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San Antonio Research Partnership Portal: Smart Artificial Intelligent Community Applications

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Abstract

Urban governance is vital for efficiently managing cities, promoting sustainable development, and improving quality of life for residents. In the realm of urban governance, the San Antonio Research Partnership Portal stands as a groundbreaking initiative, fostering collaboration between diverse city entities and leveraging innovative smart applications. In this paper, we will focus on its ability to facilitate strategic alignment among city departments, public feedback integration, and streamlined collaboration with academic institutions. Through technical insights and real-world case studies, this paper underscores the portal's role in enhancing municipal responsiveness, improving decision-making processes, and exemplifying the potential of smart applications utilizing artificial intelligence for fostering effective city management and community engagement.

Index Term *- Artificial Intelligence, Community Research Partnership, Document Matching, Information Retrieval, Keyword Extraction Tool, Web Application.*

Introduction

Artificial Intelligence (AI) has seen exponential growth in recent years, becoming a cornerstone in various fields due to its unparalleled capability to process and analyze vast amounts of data with remarkable accuracy and speed. From healthcare, where AI assists in diagnostics and personalized medicine, to finance, where it enhances risk assessment and fraud detection, the applications of AI are vast and transformative. AI's influence extends to fields such as transportation, with autonomous vehicles, and retail, with personalized shopping experiences, demonstrating its versatility and far-reaching impact.

Despite its widespread adoption, the potential of AI in local government entities remains relatively untapped. AI adoption in local government faces various challenges, including limited resources for implementation and maintenance, concerns about data privacy and security, as well as organizational resistance to change. Additionally, the complex nature of government processes and regulations often complicates the integration of AI solutions. Harnessing AI in local governance presents a significant opportunity to enhance operational efficiency, foster collaboration, and bridge the gap between government departments and research institutes. By integrating AI-driven solutions, local governments can streamline processes, optimize resource allocation, and improve decision-making, ultimately leading to more responsive and effective governance.

This paper introduces the San Antonio Research Partnership Portal, an innovative AI-powered platform designed to enhance research collaboration between government departments and academic institutions [1]. The portal facilitates the alignment of city department strategic plans with real-time public feedback and connects city research opportunities with the expertise at the University of Texas at San Antonio (UTSA). By leveraging AI, the portal not only strengthens inter-departmental collaboration but also fosters a closer relationship between the local government and the academic community. This integration is crucial for reducing operational silos, promoting transparency, and ensuring that public policies are informed by cutting-edge research and community needs. Through an exploration of the portal's technical architecture, functionality, and real-world applications, this paper highlights the transformative potential of AI in local governance. By showcasing tangible benefits and case studies, it aims to demonstrate how cities can harness AI to create more efficient, collaborative, and citizen-centric governance models.

The rest of the paper is organized as follows: Section II describes the background of this research including the initiative of San Antonio Research Partnership Portal and different techniques to implement smart AI community applications. Section III portraits the design and implementation of smart AI community applications. Different software tools used to develop the smart AI applications for the portal are briefly discussed in Section IV. Finally, the future research direction is planned in Section V and the concluding remarks are outlined in Section VI.

II. Background

In this section, we briefly discuss the San Antonio Research Partnership Portal initiative and the concept of an AI-driven information retrieval system. The section also covers related works.

A. San Antonio Research Partnership Portal

Operating from the City of San Antonio's Office of Innovation, the R&D League was established in January 2020 through a three-year Memorandum of Understanding (MoU) between the City of San Antonio, Southwest Research Institute (SwRI), the University of Texas at San Antonio (UTSA), and USAA [2]. This partnership aims to foster cross-sector research, facilitate evidence-based decision-making, and explore innovative solutions. Over its first three years, the League has engaged the community and experts across various fields to address critical issues such as mobility, environment, public safety, housing, health, and the digital divide. In 2021, a Master Research Agreement was established between the City and UTSA to enhance research collaboration. To further these efforts, the R&D League introduced the San Antonio Research Partnerships Portal, designed to con-

