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RESEARCH ARTICLE

INVESTIGATION OF USE OF SALIENCE FOR EFFECTIVE NARRATIVE PLANNING

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Abstract

This paper explores the integration of salience modeling into narrative planning to enhance the generation of coherent and engaging stories for interactive experiences. Salience indices and a salience-based cost function were incorporated to improve the efficiency and effectiveness of narrative planning algorithms. The research demonstrated that solutions with lower salience costs were more prevalent, thereby highlighting the potential for optimizing narrative planning by prioritizing such solutions. Moreover, the study emphasized the importance of accurately defining the relationship between actions for salience representation. In conclusion, the integration of salience modeling in narrative planning streamlined the process, resulting in improved storytelling experiences and better utilization of computational resources.

Introduction:-

We use artificial intelligence in the entertainment sector[1], focusing on story-generating algorithms for interactive experiences such as video games and movies[2]. These algorithms aim to provide users with individualized and engaging experiences, enhancing the overall gaming experience. However, planning-based narrative systems face challenges in balancing rich story representation and fast planning algorithms. Despite these challenges, planning-based models have benefits such as generating coherent and personalized stories and can be applied in various domains. It also highlights the importance of psychological factors in storytelling, including the "who," "where," "when," "how," and "why" of events, which influence their memorability[3]. More engaging and memorable interactive narratives can be created by incorporating these factors into planning-based models. The article introduces a model of event salience based on the Glaive algorithm and it is known for its ability to reason about character motivations and interactions. This paper aims to investigate whether salience modeling can improve the efficiency of the planning process without compromising the quality of generated stories. By testing salience modeling on different domains using the Glaive planner[4], the research aims to contribute to the development of more efficient and engaging narrative planning algorithms.

Literature Review:-

Salience concept related work:

[3] presents a framework and methodology for understanding the multidimensionality of situation models. It emphasizes considering dimensions such as time, space, causation, intentionality, and protagonist. The event-indexing model is introduced to address the issue of investigating these dimensions separately. Research work in [5] introduces Indexter, a computational model that focuses on the audience's comprehension process during narratives.

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It predicts the salience of previously experienced events in memory based on the current event, considering how authors intentionally design stories.

Implementation related work:

[6] examines the use of computational models to measure the salience of events in stories, aiming to improve the speed of search algorithms in generating interactive narratives with the use of Sabre narrative planner[7]. The study compares different search strategies and finds that salient events tend to be more closely related in solution sequences. This suggests that measuring salience during planning can enhance the efficiency and quality of a narrative planner. However, the research is limited to specific domains and does not consider other factors influencing the quality of story. Research[4] introduces Glaive, a state-space narrative planner based on Fast-Forward[8]that solves narrative planning problems by considering character cooperation and conflict. Glaive demonstrates effective performance on benchmark problems but has limitations regarding temporal constraints, uncertainty, and scalability.

Methodology:-

Example domain:

We usedthe Magical Kingdom[9] domain in this research.It was used as an example to validate the CPOCL narrative structure in narrative planning. The domain includes characters like Talia, Rory, Vince, and Gargax, with various attributes and actions. The goal is for Talia to be happy and rich and for Vince to stay alive. Actions require characters to be in the same place, with specific conditions for proposing, accepting proposals, and getting married. Other actions include stealing, getting hungry, and eating other creatures. The example demonstrates how the method can be applied to narrative planning scenarios with multiple characters, actions, and goals (Figure 1).

Figure 1:- The Magical Kingdom domain's characters and locations.

Solutions and non-solutions:

The methodology utilized the Glaive narrative planner to generate solutions and non-solutions for the problem. Glaive is a forward-chaining state-space planner that takes input in the form of domain and problem filesin PDDL format[10][11][12]. It creates a list of possible steps in the world and supports partially executed plans. Solutions were generated by creating action sequences within a given length. Glaive's heuristic function estimates the remaining steps to find a solution. The heuristic considers character goals and the current state to calculate estimates. The maximum estimate is used to avoid overestimation. The generated solutions and non-solutions were used to calculate the salience of the results.

Salience distance:

Salience distance determines the importance of consecutive actions and the overall cost of salience in a sequence. It utilizes three indices (Protagonist, Space, and Causality) from the Indexter model to guide an efficient search. The salience distance is computed using a formula involving these indices and a constantε. The salience cost of a sequence is then calculated by summing the distances between consecutive actions. The study aims for simplicity and performance, though it may not capture all the complexities of the research domain.

