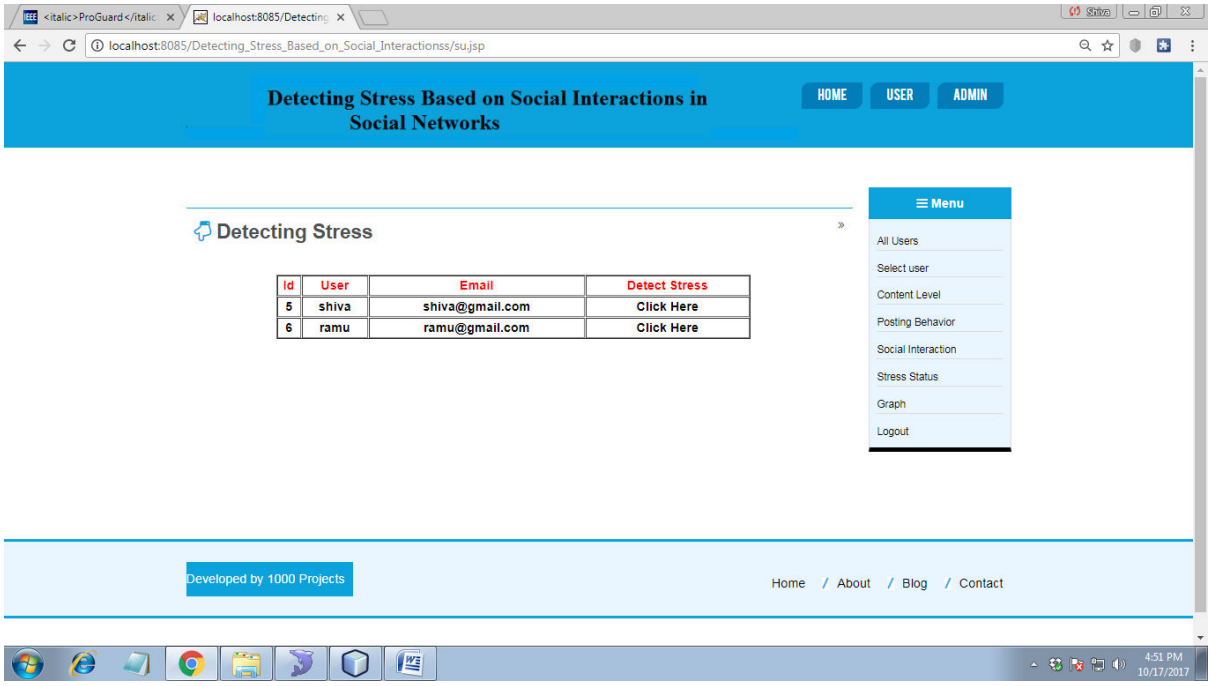
Table I: Technology Stack

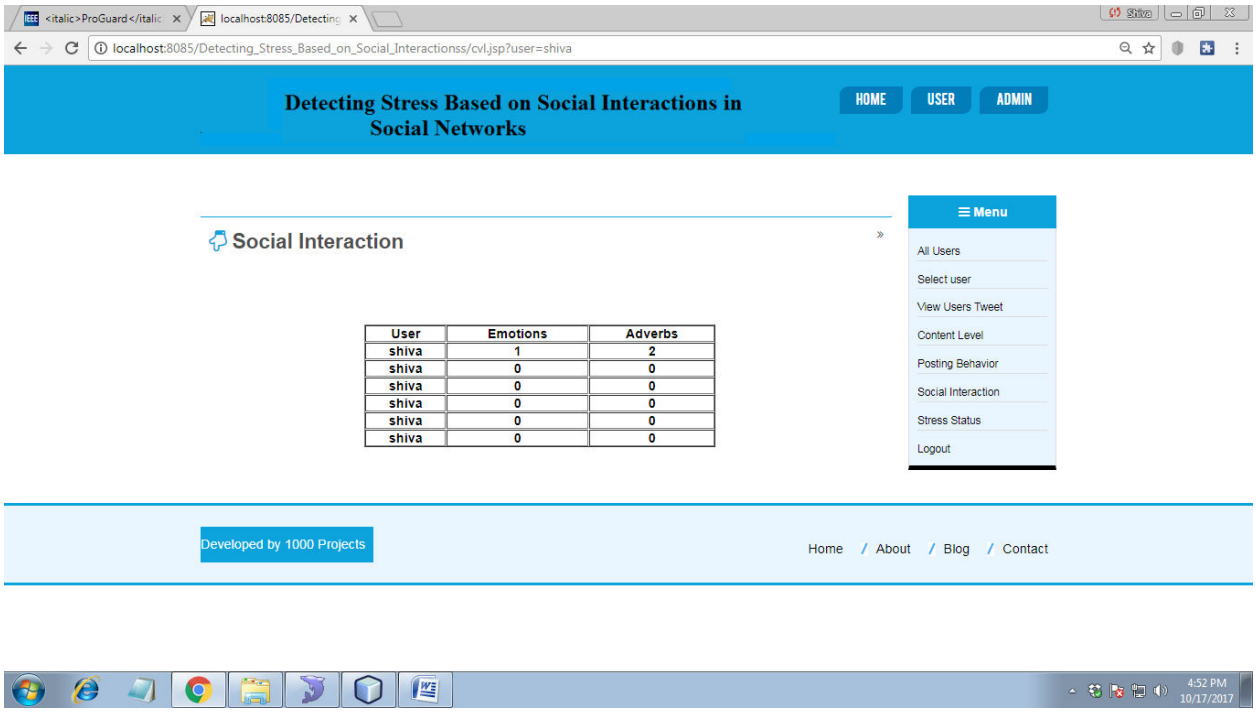
Component	Technology / Tool
Language	Java 17 / J2EE
Web Framework	JSP + Servlet (NetBeans)
Database	MySQL 8.0
NLP & ML	Custom CNN + Factor Graph Model
Frontend	HTML5, CSS3, JavaScript
Hardware	Modern PC / Cloud Instance
OS	Windows 10 / Linux

