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Development of Web System for Facilitating Research Collaboration among Local Scientists

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Abstract: The primary objective is to contribute to the enhancement of science strategic planning at the State level, with a focus on fostering research collaboration and establishing a ranking system for universities within the country. Furthermore, this research project seeks to create a web platform that will not only showcase the results of these endeavors but also facilitate the identification of potential international research partners for local scientists. Alongside these outcomes, this paper aims to generate research publications that offer in-depth analyses and recommendations for the continual improvement of science strategic planning in the country.

Keywords: Science strategic planning, research collaboration, API, data collection, FPP.

1 Introduction

International scientific collaboration serves as a cornerstone for research excellence and innovation, fostering the exchange of knowledge, expertise, and resources across borders. As the global scientific landscape continues to evolve, the significance of collaborative efforts becomes increasingly apparent. Within this context, Kazakhstan, like many emerging research nations, faces unique challenges in establishing and fostering international research partnerships.

International scientific collaboration is recognized as a crucial driver of innovation and research excellence. Such collaborations enable the sharing of diverse perspectives, access to unique resources, and the tackling of complex global challenges. Numerous studies have shown that collaborative research often results in higher impact publications, increased citations, and the acceleration of scientific progress (Adams, 2013; Wagner et al., 2015).[1][2]

Global Tools for Facilitating Collaboration: Several platforms have been developed to facilitate scientific collaboration globally. These platforms provide comprehensive databases of academic publications, allowing researchers to track citations, analyze co-authorship networks, and identify potential collaborators.

Google Scholar provides a broad and inclusive platform for accessing academic publications. It indexes scholarly articles from various disciplines and offers citation tracking, which helps researchers identify influential works and potential collaborators (Meho, 2007).[3]

Scopus offers detailed analytics on publications, authors, and institutional affiliations. It is widely used for assessing research performance and identifying collaboration opportunities. Scopus's author profiles include extensive bibliometric data, aiding in the discovery of potential research partners (Burnham, 2006).[4]

Specializing in engineering and technology fields, IEEE Xplore provides high-quality publications and facilitates connections through detailed co-authorship networks. This platform is particularly valuable for researchers in these domains looking to collaborate internationally (Heck, 2009).[5] Despite these tools, the challenge remains for Kazakhstan's researchers to find collaborators who have prior experience working with Kazakhstan's institutions, which could enhance the likelihood of successful partnerships.

Kazakhstan's researchers face several unique challenges in establishing international collaborations:

Limited Access to Localized Collaboration Platforms: There is a significant gap in the availability of platforms tailored to the needs of Kazakhstan's researchers. Existing global platforms do not sufficiently highlight connections with Kazakhstan's authors (Yessengeldin et al., 2017).[6]

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Time-Consuming Processes: Finding potential collaborators manually is a cumbersome and time-intensive process.

Researchers often need to sift through vast amounts of data to identify suitable partners (Seidametova et al., 2020).[7]

Low Visibility in International Journals: Kazakhstan's researchers frequently struggle with lower visibility and recognition in major international journals, which hinders their ability to attract collaborations (Dukenbayev et al., 2019).[9]

In summary, while global platforms like Google Scholar, Scopus, and IEEE Xplore offer valuable resources for finding collaborators, they do not adequately serve the specific needs of Kazakhstan's researchers. The challenges of limited access, time-consuming manual searches, and low visibility in international journals highlight the need for a more efficient and targeted solution. Our proposed system aims to fill this gap by providing an automated platform that leverages existing connections between Kazakhstan's researchers and their international counterparts, thereby facilitating more effective and successful collaborations.

2 Methodology

Our approach involves developing a web-based system FPP to facilitate research networking for Kazakhstan's scientists. This system will integrate data from major academic databases such as Google Scholar and Scopus, using APIs to gather information on researchers' profiles, publications, and collaboration histories. We had such experience with collecting biometric data in the research called "The system of automated formatting conversion for bibliometric data", where we create web platforms that help researchers collect their publications and then automatically create portfolios with the ability to export in CSV or PDF format. Therefore, we are familiar with the methods of collecting data from sources such as IEEE Xplore, Scopus, Google Scholar. The methodology includes:

2.1 Data Collection Methods

Data collection is conducted using web scraping techniques and Client APIs. Python libraries such as BeautifulSoup, request, and selenium are employed to extract relevant information. The process involves:

- Identifying Kazakhstan's authors from Google Scholar using domain-specific email addresses (.kz).
- Scraping Scopus by filtering with query country for authors from Kazakhstan.
- Supplementing data with information from IEEE Xplore to obtain ORCID IDs and additional author details where necessary.
- Collecting comprehensive author information (name, university, country, Scopus ID, ORCID) and publication details.
- Mapping co-authors' information to establish collaboration networks.

