PREDICTIVE ANALYTICS IN FALL DETECTION FOR ELDERLY CARE: A COMBINED HEALTHCARE INFORMATICS AND DATA SCIENCE APPROACH

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ABOUT THE AUTHOR

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Experience in python, statistics, machine learning, predictive modeling

PAPER OUTLINE

This outline serves as preliminary guide for the direction for my paper

Title:

- **Predictive Analytics in Fall Detection for Elderly Care: A Combined Healthcare Informatics and Data Science Approach**

Abstract:

Introduction:

- Address the high incidence of falls among the elderly and their impact on healthcare systems.
- Present healthcare informatics as a pivotal tool for improving patient outcomes.

Literature Review:

- Review and summarize pivotal findings from previous studies on fall detection and prediction.
- Explore the integration of electronic health records and predictive modeling in assessing fall risks.

Methodology:

- Outline the data collection process, detailing the types and significance of data for predictive modeling.
- Describe the machine learning algorithms used, focusing on the decision tree and XGBoosted models.
- Discuss the creation of the decision_fall feature and its importance in the model's predictive accuracy.

Results:

- Unveil the findings from the predictive models.
- Analyze the models' accuracy and reliability in predicting the decision_fall feature.

Discussion:

- Interpret the results and their implications for enhancing elderly care.
- Offer recommendations for model improvement and identify potential areas for future research.

Conclusion:

- Reaffirm the significance of informatics in fall prediction and its benefits for elderly patient care.

References:

- Provide a list of all sources cited.

ABSTRACT

This serves as a basic level summary of my paper

The intersection of healthcare informatics and elder care is witnessing transformative advancements through the integration of machine learning and wearable devices. This paper explores two pioneering studies: the Loretto Fall Prevention project, which leverages machine learning for fall prediction, and the cStick initiative, an IoMT-enabled device designed to predict, detect, and control falls in real-time. By gleaning insights from these studies, this research aims to develop a predictive model that not only enhances fall detection accuracy but also addresses the unique needs of visually and hearing-impaired older adults.

INTRODUCTION

This serves to get readers familiar with the problem and my project

Predictive Analytics:

- Improves patient care and safety.

Fall Intensity Prediction

- Key application in elderly care.

Fall Statistics

- Many elderly falls go unreported.

XGBoosted Model

- High accuracy in forecasting fall incidents.

Integration of Variables

- Improvement over traditional methods.

Use of Machine Learning

- Precision in fall prediction.

Resulting Model

- Predicts fall likelihood and intensity.

Distance	Pressure	HRV	Sugar level	SpO2	Accelerometer	Decision	Decision_fall
25.54	1	101.396	61.08	87.77	1	1	1
2.595	2	110.19	20.207	65.19	1	2	1
68.067	0	87.412	79.345	99.345	0	0	0
13.09	1	92.266	36.18	81.545	1	1	1
69.43	0	89.48	80	99.99	0	0	0
27.16	1	102.584	64.32	88.58	1	1	1
57.134	0	70.824	73.69	93.69	0	0	0
66.356	0	84.816	78.46	98.46	0	0	0
60.382	0	75.752	75.37	95.37	0	0	0
23.17	1	99.658	56.34	86.585	1	1	1
63.108	0	79.888	76.78	96.78	0	0	0
58.874	0	73.464	74.59	94.59	0	0	0
24.58	1	100.692	59.16	87.29	1	1	1
23.98	1	100.252	57.96	86.99	1	1	1
2.835	2	110.67	21.151	65.67	1	2	1
64.123	0	81.428	77.305	97.305	0	0	0
26.86	1	102.364	63.72	88.43	1	1	1
4.365	2	113.73	27.169	68.73	1	2	1
66.153	0	84.508	78.355	98.355	0	0	0
63.92	0	81.12	77.2	97.2	0	0	0
8.73	2	122.46	174.337	77.46	1	2	1
53.161	0	64.796	71.635	91.635	0	0	0
5.85	2	116.7	163.009	71.7	1	2	1
62.789	0	79.404	76.615	96.615	0	0	0
18.67	1	96.358	47.34	84.335	1	1	1
18.76	1	96.424	47.52	84.38	1	1	1
27.58	1	102.892	65.16	88.79	1	1	1
11.29	1	90.946	32.58	80.645	1	1	1
64.036	0	81.296	77.26	97.26	0	0	0
2.43	2	109.86	19.558	64.86	1	2	1
28.15	1	103.31	66.3	89.075	1	1	1
27.73	1	103.002	65.46	88.865	1	1	1
23.2	1	99.68	56.4	86.6	1	1	1
4.785	2	114.57	28.821	69.57	1	2	1
7.185	2	119.37	168.26	74.37	1	2	1
26.74	1	102.276	63.48	88.37	1	1	1
0.78	2	106.56	13.068	61.56	1	2	1
0.54	2	106.08	12.124	61.08	1	2	1
13.15	1	92.31	36.3	81.575	1	1	1

DATASET OVERVIEW

SOURCE

Sourced from Kaggle

Data is from a touch stick used to monitor and predict falls in the elderly

SIZE

2040 instances

7 features

RELIABILITY/USABILITY

Comes with academic sources and references

Kaggle rated usability of 8.82

IMPORTANT FEATURES

Decision (0=no fall, 1=minor trip, 2=serious fall)

