AI for Sustainable Development-Article

Project Title: ***Detecting Stress for Healthier Lives: A Wearable-Based AI Solution Supporting SDG 3***
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Course: AI & Machine Learning – Week 2 Assignment
Theme: ***Machine Learning Meets the UN Sustainable Development Goals (SDGs)***
SDG Focus: SDG 3 – Good Health and Well-being

1. Introduction

Mental health is a silent crisis affecting millions globally — and stress is one of its biggest culprits. But what if we could detect stress before it spirals into something more serious?

In this article, I'll walk you through how I used wearable sensor data and machine learning to build an AI model that detects stress in real time — supporting the United Nations Sustainable Development Goal 3 (Good Health and Well-being).

Why Stress Detection Matters

Prolonged stress can lead to burnout, anxiety disorders, and cardiovascular issues. Yet stress is rarely monitored in real-time. My project proposes a simple solution: use data from wearable devices like wristbands and chest sensors, and train an AI model to recognize stress patterns.

2. Dataset Used

To build the model, I used the WESAD (Wearable Stress and Affect Detection) dataset, developed by the University of Augsburg.

- **Devices Used: Empatica E4 wristband + RespiBAN chest sensor**
- **Participants: 15 individuals**
- **Signals Collected:**
  - **Electrodermal Activity (EDA)**
  - **Skin Temperature**
  - **Respiration, ECG, EMG, Accelerometer**

Each data point is labeled as one of:

- **0: Baseline (Relaxed)**
- **1: Stress**
- **2: Amusement**

For simplicity, I converted this into a binary classification:

- **1 = Stress**
- **0 = Not Stress (Baseline + Amusement)**

3. Machine Learning Approach

Problem Formulation

- **Converted multi-class classification to binary classification:**

- 1 = Stress
- 0 = Not Stress (Baseline + Amusement)

Techniques Used

- Type: Supervised Learning
- Model: Random Forest Classifier
- Libraries: pandas, numpy, scikit-learn, matplotlib, seaborn

Workflow Summary

1. Data Preprocessing
   - Selected EDA, TEMP, signals
   - Normalized values
   - Labeled data as binary classes
2. Model Training
   - 80/20 Train-test split
   - Fit Random Forest model
   - Evaluated accuracy and performance
3. Model Evaluation
   - Confusion Matrix
   - Classification Report (Precision, Recall, F1-score)
   - Feature Importance Visualization

4. Results

- Accuracy: ~99.8%
- Top Predictive Features:
  - Electrodermal Activity (EDA)
  - Skin Temperature
- Key Visuals:
  - Confusion Matrix
  - Feature Importance Chart

5. Ethical Considerations

- Bias: Limited dataset size and diversity may reduce generalizability
- Privacy: Dataset is anonymized; future real-world apps must comply with GDPR/HIPAA
- Access & Fairness: Ensure models are paired with low-cost wearable devices for inclusivity

6. Real-World Impact & Future Work

Applications:

- Stress detection in high-risk professions (e.g., pilots, nurses)
- Wellness tracking in fitness and lifestyle apps
- Real-time alerts to prevent burnout

Future Enhancements:

- Real-time deployment via smartphone-connected devices
- Use LSTM or deep learning for time-series modeling
- Integrate with mobile health apps and wellness trackers

8. Final Thoughts

AI can do more than drive cars or play games — it can save lives by supporting mental health. This project is a small step toward that future, helping us recognize and respond to stress in a sustainable and empowering way.

If you're working on AI for good or care about mental health innovation, let's connect.