2.2 Data Processing

- JSON Storage: The collected data is stored in JSON format for ease of access and processing. This format is chosen for its flexibility and compatibility with various web technologies.
- Data Cleaning and Organization: We use Python scripts to clean and organize the data, ensuring accuracy and consistency. Correction algorithms help rectify any discrepancies in the dataset.

2.3 Network Visualization

We develop models to visualize collaboration networks between Kazakhstan's researchers and their international counterparts. These models will provide insights into existing collaboration patterns and identify potential areas for new collaborations. As shown in Fig. 1, this network shows the connections of coauthors (that in green note) by publications (in blue note) with between main author (mentioned in grey note).

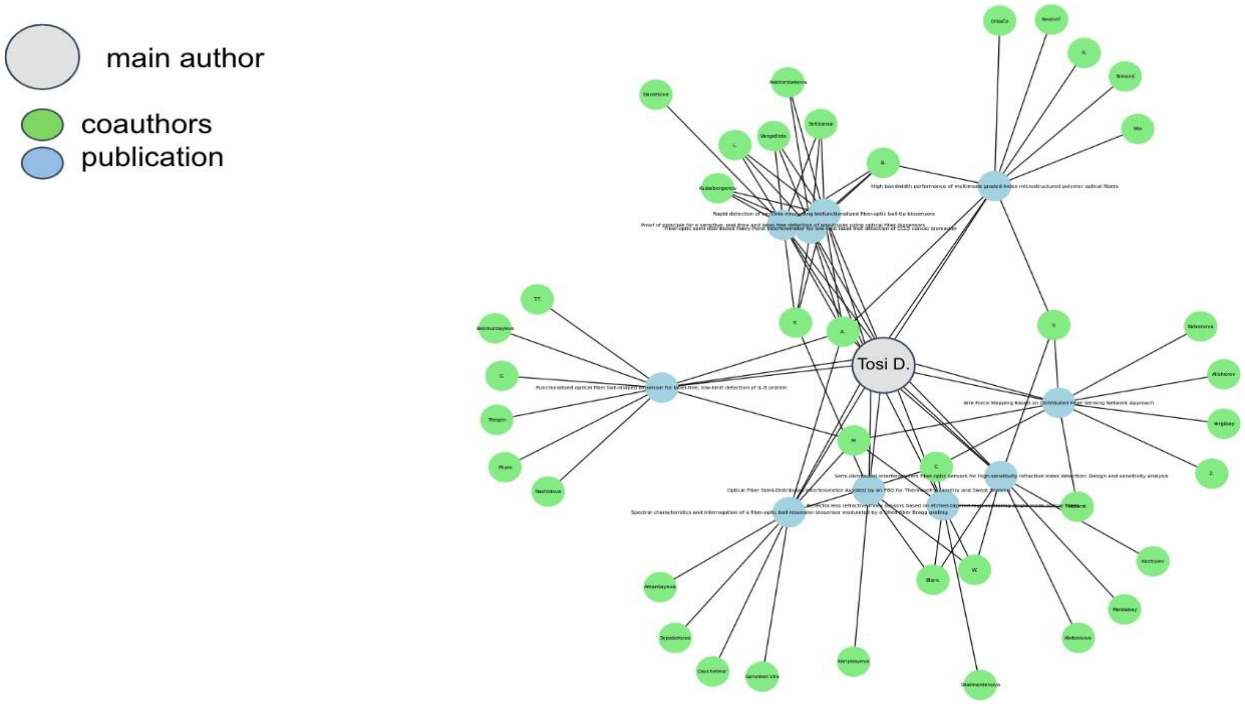

Fig. 1: Network Visualization.

3 Technical Solution

The web platform will be developed using modern web technologies. Key components include:

- Data Collection Techniques: The data system has been developed using Python, leveraging libraries such as Selenium and Beautiful Soup for data scraping and processing. Example of scraping data from Scopus see Fig.2. The system will use APIs to access data from Google Scholar and Scopus, storing it in a relational database for efficient querying and analysis.

The developed database includes 11,939 records with information on 520 international universities that collaborated with Kazakhstan's authors.

