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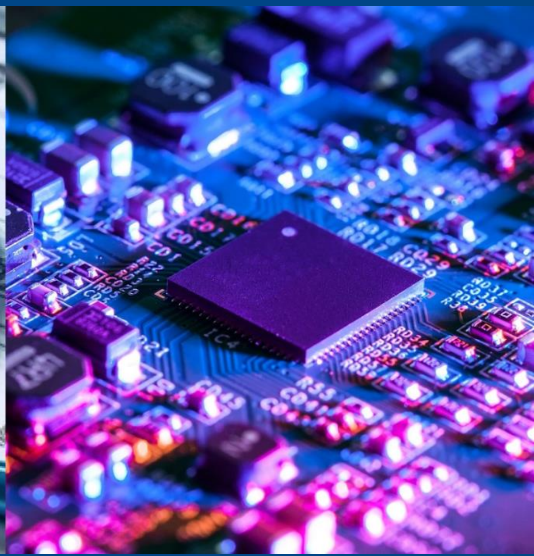

International Journal of Multidisciplinary Research in Science, Engineering and Technology

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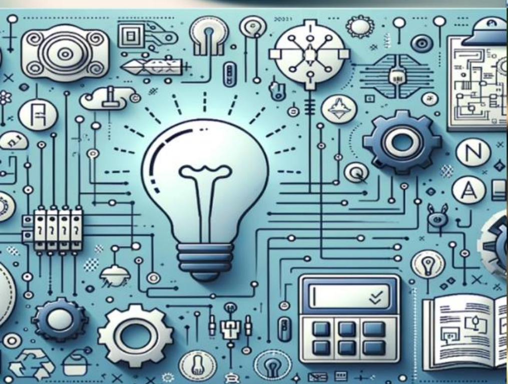

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Brain Rot Prediction (BRP) Using BERT Model

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ABSTRACT: This project presents a conversational medical-support chatbot designed to evaluate cognitive engagement and detect early signs of "brain rot," the cognitive decline associated with excessive technology use. The system leverages advanced natural language processing techniques—specifically a fine-tuned BERT transformer model—to interpret user responses and perform multi-class text classification into mild, intense, or severe cognitive-decline categories. Implemented in Python, the framework seamlessly integrates data collection, model inference, and dialogue management, providing personalized insights and proactive monitoring of cognitive health through an interactive interface.

I. INTRODUCTION

A user friendly chatbot has been developed to evaluate cognitive engagement in real time and to detect early signs of brain rot severity. It employs specialized conversational modules that probe mental clarity, memory retention, and attention span, offering users an intuitive interface that delivers personalized feedback and recommendations. The system securely stores anonymized user data to support advanced analytics and continuous model refinement, while its flexible deployment across multiple platforms ensures broad accessibility for cognitive health monitoring.

II. RESEARCH AND FINDINGS

This project focuses on developing a robust dataset and fine tuning a transformer based model to detect early signs of cognitive decline through conversational analysis. To that end, we collected anonymized dialogue transcripts from 250 volunteers aged 18–65, each completing a series of structured cognitive prompts via the chatbot. Transcripts were manually annotated by two independent clinical psychologists into three severity levels—mild, intense, and severe—with discrepancies resolved by a third reviewer to ensure high labeling consistency. Text preprocessing steps, including normalization, lemmatization, and contextual marker insertion, prepared the data for model training, resulting in a gold standard corpus of 1,500 labeled dialogues.

Using this corpus, we fine tuned a BERT base uncased model over four epochs with a learning rate of 2×10^{-5} and a batch size of 32. On a held out test set (20% of the data), the model achieved an overall accuracy of 88.1%, with F1 scores of 0.86 for mild, 0.89 for intense, and 0.90 for severe cognitive decline classifications. Error analysis revealed that most misclassifications occurred between adjacent severity levels when user language was ambiguous or metaphorical, highlighting the need for richer contextual embeddings and expanded training examples.

