ISSN: 3107-6513

AI-Based Lie Detection System Using Voice and Facial Analysis

Muhammad Muzzammil A H, Dr. T. Velumani
BCA DEVOPS & AUTOMATION, Rathinam College of Arts and Science Coimbatore, Tamil Nadu, India
muhammedmuzzammil8655@gmail.com
Department of Computer Science, Rathinam College of Arts and Science Coimbatore, Tamil Nadu, India
velumani46@gmail.com

Abstract:

Lie detection is a challenging task that traditionally depends on human judgment and physiological measurements. Existing methods such as polygraph tests are costly, require trained professionals, and are not always accurate. This project proposes an AI-Based Lie Detection System that uses voice and facial analysis to detect stress, which is a key indicator of deception.

The system captures real-time voice input using a microphone and facial data using a webcam. Voice features such as pitch, energy, and MFCC are extracted and analyzed using signal processing techniques. At the same time, facial stability and movements are monitored using computer vision methods.

The system combines both voice and facial analysis using a rule-based decision approach to determine whether the behavior is normal or indicates possible deception. This multimodal approach improves accuracy and reliability compared to traditional methods. The proposed system is simple, cost-effective, and suitable for real-time applications such as interviews and behavioral analysis.

INTRODUCTION

The rapid development of technology has increased the need for reliable methods to analyze human behavior. Lie detection plays an important role in areas such as security, criminal investigations, and job interviews. Identifying whether a person is telling the truth is difficult because individuals can control their expressions and behavior.

Traditional methods like polygraph tests measure physiological signals such as heart rate and blood pressure. Although these methods provide some level of accuracy, they are expensive, require controlled environments, and are not easily accessible. In addition, human observation-based methods are subjective and prone to errors.

With advancements in Artificial Intelligence, it is possible to analyze voice and facial patterns to detect stress. Stress is considered a major indicator of deception. Voice signals contain features like pitch and energy, while facial expressions provide visual cues about emotional state.

The proposed AI-Based Lie Detection System uses both voice and facial analysis to detect stress. By combining these two inputs, the system provides a more accurate and reliable solution. The system works in real time and can be used in practical environments such as interviews and monitoring systems.

Existing Systems and Limitations

Existing lie detection systems mainly depend on polygraph devices or manual observation. Polygraph systems measure physiological signals such as heart rate, respiration, and skin conductivity. However, these systems require specialized equipment and trained professionals, making them expensive and less practical.

Manual observation methods rely on analyzing body language and speech patterns. These methods are subjective and depend on the experience of the observer, leading to inconsistent results.

Some systems use basic keyword-based analysis, but they fail to understand context and emotional variations. Even advanced systems face challenges such as detecting sarcasm, handling different languages, and analyzing natural human behavior.

Therefore, there is a need for an automated, accurate, and cost-effective solution that can analyze multiple inputs simultaneously and provide real-time results.

Methodology / Approach

The proposed system follows a structured approach for detecting stress and possible deception.

❖ Data Collection

The system collects real-time voice input through a microphone and facial data through a webcam.

ISSN: 3107-6513

❖ **Feature Extraction**
Voice features such as pitch, energy, and MFCC are extracted using Librosa. These features help in identifying variations in speech patterns.

❖ **Face Detection**
OpenCV is used to detect faces and monitor facial stability. Continuous face detection helps in analyzing behavioral changes.

❖ **Stress Analysis**
The system compares extracted features with predefined thresholds to determine stress levels. Stress is classified as LOW, MEDIUM, or HIGH.

❖ **Decision Making**
The results from voice and face analysis are combined using rule-based logic to generate the final output:

- NORMAL
- POSSIBLE LIE

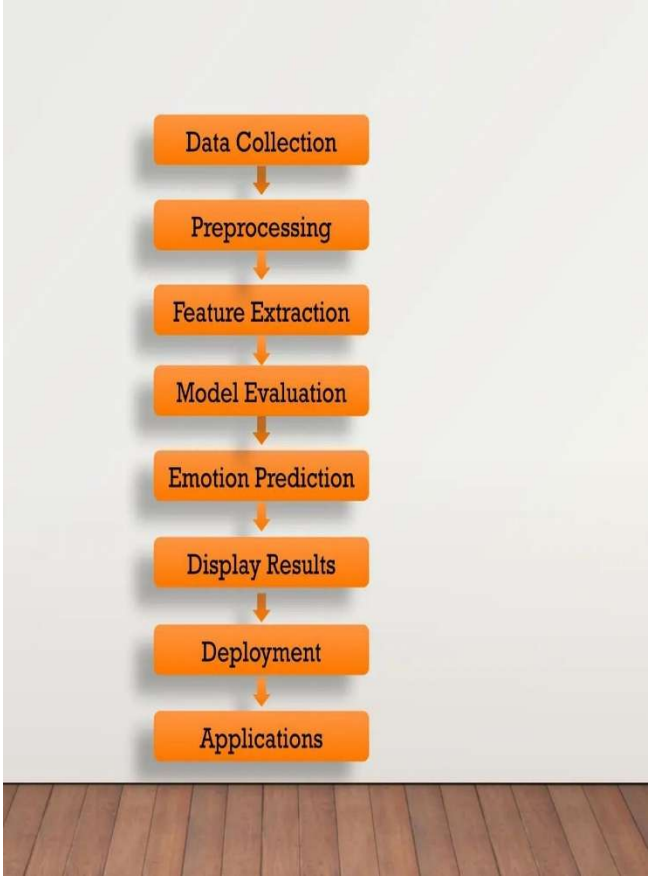
Results and Discussion

The system was tested under different conditions such as normal speech, stressed speech, and varying lighting environments. The results show that the system is able to detect stress levels effectively in most cases.
Voice analysis provides strong indicators through pitch and energy variations, while face detection supports the decision by analyzing facial stability. The combination of both inputs improves overall accuracy.
The system performs well in controlled environments and provides real-time results. However, it may face limitations in noisy environments or when users intentionally control their expressions.
Overall, the system demonstrates good performance and reliability for basic lie detection applications.

System Architecture

The system architecture consists of multiple modules connected in a sequential flow:

- Input Module (Microphone & Webcam)
- Feature Extraction Module
- Face Detection Module
- Stress Analysis Module
- Decision Module
- Output Display



Conclusion

This project presents an AI-Based Lie Detection System that uses voice and facial analysis to detect stress and possible deception. The system provides a simple and cost-effective solution compared to traditional methods.
By combining multiple inputs, the system improves accuracy and reduces dependency on human judgment. It demonstrates the potential of AI in behavioral analysis and real-time decision-making. The system can be used in applications such as interviews, security monitoring, and basic investigations. It serves as a foundation for future research and development in AI-based human behavior analysis.

References

1. Speech Processing using Librosa Documentation
2. OpenCV Face Detection Documentation

ISSN: **3107-6513**

3. Machine Learning Concepts – Scikit-learn
4. Research on Stress Detection using Voice Analysis
5. AI Applications in Behavioral Analysis