There is a novel approach to computing the salience distance between two successive actions,namely a_j and a_{j+1}[6].

$$d(a_j, a_{j+1}) = \varepsilon + (1-\varepsilon)\left(1 - \frac{\sum_{i \in I} I\, i(a_j, a_{j+1})}{|I|}\right) \quad ; \text{where } 0 < \varepsilon \leq 1$$

Having defined the distance between a pair of contiguous actions, we can define the salience cost of a sequence of n actions $\pi = \{a_1, a_2 \ldots a_n\}$ as:

$$s - cost(\pi) = \sum_{j=1}^{n-1} d(a_j, a_{j+1})$$

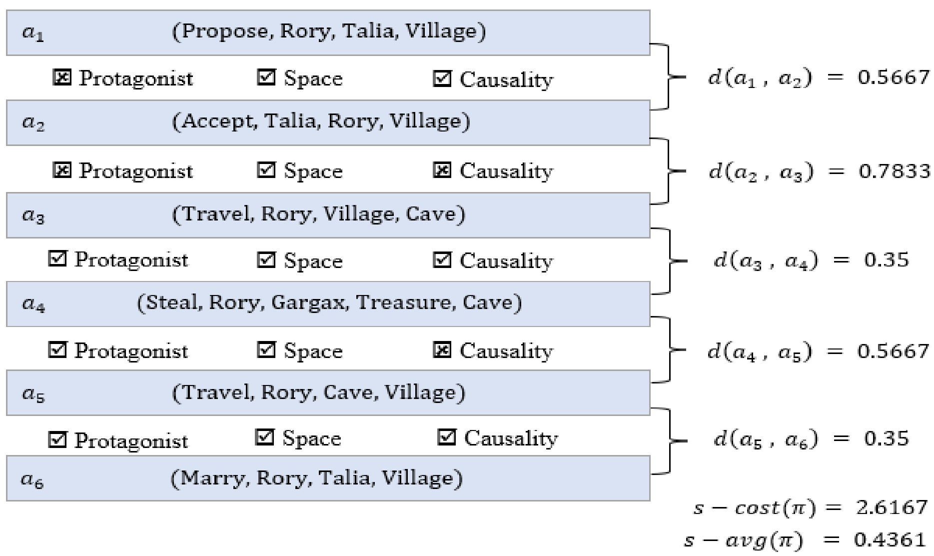


Figure 2:- Example solution with salience calculation (***ε***=0.35).

Calculating salience distances (Figure 2) for non-solutions is the same as calculated in the previous solutions. The s-cost(π) is not really a heuristic in the traditional sense of measuring the distance from the current state to the goal. It is a measure of the cost of the plan built so far. We use s-avg(π),the average salience cost, for comparison purposes.

Results and Evaluation:-

We have tested two domains, Magical Kingdom, and Raiders, using the Glaive narrative planner. The objective was to evaluate performance and compare our results with previous findings of using the Sabre narrative planner with Grammalot, Raiders, and Prison domains[6]. Table 1 shows the analysis of the first 5000 solutions generated for each domain and it also reveals variations in the number of solutions and non-solutions, indicating domain-specific characteristics and the impact of narrative length.

Domain				Solutions			Non-Solutions		
Name	Agent	Actions	Length	Count	Avg. distance	σ	Count	Avg. distance	σ
Magical Kingdom	4	46	6	10	0.5192	0.0638	4990	0.5506	0.0566
			7	116	0.5454	0.0553	4884	0.5660	0.0534
Raiders	3	69	7	4	0.5322	0.0400	4996	0.5488	0.0601
			8	34	0.5431	0.0447	4966	0.5671	0.0592

Table 1:- Comparison of salience cost between solutions and non-solutions in Glaive planner.

