Republic of the Philippines
CAVITE STATE UNIVERSITY

Don Severino de las Alas Campus
Indang, Cavite
SELF-ASSESSMENT CHECKLIST
Research Proposal Making for Computer
Science

Instruction: Review the self-assessment criteria provided and evaluate your CS research proposal. Please denote whether each criterion has been satisfied with either a '*Yes*' or '*No*' within the self-assessment form by putting a checkmark (✔) in the appropriate box accordingly.

Proposed Thesis Title : Modeling Fire Progression: Predicting Fire Behavior Based on Oxygen Concentration in the Environment

Area of Study : Modelling and Simulation

NO.	CRITERIA	YES	NO
1	Is your research proposal clearly defined and aligned with the research tracks and program objectives of computer science?	✔	
2	Does your research aim to address a gap in existing knowledge?	✔	
3	Does your research propose a novel/original solution to a CS-related problem?	✔	
4	Does your proposed methodology involve the creation and analysis of computer models to simulate complex systems or phenomena?	✔	
5	Are you going to (develop new **OR** modify existing) algorithms or software to imitate processes, events, or behaviors?	✔	
6	Does your methodology include hands-on experimentation, data collection, and analysis to validate hypotheses or test new ideas?	✔	
7	Are you implementing and testing your ideas in real-world scenarios or through practical applications? **NOTE:** This pertains to assessing the quality or attributes of the software through testing rather than gathering opinions from individuals regarding their perception of the software.	✔	
8	Does your thesis primarily focus on developing new concepts, frameworks, or models without extensive experimentation or implementation?		✔
9	Does your proposed methodology rely on mathematical proofs, logic, or conceptual discussions to support your research findings?	✔	
10	Will your research contribute new insights, theories, algorithms, or methodologies to the broader field of computer science?	✔	
11	Will your proposed research be considered acceptable and relevant by the academic community and potential stakeholders?	✔	
12	Does your proposal have direct client or organization who will serve as your beneficiary?		✔
13	Does your proposal will involve database and web/mobile app?	✔	
14	Does your research proposal align with accepted research areas within the field of computer science, such as artificial intelligence, data science, algorithms, computer networks, etc.?	✔	
12	Overall, is this proposal acceptable if you were the evaluator?	✔	

Submitted by:

                                        _____APRIL 05, 2024_____

    JAIMEE ROSE D. MERCADO
Name and Signature of the Student   Date

Republic of the Philippines
CAVITE STATE UNIVERSITY

Don Severino de las Alas Campus
Indang, Cavite

COLLEGE OF ENGINEERING AND INFORMATION TECHNOLOGY
Department of Information Technology

Modeling Fire Progression: Predicting Fire Behavior Based on Oxygen Concentration in the Environment

Proponents

Main Proponent: Mercado, Jaimee Rose D.

Group Members: Rivera, Edrei Reigne I.

Sumayang, Iresh Abbegail D.

Involved Sustainable Development Goals

1. Life on Land (SDG 15): This research directly addresses the impact of fires on terrestrial ecosystems. By modeling fire progression, you aim to understand how fires affect land ecosystems, biodiversity, and ultimately contribute to the goal of sustainable land use.

Involved CvSU Research Thematic Area

1. Area 1: Biodiversity and Environmental Conservation: This research is directly related to understanding and mitigating the impact of fires on the environment. By studying fire behavior and its correlation with oxygen concentration, you're contributing to knowledge that can inform conservation efforts and management strategies to protect biodiversity and ecosystems.

Rationale

For centuries, fire has been integral to the Earth's ecosystem, shaping landscapes and influencing the atmosphere (Zalzal, 2018) Fire has significantly impacted the planet's history, shaping landscapes and biodiversity. However, The understanding of the intricate relationship between fire and the environment is still evolving. The atmosphere, consisting primarily of nitrogen and oxygen, has long been a focus of scientific investigation, tracing back to the pioneering studies of John Dalton in the early 19th century (Carpi & Egger, 2017). Oxygen, a key component of the fire triangle and one of the most common gasses that could be found in the atmosphere, plays a crucial role in formulating combustion. The fire triangle, comprising fuel, heat, and oxygen, serves as the foundational model for understanding combustion processes. (Furer, 2021). Oxygen concentration, a critical component of this model, exerts significant influence on fire behavior. Incomplete combustion due to inadequate oxygen availability alters reaction products, affecting flame color, heat release rate, and fire growth (Vinay et al., 2023). Despite its significance, the precise impact of oxygen concentration on fire dynamics remains a subject of exploration.

While the importance of oxygen in combustion is well-established, its specific role in shaping fire behavior has garnered increasing attention (Furer, 2021). This is due to the fact that while oxygen plays a crucial role in combustion, the behavior of fire under different oxygen concentrations is still open for exploration. By acknowledging the interconnectedness of fire with factors such as oxygen levels and atmospheric conditions, we gain a deeper understanding of their profound effects on the ecosystem. It serves as a crucial factor in understanding the formation and behavior of fires. With this in mind, it is hypothesized that higher oxygen levels accelerate flame spread rates and intensify fires.

