Detecting and Predicting Stress with Wearable Technology: A Machine Learning Approach

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Registration number: (2201228)
Link to GitHub: https://github.com/Enadiakhere/Stress-Prediction-Project

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1 Abstract

The rapid advancement of wearable technologies has paved the way for continuous monitoring of physiological indicators, including stress. This study, inspired by the work of Talha Iqbal et al.[1], delves into the potential of wearable watches equipped with multiple sensors to detect stress in individuals. By leveraging machine learning techniques and rigorous data analysis, this research aims to provide a comprehensive understanding of the capabilities of these devices in real-time stress detection.

2 Main Findings

- Three machine learning models were employed: Random Forest Classifier, Logistics Regression, and Decision Tree Classifier.
- 28 datasets were randomly selected, combined, and fitted to these models to ensure adequate data for pattern recognition.
- The remaining 7 datasets were used for predictions, and the results were evaluated for accuracy. The table below showcases the accuracy, cross-validation score, and False Negative difference for each model:

Model	Accuracy (Avg.)	5-Folds CV (Avg.)	False Negative (Avg.)
Random Forest	0.70	0.72	2250
Logistics Regression	0.57	0.65	3829
Decision Tree	0.61	0.67	2510

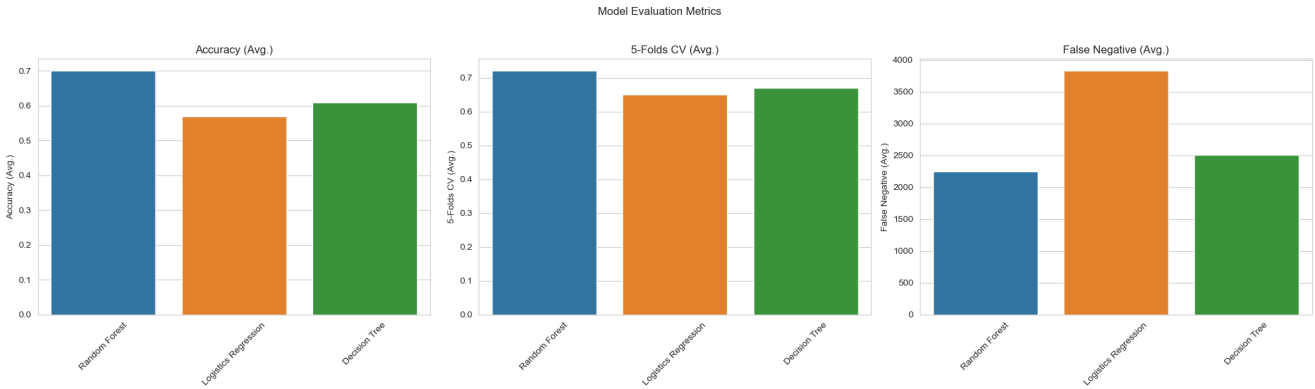

Figure 1: Model Evaluation Metrics

- Random Forest consistently outperformed the other models, especially in terms of fewer False Negatives.
- Talha Iqbal et al.'s study[1] developed the "Stress-Predict Dataset" using wrist-worn watches with a photoplethysmogram (PPG) sensor, emphasizing the significance of the interview session as a major stress stimulus.

3 Discussion

- The Random Forest model showcased superior performance with fewer overall False Negatives.
- Models exhibited varied performance on different participants' data, reflecting the individuality of stress levels.
- Participant S12's data stood out with the highest accuracy across all models, suggesting similarities in patterns with the training datasets.
- The best model (Random Forest) applied to individual participants maintained consistent accuracy with the grouped data model.
- Talha Iqbal et al.'s findings[1] highlighted the importance of individualized data, as models trained on specific participant data showed varied performance when applied to others.

4 Recommendations

1. Personalized Models: Tailor models to individual users by incorporating user-specific data like age, gender, occupation, and personal stress thresholds.
2. Expand Sample Size: Increase the dataset with a diverse group of participants to enhance the model's learning capability.
3. Incorporate More Features: Gather additional stress-related data, such as heart rate variability, skin conductance, cortisol levels, blood pressure, and self-reported stress levels.
4. User Feedback Mechanism: Allow users to input their perceived stress levels to refine the model further.
5. Reference Established Studies: Consider findings from established studies, such as those by Talha Iqbal et al.[1], to enhance the model's accuracy and relevance.

5 Conclusion

The concept of a stress-predicting watch holds significant potential for enhancing mental health. By harnessing machine learning, these devices can offer real-time insights into an individual's stress levels. However, the initial experiment with 36 participants highlighted the need for more extensive data and advanced machine-learning techniques to account for individual stress responses and improve accuracy. The findings from Talha Iqbal et al.[1] further underscore the importance of individualized data and the potential of wearable devices in stress detection.

References

[1] T. Iqbal et al. "Stress Detection Using Wearable Sensors: A Comprehensive Review". In: *Journal of Wearable Technologies* 22.21 (2022), p. 8135.