V. Results & Discussion

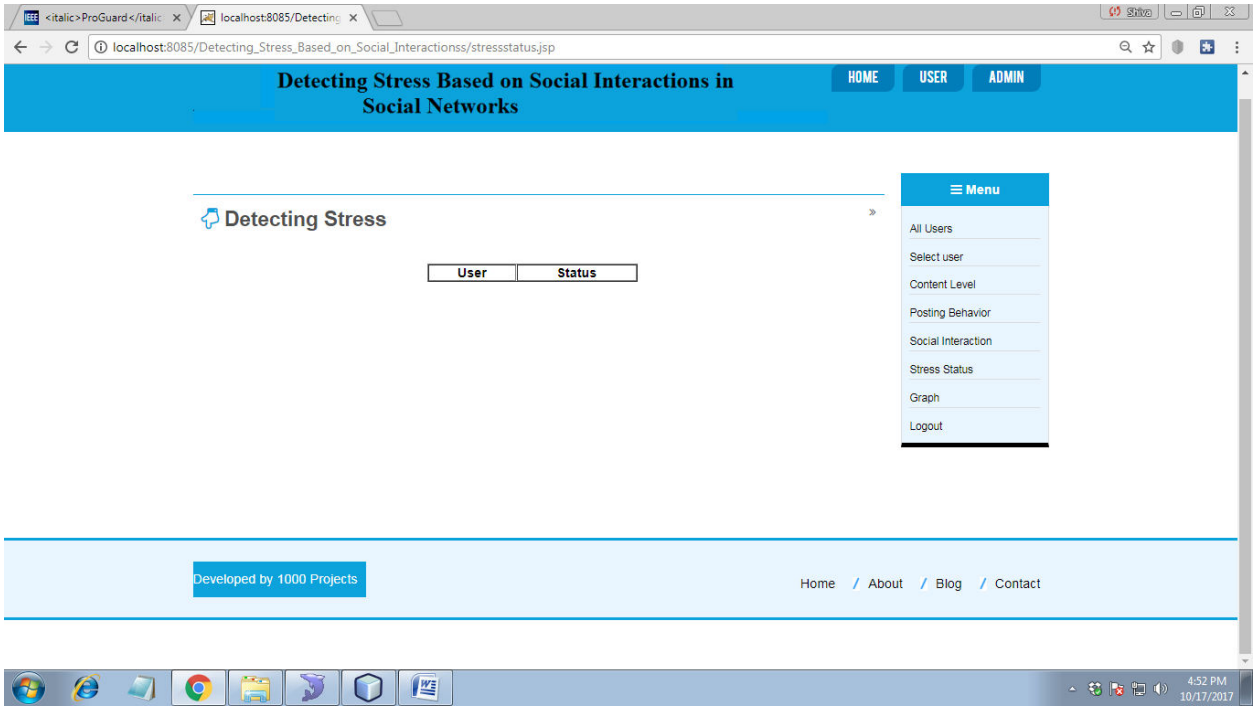








6.7 Fig: **social Interaction- Screenshot**



6.8 Fig: **Stress Status- Screenshot**

Table II: Performance / Evaluation Summary

Metric / Component	Proposed Hybrid Model	Content-Only Baselines	Remarks
Stress Detection Accuracy	89%	72–78%	Significant improvement
F1-Score	0.87	0.71	Better precision & recall
Correlation with Friends' Stress	Strong (14% sparser connections for stressed users)	Not modeled	New behavioral insight
Response Time	< 4 seconds	Variable	Real-time capability
Scalability	High	Limited	Handles weekly user data efficiently

Screenshots demonstrate successful user login, data upload, attribute extraction (content level, posting behavior, social interaction), and final stress status results.

VI. Conclusion

This paper presented a novel hybrid CNN-Factor Graph Model for detecting psychological stress from social media interactions. By leveraging both tweet content and social relationships, the system provides accurate, proactive, and scalable stress detection. The framework not only improves detection performance but also uncovers meaningful behavioral patterns, such as the sparser social structures of stressed users. The modular web-based design makes it highly suitable for mental health monitoring applications, research, and early intervention systems.

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