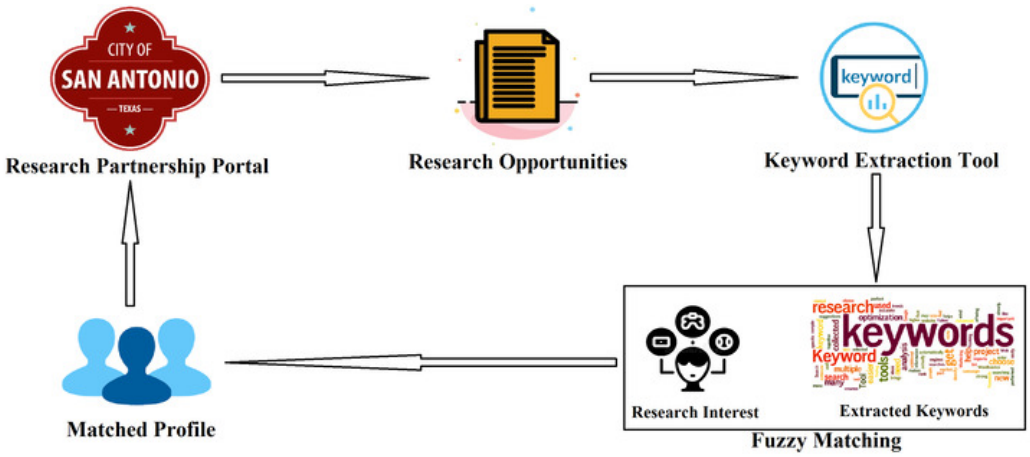

Figure 1. *Workflow of ResearchConnect AI to match the academic researchers with research opportunities.*

nect city-identified challenges with academic and scientific researchers capable of providing evidence-based solutions. Emphasizing durable partnerships and transparency, the Portal seeks collaborators from diverse disciplines to share knowledge and support research publication, ultimately improving public services and policy.

B. Information Retrieval System

An AI-driven information retrieval system leverages advanced technologies such as natural language processing (NLP), machine learning (ML), and deep learning to enhance the accuracy and relevance of search results from large datasets. These systems understand and interpret user queries in natural language, consider contextual factors, and utilize semantic search to grasp the intent behind queries, thereby providing more precise and contextually appropriate results. Applications include personalized recommendations, context-aware responses, and the ability to handle diverse data formats, making them invaluable in fields like healthcare, legal, finance, and education by significantly boosting productivity and decision-making capabilities. In the context of an information retrieval system, keyword extraction tools play a crucial role in enhancing search capabilities by identifying the main themes or topics within documents. Keyword extraction tools are designed to analyze text documents and automatically identify and extract the most important words or phrases, known as keywords or key phrases [3]. Techniques include term frequency (TF), TF-IDF, RAKE, TextRank, YAKE!, POS tagging, machine learning, and deep learning models like BERT. It enhances search engine optimization (SEO), content categorization, document indexing, summarization, and topic modeling, thereby improving the organization and retrieval of information in various applications. Similarity matching is another fundamental technique in information retrieval and AI applications, used to compare data items like text documents, images, and other data types to identify the most similar ones. It employs methods such as vector space models, TF-IDF, BM25, word embedding, deep learning models like BERT and GPT, Jaccard similarity, cosine similarity, Euclidean distance, and edit distance. These techniques enable enhanced search results, personalized recommendations, document clustering, image retrieval, plagiarism detection, and fraud detection, thereby improving the relevance and effectiveness of information retrieval systems across various applications.