- Frontend Development: Vue.js powers the front-end interface, offering a dynamic and user-friendly platform for researchers to navigate effortlessly. The interface enables users to explore potential collaborators, review detailed profiles, and visualize collaboration networks with ease. The interaction between the user and the system can be easily illustrated with a use-case diagram, As can be seen in the Fig. 3, users can search for a research partner in a hierarchy by clicking on the buttons going to the following selections such as first a country from the list of countries, then a university from the list of universities, the next direction in which he wants to work and then select an author from the list of authors and so the user finds his publication partner.

```
from selenium import webdriver
from selenium.webdriver.common.by import By
from selenium.webdriver.common.keys import Keys
import pandas as pd
import time
from bs4 import BeautifulSoup
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import expected_conditions as EC

# Initialize Selenium WebDriver
driver = webdriver.Chrome()

# Example function to scrape data from Scopus
def scrape_scopus_data(query):
    url = f"https://www.scopus.com/results/results.uri?query={query}"
    driver.get(url)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.ID, "resul
    soup = BeautifulSoup(driver.page_source, 'html.parser')
    data = []
    for entry in soup.find_all('div', class_='result-item-content'):
```

Fig. 2: Scraping data from Scopus.

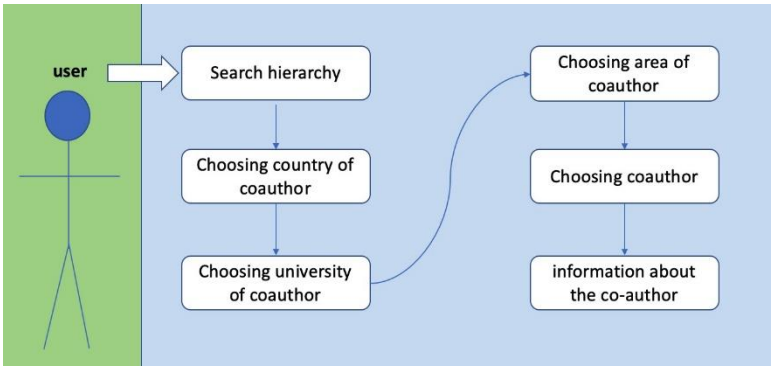

Fig. 3: A scheme of use cases for user-oriented design.

In developing the system, a key priority was to create a user-friendly interface tailored to scientists and administrators of scientific organizations. The design strategy emphasized minimalism and task orientation. The web application's usability was centered on three main criteria: efficiency, ease of use, and achieving optimal results.

- Backend Development: PHP Laravel forms the backbone of the backend infrastructure, providing robust functionality and facilitating efficient communication between frontend and database components. This ensures smooth operation and seamless integration of data across the platform.
- Data Visualization: D3.js is employed to create immersive data visualizations, including interactive graphs and charts that enable users to explore collaboration patterns and identify key research clusters. These visualizations enhance the platform's usability and provide valuable insights for researchers.

4 Results

As a result of the development of the system, the web application searches for a potential partner using the hierarchy of the subsequent user interface. How it all starts with choosing a country, let's take the country of Argentina as an example from all our 124 countries collected from our databases. After selecting the countries, we can see which universities in this country are already cooperating with local (Kazakh) scientists. And also, local (Kazakh) universities that have collaborated with the universities of Argentina. And one of the universities (Fig.4), for example, Consejo Nacional de Investigaciones Cient´ıficas y Te´cnicas cooperates with Nazarbayev University, Kazakh-British Technical University. After selecting one

of the universities, a list of areas /interests of the authors is displayed on the page, and after selecting the author's direction, a transition takes place to the page of the list of authors in the selected direction, in our case it is Mathematical Physics area. And then it will be possible to select one author with whom the user would like to cooperate as in Fig. 5. The user can also get acquainted with the author's works and his data (as shown in Fig. 6 and Fig. 7). So, using our website, you can find the authors and their connections.

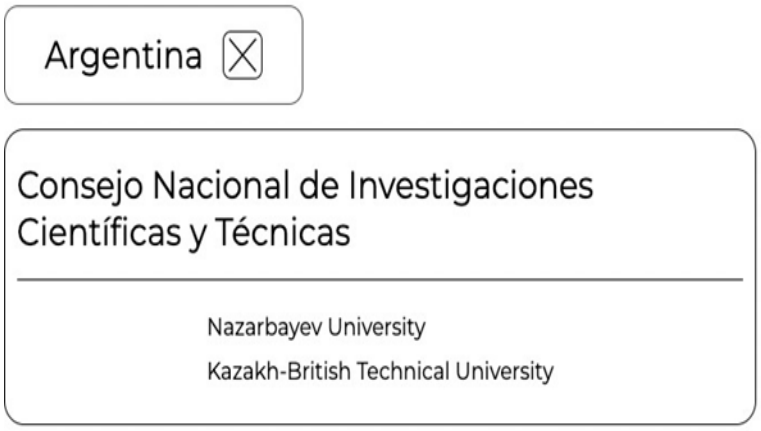

Fig. 4: Screen page of FPP on page for choosing university.