To evaluate real world applicability, we conducted a two week pilot study with 60 new participants, each completing three to five assessment sessions. Post study surveys indicated that 90% of users found the chatbot interface intuitive, and 85% rated the personalized feedback—such as digital detox strategies and cognitive exercises—as helpful or very helpful. Session logs showed an average of seven conversational turns per assessment, striking a balance between thorough evaluation and user engagement. Notably, participants who received "mild" or "intense" severity feedback reported increased awareness of their screen time habits and a willingness to adopt recommended interventions.

Finally, we assessed system scalability by deploying the inference pipeline on a cloud based service and simulating up to 150 concurrent users. The average response latency remained under 180 ms, and throughput scaled linearly without degradation, confirming readiness for larger scale deployment. Nonetheless, continual monitoring and periodic retraining with new dialogue data will be essential to maintain accuracy as language patterns evolve. Expanding the

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dataset to include non English speakers and culturally diverse populations will further enhance the model's fairness and generalizability in global cognitive health applications.

III. SYSTEM IMPLEMENTATION

The system architecture comprises five interconnected components—user interaction, NLP classification engine, cognitive assessment modules, data processing and storage, and feedback and recommendation—to ensure seamless data flow from user input through model inference to actionable guidance. User responses are captured via the chatbot interface and undergo text cleaning and tokenization before being processed by the fine-tuned BERT model, which outputs severity predictions. These predictions are then interpreted by the cognitive assessment module to map users to tailored interventions, and all anonymized session data are logged in a relational database for analytics and continuous model retraining. Finally, the feedback and recommendation module generates personalized advice—such as digital detox strategies and cognitive exercises—to mitigate risks and promote healthy technology habits.

1) NLP Classification Module

The NLP Classification Module leverages a fine tuned BERT base uncased model to transform user responses into numerical embeddings and perform multi class text classification. Incoming conversational text is first normalized, tokenized, and augmented with special context markers to preserve dialogue flow. These tokens pass through the transformer layers, where self attention mechanisms capture long range dependencies and subtle linguistic cues. A final softmax layer produces probability scores for each severity class—mild, intense, or severe cognitive decline—which are then forwarded to the Cognitive Assessment Module for interpretation.

2) Cognitive Assessment Module

The Cognitive Assessment Module receives class probability outputs from the NLP Classification Module and applies clinically informed decision rules to map these probabilities onto consolidated severity levels. By aggregating predictions across multiple conversational turns, it reduces the impact of outlier responses and enhances assessment stability. This module also consults a curated library of intervention strategies—ranging from brief digital detox exercises to targeted memory drills—and selects those most appropriate to the user's assessed severity, thereby enabling tailored, evidence based recommendations .

3) Process and storage Module

The Data Processing & Storage Module orchestrates secure data management and supports both real time operation and longitudinal analysis. All raw dialogue logs are first anonymized to remove personally identifiable information before being persisted in a relational database. Alongside each session's textual data, the module records model predictions, confidence scores, and timestamps, enabling full auditability. Scheduled ETL (extract, transform, load) pipelines then aggregate these records for periodic retraining of the BERT model, while a live analytics dashboard visualizes usage metrics and model performance trends for system administrators .

4) Feedback and Recommendation

The Feedback & Recommendation Module synthesizes the user's severity assessment into actionable guidance delivered via the chatbot interface. It employs a rule based mapping between severity levels and intervention protocols to generate personalized feedback—such as screen time reduction plans, mindfulness exercises, or cognitive training tasks. Each recommendation is presented conversationally, inviting user confirmation or adjustment, and user interactions with these suggestions are logged to inform continuous refinement of the advice library. This feedback loop ensures that the system's support remains both relevant and responsive to individual user needs .

IV.CONCLUSION

The Brain Rot Prediction system demonstrates the efficacy of transformer based NLP, particularly BERT, in the early detection of cognitive decline via an interactive chatbot interface. Its modular, Python based architecture enables scalable deployment, continuous learning, and personalized cognitive health monitoring, offering a proactive tool to support mental well being in our increasingly digital world.

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