C. Related Work

In community-based collaborative research partnership approach, academic researchers, local government, community members, and other partners contribute their expertise in research process and share in the policy-making decisions [4]. All partners in this collaborative research process must work together to overcome the challenges [5]. Nadim et al. examine the importance and challenges of community research partnerships and introduces the Research Partnership Portal, a collaborative platform in San Antonio that facilitates cooperation between academic researchers, organizations, and city departments to address community issues using current administrative data [6]. The authors further investigate the performance of popular keyword extraction tools in identifying keywords from research opportunities to automate matching academic researchers with corresponding projects in the San Antonio Research Partnership Portal [7]. Mikhaylov et al. discuss the opportunities and challenges of AI in the public sector and proposes strategies for effectively managing cross-sector collaborations [8]. Nadim emphasises on the machine learning-based applications and the security aspects of community-based research partnership platforms [9].

III. Smart AI Community Applications

Smart AI applications for communities leverage advanced algorithms to analyze data from various sources, enabling informed decision-making, efficient resource allocation, and tailored solutions to address specific community needs and challenges. In this section, the design and implementation of smart AI community applications deployed in San Antonio Research Partnership Portal are portrayed.

A. ResearchConnect AI

ResearchConnect AI is a sophisticated application developed to enhance the collaboration between the University of Texas at San Antonio (UTSA) and the City of San Antonio through the San Antonio Research Partnership Portal. Leveraging advanced artificial intelligence, the platform matches academic researchers

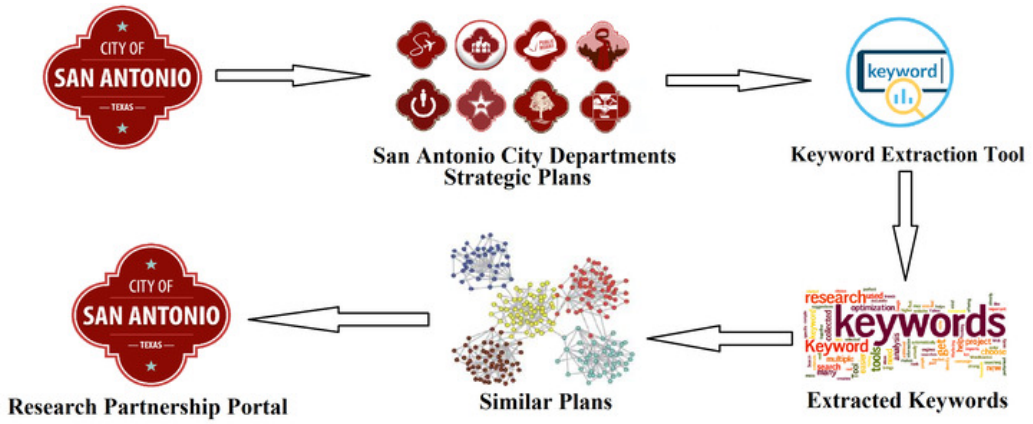

Figure 2. *Workflow of NexusConnect AI to match the strategic plans from different departments.*

from UTSA with research opportunities presented by various city departments. The application works by analyzing detailed profiles of UTSA researchers, including their areas of expertise, past research, and current interests. Simultaneously, it evaluates the specific needs, objectives, and challenges outlined in research opportunities posted by city departments. By employing natural language processing (NLP) and machine learning algorithms, ResearchConnect AI can accurately match researchers to projects where their skills and knowledge are most applicable.

ResearchConnect AI includes key features such as automatic profile matching to connect UTSA researchers with relevant city research opportunities based on expertise and interests, automated notifications for streamlined collaboration initiation, built-in tools for communication and project management, utilization of current administrative data from UTSA and the City of San Antonio to refine matches, impact tracking through metrics and analytics, and a user-friendly interface for ease of use by researchers and city department representatives.