This study aims to deepen understanding of the relationship between oxygen concentration and fire progression dynamics. Moreover, this seeks to elucidate the influence of oxygen concentration on fire behavior, aiming to provide insights that can inform fire management and mitigation strategies. To test the hypothesis, a comprehensive simulation framework integrating environmental factors and fire dynamics will be developed. Advanced machine learning algorithms, including Logistic Regression, Decision Trees, Random Forests, Gradient Boosting Machines (GBM), Support Vector Machines (SVM), Survival Analysis, and Neural Networks, will be employed. Data on oxygen concentration, fuel characteristics, and other relevant environmental variables will be incorporated into the model to achieve desired results.

Significance of the Study

The significance of this study lies in its contribution to advancing the understanding of the intricate relationship between oxygen concentration and fire behavior, which has far-reaching implications for fire management and ecosystem preservation. By exploring the specific role of oxygen in shaping fire dynamics, this study addresses a critical gap in current knowledge, especially regarding the precise impact of oxygen levels on flame spread rates, fire intensity, and combustion patterns. Understanding these dynamics is crucial for developing effective fire management and mitigation strategies that can adapt to varying environmental conditions and oxygen concentrations.

Furthermore, this study's use of advanced machine learning algorithms and a comprehensive simulation framework allows for a more nuanced analysis of fire behavior under different oxygen levels. The integration of data on oxygen concentration, fuel characteristics, and environmental variables into the model enhances the accuracy and reliability of predictions, providing valuable insights for stakeholders involved in fire safety, ecosystem management, and environmental conservation.

Ultimately, the findings of this study are expected to inform evidence-based decision-making in fire management, leading to more efficient allocation of resources, improved risk assessment, and enhanced strategies for mitigating the impact of wildfires on ecosystems and human communities. By deepening the understanding of the relationship between oxygen concentration and fire progression dynamics, this study contributes to broader efforts aimed at preserving biodiversity, protecting natural landscapes, and ensuring the safety and well-being of ecosystems and populations vulnerable to wildfires.

Objectives of the Study

The objective of this study is to develop a predictive model for fire progression by analyzing and correlating fire behavior with oxygen concentration in the environment. Specifically, the study aims to achieve the following goals:

1. Develop and implement a comprehensive simulation framework for modeling fire progression, integrating environmental factors such as oxygen concentration into fire behavior predictions.

2. Collect and integrate historical data on wildfires, including fire spread rates, intensity, and environmental conditions, to capture the dynamic interactions between oxygen concentration and fire behavior across different geographical areas and ecosystems.

3. Incorporate measurements of oxygen concentration, atmospheric composition, and other relevant environmental variables into the simulation framework to assess their impact on fire behavior, flame spread rates, and heat release.

4. Conduct detailed analysis of fire progression patterns, including flame spread rates, intensity variations, and combustion products, to elucidate the influence of oxygen concentration on fire dynamics.

5. Evaluate the effectiveness of the simulation framework in predicting fire behavior based on oxygen concentration compared to traditional fire modeling approaches, using real-world wildfire datasets.

By achieving these objectives, the study aims to advance the understanding of the relationship between oxygen concentration and fire behavior, contributing to improved wildfire prediction and management strategies for enhancing environmental and public safety.

Expected Outputs

The expected output of this study is a comprehensive simulation framework that accurately predicts fire behavior based on varying oxygen concentrations in the environment. The framework will incorporate advanced machine learning algorithms, including Logistic Regression, Decision Trees, Random Forests, Gradient Boosting Machines (GBM), Support Vector Machines (SVM), Survival Analysis, and Neural Networks, to analyze the relationship between oxygen levels and fire progression dynamics. Through data integration on oxygen concentration, fuel characteristics, and relevant environmental variables, the model aims to provide precise insights into how different oxygen levels influence flame spread rates, fire intensity, and combustion patterns. The simulation results will be validated against real-world data to ensure the accuracy and reliability of the predictive model. Ultimately, this study expects to contribute valuable knowledge to fire management and mitigation strategies, enabling stakeholders to make informed decisions for enhancing fire safety and ecosystem management.

References

Furer, M. F. (2021b, May 5). Fire triangle: Three necessary ingredients of fire. Spectrum News 1. https://spectrumnews1.com/ca/la-west/weather/2020/10/30/fire-triangle

Investigating the impact of oxygen concentration on fire dynamics using numerical simulation with FDS. Process Safety and Environmental Protection, 178, 195–203. Vinay, V., Raja, S. V., Tauseef, S. M., & Varadharajan, S. (2023. Retrieved from https://doi.org/10.1016/j.psep.2023.07.090

A flammable planet: Fire finds its place in Earth history. Kate S. Zalzal, January 19, 2018. Retrieved from https://www.earthmagazine.org/article/flammable-planet-fire-finds-its-place-earth-history

Carpi, A., PhD, & Egger, A. E., PhD. (2017, February 12). A brief history of scientific practice. Visionlearning. https://www.visionlearning.com/en/library/earth-science/6/earth