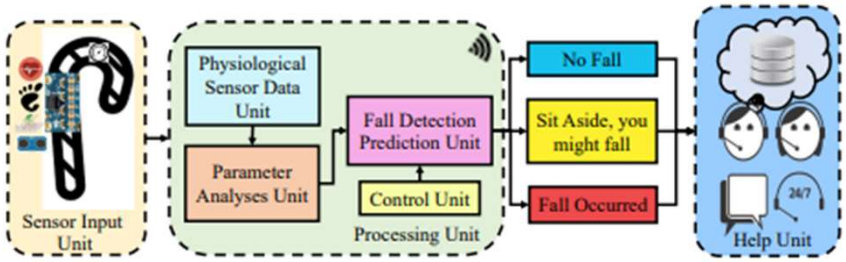
Decision_fall (0=no fall, 1=fall)

Distance (to closest object, cm)

Pressure (how hard the stick is pressed)

LITERATURE REVIEW

This serves as a dive into the other papers that influenced or helped in my research



- **Tech Advancements**: Various technologies are improving patient care outcomes in fall prevention.
- **Loretto Study**: Uses machine learning to analyze EMR data for fall risk factors among the elderly.
- **Benefits**: Reducing falls can decrease medical costs and emotional hardships associated with fall-related injuries.
- **cStick**: A robust tool for fall management with a 95% accuracy rate.
- **Inclusivity**: The cStick is designed for older adults with sensory impairments.
- **IoMT**: The cStick showcases the potential of IoMT in transforming healthcare delivery.
- **Future Research**: Aims to refine predictive modeling techniques and broaden the scope of smart healthcare solutions for fall prevention.

METHODOLOGY

This explains the methods and steps I took in creating this model

Ethical Considerations

- The dataset was cleaned to remove all personally identifiable information, adhering to ethical standards and regulations such as HIPAA.

Feature Engineering

- A new binary feature named decision_fall was created to encapsulate the occurrence of a fall, aiming to increase the model's accuracy and reduce false negatives.

Decision Tree Model

- A non-linear predictive modelling tool used for its effectiveness in classification tasks.

XGBoost

- Enhances the decision tree model by sequentially correcting errors from previous trees, focusing on challenging cases to predict.

Goal

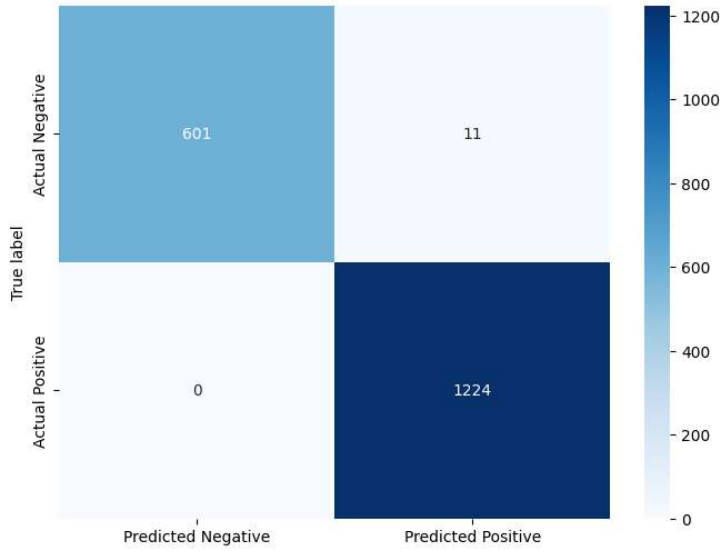
- Minimize false negatives in fall detection and increase the sensitivity of the model.

Accuracy Metrics:

- Precision, recall, and the area under the ROC curve (AUC) are used to evaluate the model's accuracy in predicting falls.

RESULTS

This serves to show and explain to readers the results of the model



Confusion Matrix

TN- 601
TP- 1224
FP- 11
FN-0

```
Accuracy: 0.9940087145969498
Balanced Accuracy: 0.9910130718954249
Precision: 0.9910931174089069
Recall: 1.0
Sensitivity: 1.0
Specificity: 0.9820261437908496
```

DISCUSSION

This highlights the importance of my results and their impact

- **Model Performance**: The predictive model reliably forecasts fall incidents, facilitating prompt interventions and mitigating the likelihood of grave injuries among the senior population.
- **False Positives**: The model's deviations manifest as false positives, aligning with the research objectives to minimize the occurrence of undetected falls.
- **Machine Learning Techniques**: The amalgamation of decision tree classifiers and XGBoost algorithms with healthcare informatics has emerged as a formidable strategy to combat falls in the elderly demographic.
- **Current Application**: The current application of the model is confined to the dataset and attributes employed in this study.
- **Future Research**: Prospective research should aim to integrate a broader spectrum of data and examine additional predictive attributes to augment the model's precision in fall prediction.
- **Bespoke Systems**: The research accentuates the necessity for bespoke fall detection systems that accommodate the distinct requirements of older adults with visual and auditory impairments.

CONCLUSION

This concludes the paper and mentions steps for future research

Potential

- Predictive analytics has significant potential in revolutionizing fall detection for geriatric care.

Model Performance

- The enhanced metrics signify a notable advancement in healthcare informatics.

Interdisciplinary Approach

- The validity of combining healthcare informatics and data science is corroborated.

Individualized Systems

- There's a critical need for fall detection systems tailored to the specific needs of visually and auditorily challenged seniors.

Machine Learning

- The synthesis of machine learning algorithms with healthcare informatics has proven to be an instrumental asset.

Future Research

- It's essential to explore diverse datasets and predictive variables to further refine the model's accuracy and inclusivity.

Role of Healthcare Informatics

- The study reaffirms the integral role of healthcare informatics in enhancing elderly care and sets the stage for future breakthroughs in fall prevention

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THANK YOU

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