Figure 1 shows the workflow of ResearchConnect AI application integrated with San Antonio Research Partnership Portal to match the academic researchers with research opportunities. By integrating a keyword extraction tool with the San Antonio Research Partnership Portal, the user experience and functionality of the application are significantly enhanced. This integration involves automatically analyzing the content of web pages or user input to identify important keywords and phrases, thereby improving the accuracy of search results and enabling users to quickly find relevant information. Python programming language is utilized to implement this integration, with a focus on minimizing the execution time of the keyword extraction tools and optimizing their performance metrics. The workflow of this application involves pulling community research opportunities from databases or web pages, extracting keywords using the keyword extraction tools, and utilizing a fuzzy matching algorithm to match the research interests of UTSA academic researchers with the extracted keywords. Based on the matching score, user profiles of UTSA researchers are presented with corresponding community research opportunities, facilitating efficient collaboration between academia and local government.

B. NexusConnect AI

NexusConnect AI is a sophisticated platform tailored specifically for the City of San Antonio, aimed at optimizing collaboration and coordination among its diverse departments. By harnessing the power of artificial intelligence, NexusConnect AI streamlines the alignment of strategic plans across various municipal entities, including departments responsible for public safety, transportation, infrastructure, education, and more. This innovative solution analyzes and synthesizes strategic objectives, goals, and action plans from different departments, ensuring consistency and coherence in the pursuit of the city's overarching vision. By automatically identifying synergies and potential areas of collaboration, NexusConnect AI accelerates decision-making processes and promotes cross-functional teamwork.

Moreover, NexusConnect AI facilitates data-driven insights and recommendations, allowing city officials to make informed decisions and allocate resources effectively. It provides real-time updates on progress and performance metrics, enabling continuous monitoring and evaluation of strategic initiatives. Furthermore, NexusConnect AI enhances transparency and accountability within the City of San Antonio by providing stakeholders with visibility into the strategic planning process and fostering a culture of collaboration and innovation. With NexusConnect AI, the City of San Antonio can leverage its resources more efficiently, maximize the impact of its initiatives, and ultimately create a more resilient, inclusive, and prosperous community for all residents.

Fig 2 shows the workflow of NexusConnect AI application integrated with San Antonio Research Partnership Portal to match the strategic plans across different departments in City of San Antonio. This application begins with collecting strategic plans from the departmental websites of San Antonio's city departments. Next, keyword extraction (KE) tools analyze these plans to extract relevant keywords. These keywords are then used to group similar strategic plans together. The grouped strategic plans are displayed on the San Antonio Research Partnership Portal, facilitating collaboration among departments working on related initiatives. This streamlined approach accelerates inter-departmental synergy and ensures cohesive strategic efforts across the city.

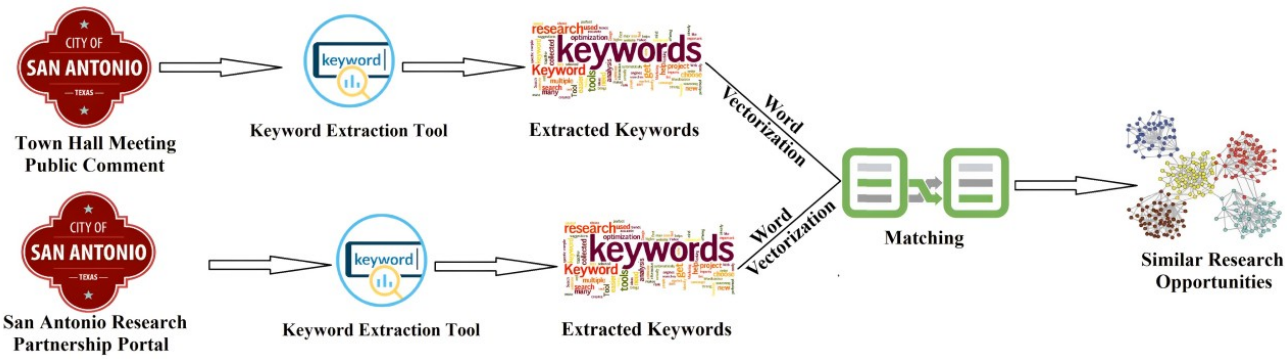

Figure 3. *Workflow of CommunityInsight AI to match public feedback from town hall meeting with research opportunities.*

C. CommunityInsight AI

CommunityInsight AI is an innovative application designed to bridge the gap between public feedback and local government initiatives by seamlessly matching community comments and feedback from town hall meetings with research opportunities and strategic plans of the local government. Tailored for cities like San Antonio, CommunityInsight AI leverages advanced artificial intelligence to analyze and synthesize public input, aligning it with relevant government projects and research initiatives to foster community-driven decision-making.