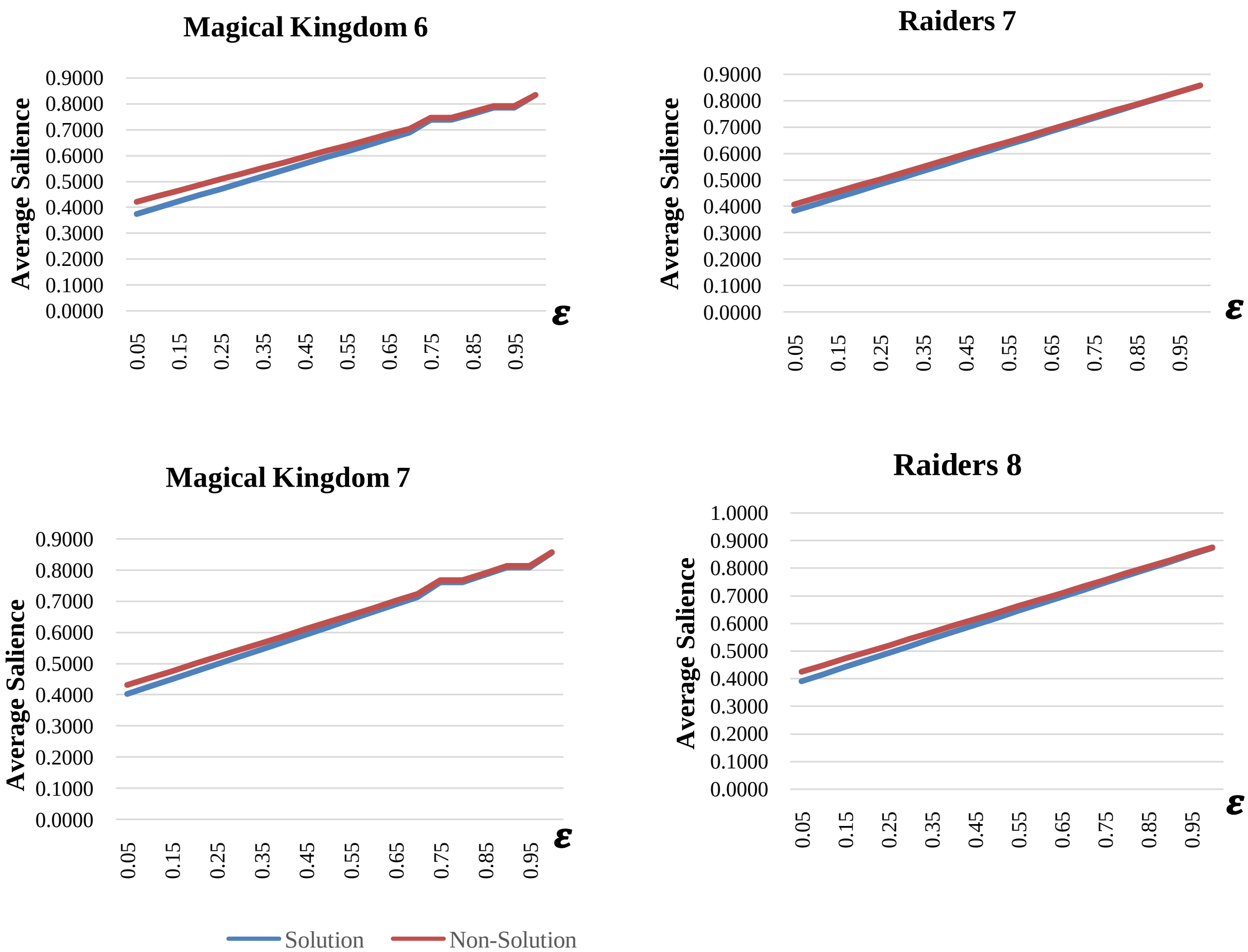
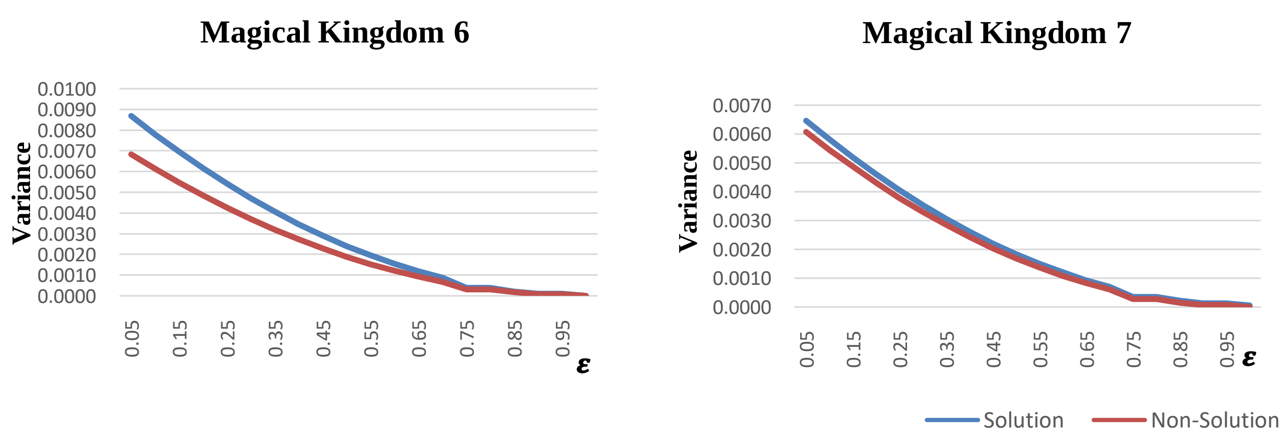
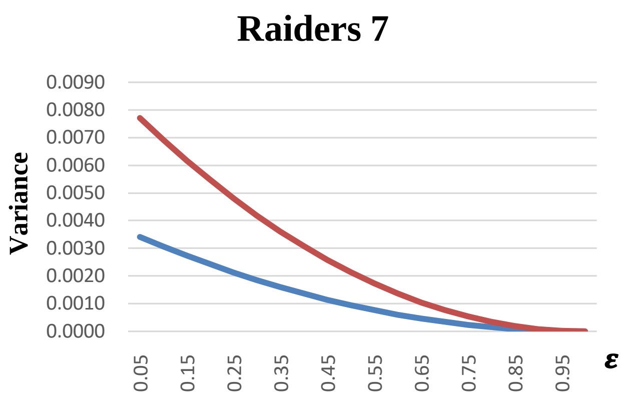


