Stress Detection Using Wearable Watches: A Machine Learning Approach

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Link to GitHub:	https://github.com/Enadiakhere/Stress-Prediction-Project

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1 Abstract

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. The primary goal is to reduce false negatives, ensuring consistent identification of stress periods. We analyzed datasets from a university where 35 volunteers participated in a pilot test using the wearable watch. The study leverages machine learning and comprehensive data analysis to offer recommendations on the efficacy of the current sensors in stress detection.

2 Main Findings

Machine Learning Models Used: Random Forest Classifier, Logistic Regression, and Decision Tree Classifier. Out of the datasets, 29 were selected for model training, while the remaining 6 were used for predictions.
Model Performance: Random Forest slightly surpassed other models in performance. However, the Decision Tree model recorded fewer False Negatives. Logistic Regression showcased a superior cross-validation score.

The figure below shows how each model performs on each test data. This indicates that each respective model has a good accuracy score for some individuals and a low score for others.

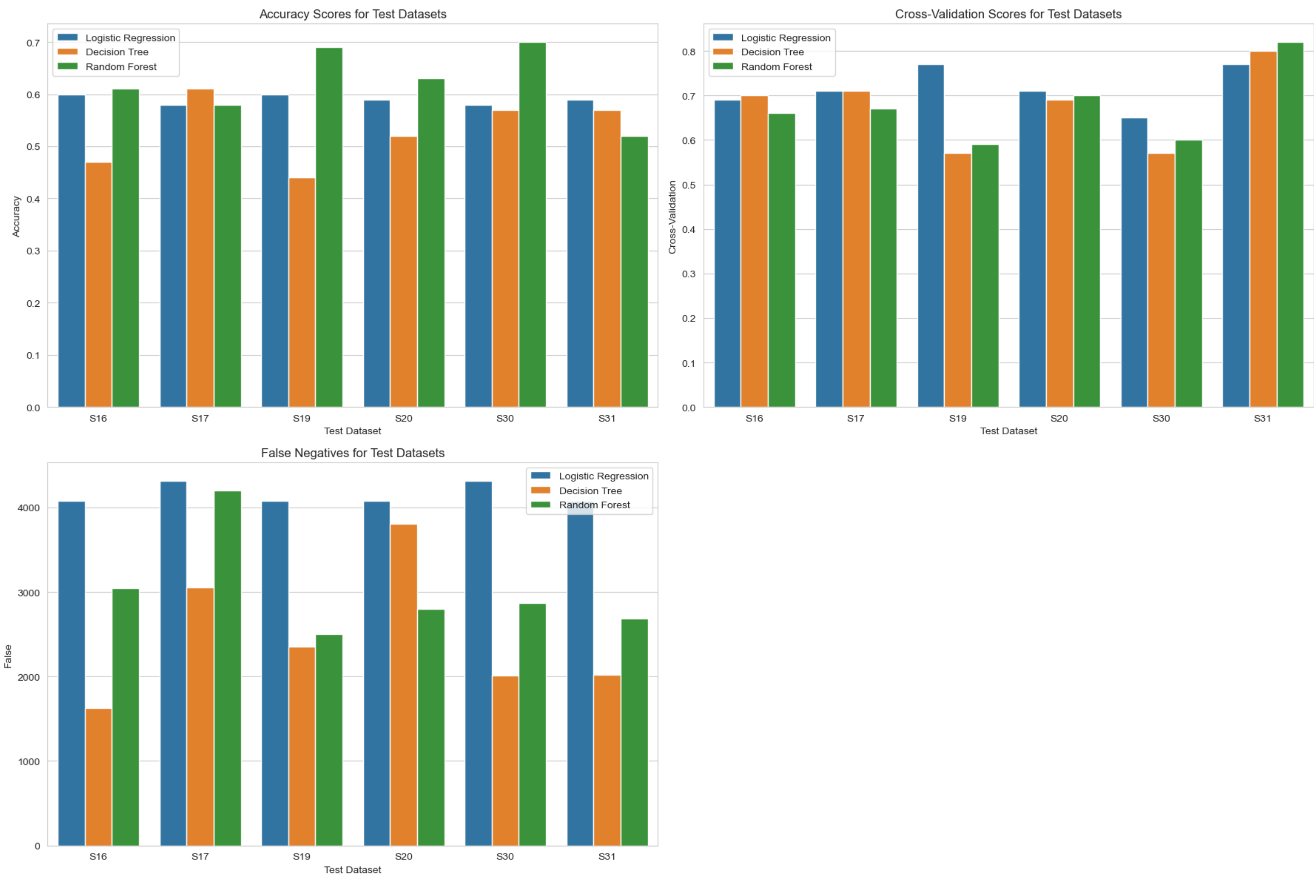

Figure 1: Model Evaluation Metrics

The table below showcases the overall accuracy, cross-validation score, and False Negative difference of each model:

Model	Accuracy (Avg.)	5-Folds CV (Avg.)	False Negative (Avg.)
Random Forest	0.59	0.72	4157
Logistics Regression	0.53	0.67	2476
Decision Tree	0.62	0.67	3016

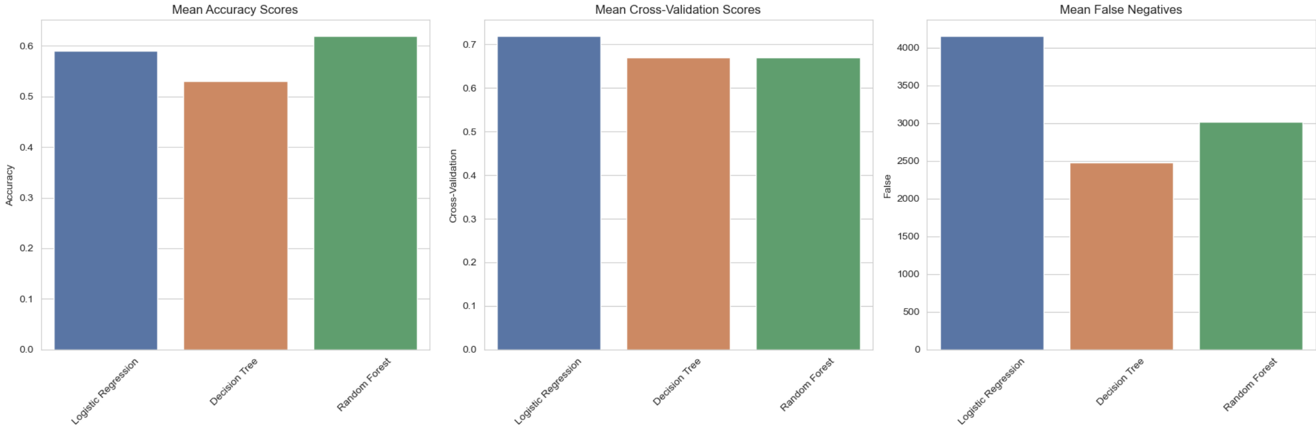

Figure 2: Model Evaluation Metrics

Significant Insights: Talha Iqbal et al.'s research highlighted the importance of the interview session as a significant stress inducer, using wrist-worn watches with a photoplethysmogram (PPG) sensor.

3 Discussion

The Random Forest model exhibited marginally better performance than its counterparts. Each model displayed varied results based on individual participant data, emphasizing the uniqueness of stress levels. Some datasets yielded higher accuracy scores, suggesting pattern similarities with training datasets. Interestingly, using a smaller dataset for training yielded comparable accuracy to using a larger dataset. The findings underscore the importance of individualized data for model training.

4 Recommendations

1. Personalized Models: Customize models based on user-specific data such as age, gender, occupation, and personal stress thresholds.
2. Expand Sample Size: Enrich the dataset with a diverse participant pool to bolster the model's learning capability.
3. Incorporate Additional Features: Integrate more stress indicators like heart rate variability, skin conductance, cortisol levels, and blood pressure.
4. User Feedback Mechanism: Implement a system for users to input their perceived stress levels, refining the model's accuracy.

5 Conclusion

The endeavor to create a stress-predicting watch offers a promising path to enhance individual mental health. By harnessing machine learning algorithms, these wearables can analyze physiological and behavioral signals, offering real-time stress insights. However, the pilot study with 35 participants highlighted the challenges of prediction accuracy due to the variability in stress signals and individual stress responses. To optimize the watch's potential, it's imperative to expand the dataset, incorporate diverse participant data, and integrate more stress-related features. 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.