CommunityInsight AI collects public comments and feedback from various sources, such as town hall meetings, online forums, and surveys. It uses natural language processing (NLP) to perform sentiment analysis, identifying key concerns, suggestions, and positive feedback. The system also extracts significant keywords and phrases to categorize and prioritize community feedback effectively. It leverages AI to align community feedback with the strategic plans of various city departments through a sophisticated matchmaking algorithm, generating detailed reports for city officials that highlight areas of alignment or divergence. It connects public feedback with relevant research opportunities via the San Antonio Research Partnership Portal, fostering collaborations between UTSA researchers and community-driven projects. The application features an interactive visualizations of public sentiment trends, strategic alignments, and research matches, while keeping stakeholders informed with alerts and notifications.

Figure 3 illustrates the workflow of the CommunityInsight application, integrated with the San Antonio Research Partnership Portal, to align community feedback with research opportunities and strategic plans. It provides city officials with data-driven insights for informed decision-making that reflects community needs and preferences. The application improves collaboration by bridging the gap between local government, academia, and the community, promoting joint efforts to tackle urban challenges. Additionally, it streamlines the alignment of public input with strategic plans and research opportunities, making governmental operations more efficient and effective. As a transformative application for cities like San Antonio, CommunityInsight AI ensures that public voices are integrated into local governance and research initiatives, driving toward a more responsive and community-centric city.

IV. Software Tools

Building smart AI applications requires a range of software tools, including machine learning frameworks like TensorFlow or PyTorch, natural language processing libraries such as NLTK or spaCy, data analytics platforms like Pandas and Apache Spark, and integration tools like RESTful APIs and microservices architectures. In this section, we briefly discuss the software tools used to build the smart AI applications for San Antonio Research Partnership Portal.

A. Keyword Extraction Tools

A keyword extraction tool is a software application or algorithm that automatically identifies and extracts important words or phrases from a given text [10]. These tools are designed to assist in information retrieval, content analysis, and other natural language processing tasks. They employ various techniques, such as statistical analysis, machine learning, linguistic patterns, and graph algorithms, to determine the relevance and significance of words within a text. Based on the result of comparative analysis of unsupervised KE tools [11], we have selected four different KE tools for this experiment that represent different undying methods including statistical-based, graph-based, and machine learning-based.

1. KPMiner

El-Beltagy and Rafea introduced KPMiner, an unsupervised keyword extraction method utilizing a modified Tf-Idf approach with n-grams [12]. The method involves three key stages: candidate keyword selection, weight calculation, and keyword refinement, integrating statistical features to ensure robust keyword selection and balancing scores between compound and single keywords.

2. TopicRank

TopicRank utilizes a graph-based approach to extract significant keywords from documents by clustering related keywords and employing a variant of TextRank to identify the most crucial keywords within each cluster [13]. The method constructs a graph representing identified topics, where nodes represent topics and edges represent the similarity between topics. This method is beneficial for identifying important topics that may not be captured by individual keywords.

3. MultipartiteRank

MultipartiteRank constructs a multipartite graph representing both individual documents and phrases within them, utilizing a modified PageRank algorithm to consider the bipartite structure and importance of each phrase [14]. It produces representative keywords for entire document collections, incorporating positional information into edge weights, resulting in a bias toward keywords that appear earlier in the text.