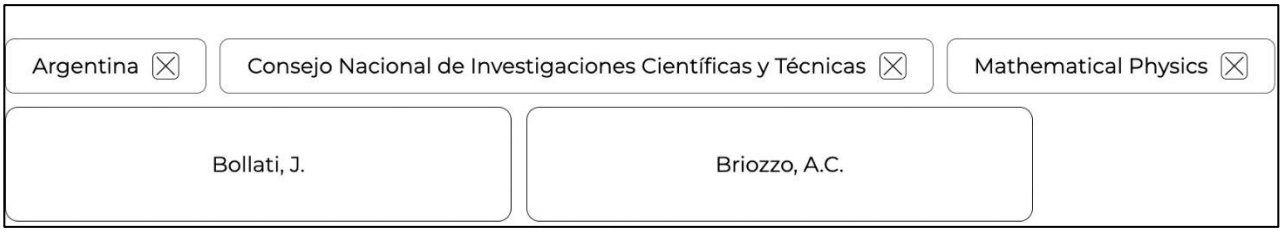

Fig. 5: Screen page of FPP on page for choosing partner.

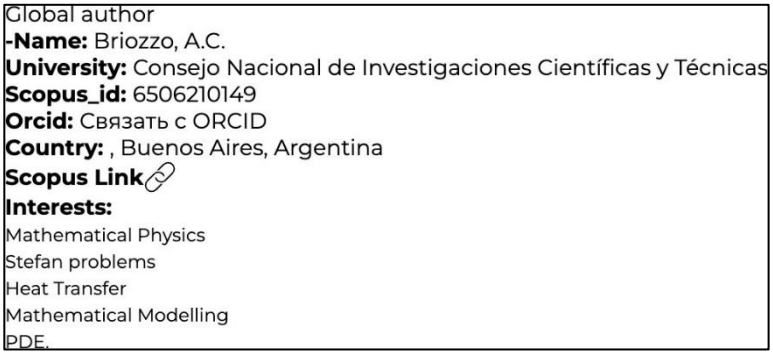

Fig. 6: Screen first part page of FPP on page for chosen partner.

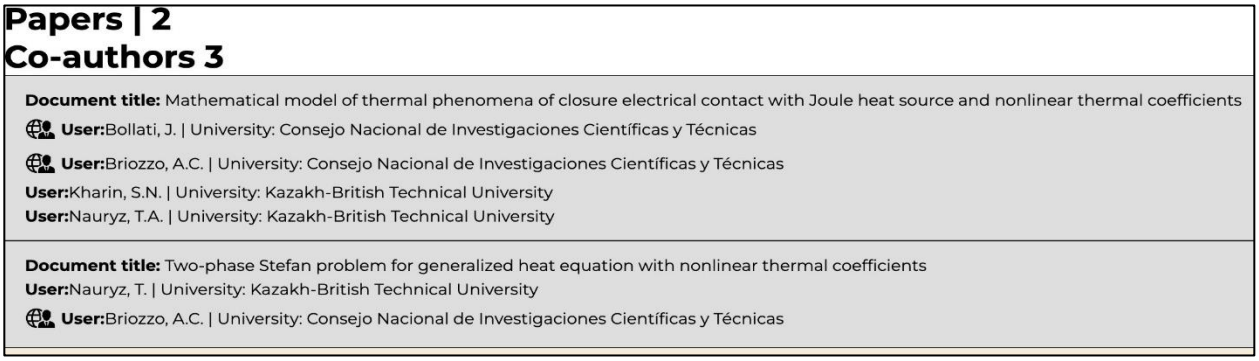

Fig. 7: Screen second part page of FPP on page for chosen partner.

5 Discussion

The project's web platform represents a significant advancement in research networking capabilities for Kazakhstan's scientists. By streamlining data collection, processing, and visualization, the platform facilitates the establishment of new research partnerships and enhances strategic scientific planning in Kazakhstan. The Statistic results feature offers valuable insights into the academic landscape, empowering policymakers and academic leaders to identify leading institutions and research clusters. These insights inform targeted strategies to enhance research output and foster collaboration, driving scientific progress and innovation forward.

6 Conclusion

In conclusion, this project underscores our commitment to bridging the gap in research collaboration within Kazakhstan. By harnessing the power of modern web technologies and leveraging data from esteemed academic databases, the project delivers a robust and user-friendly platform that simplifies the process of identifying potential research partners.By empowering Kazakhstan's scientists with valuable insights and tools for collaboration, we aim to propel Kazakhstan's scientific and technological landscape to new heights of innovation and discovery.

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