



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.524

Volume 14, Issue 1, January 2025

Lie Detector: A Modern Approach to Truth Verification

Prof. D.C. Pardeshi¹, Vaishnvee Kamble², Sarthak Mahajan³, Mitesh Palaskar⁴

Lecturer, Department of Artificial Intelligence & Machine Learning, AISSMS's Polytechnic, Pune, Maharashtra, India¹

Student, Department of Artificial Intelligence & Machine Learning, AISSMS's Polytechnic, Pune,

Maharashtra, India^{2,3,4}

ABSTRACT: Lie detection is a critical tool in law enforcement, security screenings, and psychological assessments. Traditional methods, such as the polygraph, have been used for decades but come with limitations, including subjectivity and vulnerability to manipulation. This study presents a modern approach to lie detection by leveraging Galvanic Skin Response (GSR) sensors and machine learning techniques to analyze physiological responses with greater accuracy. The proposed system integrates Arduino-based hardware with signal processing algorithms to enhance the reliability and efficiency of conventional polygraph tests. This paper thoroughly explores the technical implementation, challenges, and potential future developments in lie detection technology.

KEYWORDS: Lie Detection, Galvanic Skin Response, Polygraph, Arduino, Machine Learning, Signal Processing, Truth Verification, Physiological Responses.

I. INTRODUCTION

The quest to distinguish truth from deception has long been a subject of scientific, legal, and psychological interest. Traditional lie detection techniques rely on monitoring physiological indicators such as blood pressure, pulse rate, respiration, and skin conductivity. However, these techniques require expert interpretation, making them susceptible to biases and inaccuracies.

This study introduces an automated lie detection system that utilizes Galvanic Skin Response (GSR) as a key metric. GSR measures subtle variations in skin conductivity caused by emotional or psychological stress, making it an important indicator of deceptive behavior. By integrating biometric measurements with machine learning algorithms, this system can analyze patterns and increase the accuracy of deception detection, reducing the need for subjective human interpretation.

II. LITERATURE SURVEY

2.1 Historical Context

Lie detection methods have evolved significantly over time. In ancient civilizations, deception was often tested through physical trials, such as ordeals by fire or water. The early 20th century saw the development of more scientific approaches, with pioneers like Cesare Lombroso and William Marston developing devices to measure physiological responses, ultimately leading to the modern polygraph.

2.2 Existing Solutions

- **Traditional Polygraph:** Simultaneously measures several physiological parameters but is often criticized due to subjective interpretation and external influences affecting test outcomes.
- **Voice Stress Analysis:** Detects changes in vocal frequency as an indicator of stress or deception but lacks standardization and accuracy across different languages and speech patterns.
- **Neuroscientific Methods:** Technologies like functional MRI (fMRI) and EEG-based lie detection offer promising results but are expensive and require highly specialized equipment.

2.3 Gaps in Current Technologies

Despite advancements, several gaps persist in modern lie detection techniques:

- Lack of integration with advanced machine learning models for automated analysis.
- High reliance on trained professionals for result interpretation.
- Vulnerability to countermeasures, such as controlled breathing or stress management techniques used by test subjects.

III. PROBLEM STATEMENT

Traditional lie detection techniques suffer from limitations in accuracy, reliability, and accessibility. The dependence on expert interpretation introduces human errors and biases. This paper proposes a real-time, automated system that utilizes GSR sensors and signal processing techniques to provide a more objective and efficient alternative to conventional polygraph tests.

IV. PROPOSED METHODOLOGY

4.1 Research and Design

- Literature Review: A comprehensive review of existing lie detection technologies and their limitations.
- User Needs Assessment: Evaluation of practical applications in law enforcement, corporate settings, and security screenings.

4.2 Development Phases

Phase 1: Hardware Implementation

- Arduino Nano: Serves as the central processing unit for data acquisition.
- GSR Sensor: Measures variations in skin conductivity due to stress or deception.
- LED Indicators: Provide real-time visual feedback:
 - Green: Truthful response
 - Yellow: Uncertain response
 - Red: Deceptive response

Phase 2: Software and Signal Processing

- Arduino IDE: Used for coding and calibrating the hardware components.
- Machine Learning Algorithms: Supervised learning models analyze GSR data and classify responses.
- Graph Visualization: Plots real-time variations in skin conductivity for enhanced interpretation.