4. KeyBERT

KeyBERT, a cutting-edge keyword extraction tool by Maarten Grootendorst, employs pre-trained word embedding models to identify crucial words or phrases in documents [15]. Using scikit-learn's CountVectorizer class, it generates potential keywords and computes pairwise cosine similarity scores between each keyword and the document's embedding vector, ranking them accordingly. Additionally, KeyBERT offers diversification options such as Maximal Marginal Relevance (MMR) or Max Sum Distance (MaxSum) measures.

B. Similarity Measure Algorithms

Text similarity measure algorithms are crucial in natural language processing and text analysis, facilitating tasks like plagiarism detection and recommendation systems. These methods include lexical-based approaches, which compare texts based on word occurrence and frequency, statistical methods like the Jaccard index, and semantic-based methods, which focus on capturing word meaning and context using techniques such as word embeddings or topic modeling. Each method offers valuable insights for analyzing and understanding textual data, catering to diverse purposes like document clustering and information retrieval.

1. Jaccard Similarity

Jaccard similarity quantifies the overlap between two sets by dividing the size of their intersection by the size of their union, offering a range from 0 to 1 where 0 indicates no similarity and 1 signifies complete similarity [16]. While useful for disregarding word order and frequency, it overlooks element importance and semantic nuances, making it ideal for scenarios prioritizing set presence over contextual meaning.

2. Cosine Similarity

Cosine similarity measures the similarity between two vectors in a high-dimensional space, commonly used in text analysis to compare word representations of documents or sentences, considering both direction and magnitude [17]. While effective in capturing semantic similarities, it may overlook linguistic nuances and is influenced by the quality of word representations, yet it remains valuable for various text analysis tasks.

3. Levenshtein Distance Similarity

Levenshtein distance quantifies the difference between two strings by measuring the minimum number of single-character edits needed to transform one into the other, valuable for tasks like spell checking and DNA sequence alignment [18]. While useful for structural comparisons, it does not account for semantic meaning and can be computationally intensive for lengthy strings, yet it remains essential for various text analysis applications.

V. Future Work

In future research, we will conduct a comprehensive statistical analysis of various keyword extraction tools and similarity matching algorithms to identify the most effective solutions for the San Antonio Research Partnership Portal. This analysis will involve evaluating the performance of different keyword extraction methods, such as KPMiner, TopicRank, MultipartiteRank, and KeyBERT, in terms of accuracy, execution time, and relevance of extracted keywords. Additionally, we will compare similarity matching algorithms, including Jaccard Similarity, Cosine Similarity, Levenshtein Distance, and Word Mover's Distance, to determine their efficacy in aligning strategic plans and matching research opportunities with public feedback. By leveraging metrics such as precision, recall, F1-score, and computational efficiency, we aim to establish a robust framework that optimizes the portal's functionality and enhances its capability to foster effective collaboration among city departments, academic researchers, and the community. This future work will ensure that the portal utilizes the best possible tools to support data-driven decision-making and community-centric urban governance.

VI. Conclusion

In conclusion, the San Antonio Research Partnership Portal exemplifies the transformative potential of AI in urban governance. By fostering collaboration among city departments, integrating public feedback, and streamlining partnerships with academic institutions, the portal enhances municipal responsiveness and decision-making processes. The applications detailed—ResearchConnect AI, NexusConnect AI, and CommunityInsight AI—demonstrate how AI-driven solutions can improve strategic alignment, facilitate community engagement, and promote efficient resource allocation.

These innovations not only bridge gaps between local government and academia but also empower cities like San Antonio to address urban challenges effectively, ensuring a more resilient, inclusive, and community-centric governance model. Looking ahead, the scalable and adaptable design of the portal positions it as a blueprint for other cities seeking to leverage AI to tackle complex societal issues. By continuing to refine these tools and incorporating emerging technologies, the portal has the potential to drive data-informed decision-making, foster innovative research collaborations, and set a benchmark for smart governance. Ultimately, this initiative serves as a testament to how the integration of AI into urban systems can create sustainable, forward-thinking solutions that benefit all stakeholders.

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