Figure 3:- Average salience distance vs. Minimum distance of two actions (ε) for solutions and non-solutions in the Glaive narrative planner for each domain in each length.

Figures 3 and 4 illustrated that non-solutions consistently had higher salience values than solutions, with the difference decreasing as the ε value increased.





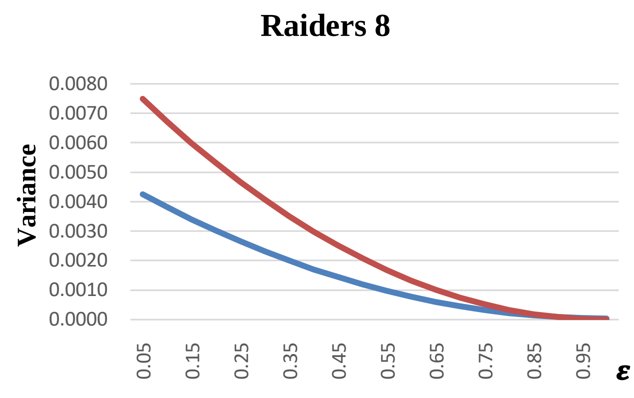


Figure 4:- Average variance vs. Minimum distance of two actions (ε) for solutions and non-solutions in the Glaive narrative planner for each domain in each length.

The study found that solutions generally have lower salience values compared to non-solutions within the investigated domains. A paired t-test confirmed this significant difference. The study also determined that an optimal value for ε in calculating salience distance was 0.35. Additionally, as result lengths increased, both solution and non-solution types showed higher average salience values.

Discussion:-

The study reveals that solutions consistently have lower salience costs compared to non-solutions in various domains. Prioritizing solutions with lower salience costs can optimize narrative planning processes for improved efficiency and effectiveness. It also highlights the importance of accurately determining the minimum distance between actions and the significance of carefully selecting the parameterε. By integrating these insights, narrative planning can be streamlined, leading to better storytelling experiences and more effective use of computational resources. The research contributes to the understanding of salience in narrative planning and paves the way for further advancements in the field.

Conclusion:-

The research concludes that measuring the salience distance between actions and summing these distances for entire plans offers an efficient way to speed up narrative planning in studied domains. While narrative planners generate distinct plots and discourses, this approach can still provide valuable insights, especially in closely aligned story-discourse interactive narratives. Salience cost during search captures the original intentions of domain authors, making it easier to remember or anticipate actions. Salience-based search techniques excel in finding intended solutions and going beyond initial intentions, particularly in domains with a larger number of solutions.

Future Work

1. Test the speed of search techniques (such as breadth first search, uniform cost search, and A* search) in finding the first solution to a problem, incorporating salience cost measurements during the search process.
2. Investigate the relationship between plan salience cost and the heuristic's estimation of proximity to a solution.
3. Encourage replication of the research in different domains to test its applicability.
4. Explore the influence of the salience cost parameter (ε) on the search and develop intelligent selection methods for its use in specific domains.
5. Replicate and extend the research to gain a more comprehensive understanding of the role of salience cost in narrative planning and advance its practical applications.

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