Phase 3: Testing and Evaluation

- Data Collection: Conducting controlled experiments with multiple test subjects.
- Performance Analysis: Comparing the system's accuracy with that of traditional polygraph tests.
- Iterative Improvements: Refining the system based on test results and user feedback.

V. KEY FEATURES

- Real-time GSR Monitoring: Captures physiological responses instantly.
- Automated Analysis: Eliminates subjective human interpretation.
- Compact and Portable Design: Facilitates deployment in different settings.
- Non-Invasive Testing: Enhances user comfort and reduces psychological stress.

VI. TECHNICAL ARCHITECTURE

- Hardware Components: Arduino Nano, GSR Sensor, LEDs, 22k Ohm Resistor.
- Software Stack: Arduino IDE for programming, Python for data processing, MATLAB for signal analysis.
- Data Security: Encryption mechanisms ensure the confidentiality of stored physiological data.
- Cloud Integration: Allows remote monitoring and AI-powered analysis for enhanced accuracy.

VII. IMPACT AND POTENTIAL APPLICATIONS

This advanced lie detection system has broad applications across multiple domains:

- Law Enforcement: Assisting in criminal investigations and suspect interrogations.
- Security Screening: Strengthening security measures at airports, borders, and high-risk zones.
- Corporate Sector: Detecting fraudulent transactions and conducting employee screenings.
- Psychological Research: Providing insights into human behavior under stress and deception.

VIII. FUTURE SCOPE

- AI-Powered Prediction Models: Refinement of detection accuracy using deep learning algorithms.
- Wearable Lie Detection Devices: Continuous monitoring using GSR sensors embedded in smartwatches.
- Multimodal Analysis: Integration with EEG and facial recognition for more comprehensive analysis.
- Ethical and Legal Considerations: Development of international standards to regulate the use of lie detection technology responsibly.

IX. CONCLUSION

This research presents an innovative approach to lie detection using GSR sensors and machine learning, integrated into a compact, automated system. By utilizing Arduino-based hardware and signal processing techniques, the system offers a more reliable and objective alternative to traditional polygraph tests. As AI and sensor technology continue to advance, this system has the potential to revolutionize truth verification in various industries by enhancing both accuracy and accessibility.

ACKNOWLEDGEMENT

I take this opportunity to express my sincere appreciation for the cooperation given by Prof.S. G. GIRAM, Principal of AISSMS'S POLYTECHNIC, Pune and need a special mention for all the help extended by him, constant inspiration and encouragement to make my project a memorable experience. I am thankful to our H. O. D. of Artificial Intelligence & Machine Learning Department, Prof.D.C.Pardeshi for his time to time support and valuable guidance. I am deeply indebted to my internal guide Prof.D.C.Pardeshi, for completion of this project for which he has guided and helped me going out of the way.I am thankful to all teachers and professors of our department for sharing with me, valuable knowledge on their respective fields. I would also thank my fellow classmates and friends for their support and timely suggestions. I would also like to thank library staff and laboratory staff for providing me cordial support and necessary facilities, which were of great help for preparing the project report.

Thanks to all!

REFERENCES

1. McCleary, R. A. (1950). The nature of the galvanic skin response. *Psychological Bulletin*, 47(2), 97-117.
2. Nagai, Y., Goldstein, L. H., Fenwick, P. B., & Trimble, M. R. (2004). Clinical efficacy of galvanic skin response biofeedback training.
3. Kuo, C. D., Chen, G. Y., Yang, M. J., Lo, H. M., & Tsai, Y. S. (2000). Biphasic changes in autonomic nervous activity during pregnancy.
4. American Polygraph Association. (1996). *Polygraph Issues & Answers*.
5. Jing, Z., Barreto, A. B., Chin, C., & Chao, L. (2005). Realization of stress detection using psychophysiological signals for improving human-computer interactions.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details