Integrating Semantic Web Technologies in Higher Education: A Decision Support System for University Selection

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***Abstract*: Selecting a suitable university is a critical and often challenging task for students as well as academic professionals, as it involves evaluating large amounts of diverse information that is scattered across multiple online sources. Existing search engines and ranking systems generally provide generic results and offer limited support for personalized, multi-criteria decision-making. To address these shortcomings, this study presents an intelligent decision support system that combines semantic web technologies with data aggregation and visualization techniques to support informed university selection. The proposed system automatically collects and integrates data from various sources, such as official university websites and publicly available datasets, using attributes including research performance, student composition, geographic location, and institutional rankings. A user- oriented visualization interface allows individuals to customize rankings and perform comparative analysis according to their specific preferences. To evaluate the effectiveness of the system, data from 301 universities in the United Kingdom were gathered through a combination of automated and manual methods. The results indicate that the proposed approach enhances efficiency, accuracy, and personalization in the university selection process. Overall, the system offers a scalable and practical decision support solution for higher education, serving the needs of students, faculty, and other stakeholders.**

***Keywords:* Information aggregation, Semantic web, Information visualization, Information retrieval, Decision Support System.**

INTRODUCTION

The rapid advancement of computer visualization techniques, together with the growth of virtual and augmented reality, has greatly expanded the potential for data visualization and the development of immersive virtual environments for educational purposes. These technological developments provide effective ways to present information and create engaging learning environments that meet the expectations of the new generation. In today's digital age, the path to higher education is shaped by an overwhelming amount of information, which makes the selection of a suitable university a challenging taskfor students, educators, and researchers alike. With more than 31,097 universities worldwide, this challenge becomes even more complex.

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This situation highlights the need for a decision support system specifically designed for university selection, capable of integrating data from multiple sources into a single, user- friendly platform. Such a system can provide a comprehensive view of universities by incorporating information related to academic programs, faculty, campus facilities, student satisfaction, and financial aid options. As a result, the university selection process can be streamlined, saving time and effort for prospective students.

Based on this concept, Figure 1 illustrates the key stages of the proposed system. The Data Layer serves as the foundation, where information is collected from RDF knowledge bases and institutional websites, including metrics such as research publications, faculty strength, international student data, student–teacher ratios, and details of academic programs (BS, Master's, and PhD). The Aggregator layer integrates and structures this data to make it suitable for analysis. At the Mining Layer, advanced data processing techniques are applied to extract meaningful insights, patterns, and trends. Finally, the User Layer presents the processed information to different stakeholders, including students (to support admission decisions), faculty members (to identify collaboration and funding opportunities), universities, and libraries.

At the core of the proposed system is the integration of advanced visualization tools with semantic web technologies. These components work together to collect, organize, and present data from a wide range of online sources, such as academic publications, university ranking platforms, and student reviews. By converting raw data into intuitive graphical representations, the system enables users to navigate complex information more easily and develop a deeper understanding of each university's characteristics, values, and performance indicators [6], [7,8].

This paper presents a decision support system that leverages visualization and semantic web technologies to simplify theuniversity selection process. By aggregating information from diverse online sources, the system provides a comprehensive platform that not only reduces the complexity of data analysis but also enhances decision-making through interactive, user- centric visualization tools [9, 10].

These tools allow stakeholders to compare universities across national and global on multiple criteria, including academic offerings, research output, campus facilities, and overall rankings, according to their individual preferences. By addressing the diverse needs of users, the system supports a more informed, efficient, and personalized approach to university selection.

The effectiveness of the proposed system was evaluated using data from 301 universities in the United Kingdom. The experimental results demonstrate that the system significantly improves the university selection process for students and academic professionals. Overall, the proposed approach offers a practical and reliable decision support tool for the higher education sector.

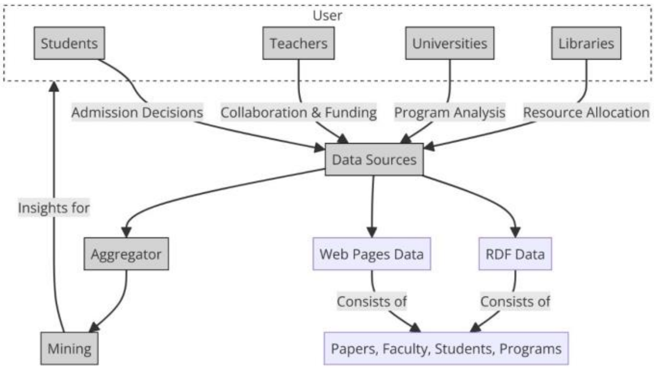

Figure 1. Brief overview of the system

LITERATURE REVIEW

Selecting a suitable university is an important decision for individuals with diverse academic and professional goals. This decision is influenced by several factors, including the research environment, student population, geographical location, available courses, and the overall ranking of the institution. Typically, users rely on search engines and online portals to gather this information by submitting multiple query strings, which often return thousands of results that require extensive manual review. In recent years, recommender systems have been widely adopted across various domains to support users in making informed choices and simplifying complex decision-making processes. Similarly, information visualization techniques play a crucial role in presenting large and complex datasets in a clear and intuitive manner. By representing data visually, these techniques enable users to easily analyze, interpret, and compare information, thereby enhancing understanding and supporting more effective decision-making.

2.1 Online Systems/Web Portals

Several online systems are available to help students and users find suitable universities and colleges. For example, the School Finder[1] system has been serving Canadian colleges and schools since 1995. Using this system, users can explore graduate, professional, and undergraduate programs offered by Canadian institutions. To search for a program, users simply type the desired program into the search box, and the system displays all schools and colleges offering that program across graduate, undergraduate, and secondary levels. However, the system lacks visualization features and does not allow users to compare programs or rank schools and colleges.

Similarly, College Finder[2] provides information about thou- sands of schools and colleges across Canada. Users can search using different parameters, including academic standards, location, cost, majors offered, and even alignment with their religious preferences. While College Finder has a comprehensive database and allows for filtering based on various criteria—such as proximity, academic standards, party scene, Greek life, and available majors—it does not provide visualization or comparison features between universities or colleges. In the Online University Finder[3] system in the United States, users can access detailed information about universities and colleges nationwide. This platform provides comprehensive profiles, including academic background, financial aid, athletics, and other relevant information. Students can even apply online, study remotely, and obtain an online degree. While the system offers extensive data and allows users to search for affordable options or student loans, it still lacks features for visual comparison of universities to determine which might be the best choice. In the UK, Unistats[4] is the official website for applying to universities and colleges. Either it allows users to search by the subject they are interested in or by the university, they wish to apply to. However, the platform makes it difficult to see which subjects are offered at which universities and does not provide an easy way to compare institutions side by side. Overall, while these systems provide detailed information, none of them fully supports visualization or comparative analysis, making it challenging for users to make informed decisions about the best universities or colleges for their needs.

2.2 Visualization Techniques

The authors [12] explain that the World Wide Web (WWW) is currently experiencing rapid growth due to the emergence of new tools, techniques, and concepts. In [13], the author addresses challenges associated with Web 2.0 technologies, exploring the use of mashups for the Journal of Universal Computer Science (JUCS) and encouraging both readers and authors to adopt these applications. Electronic journals continue to evolve, with services improving alongside technological advancements. Significant efforts have been made to provide high-level access to e-collections through 2D and 3D maps, integrating semantic analysis and topic visualization [19]. Key aspects of modern digital libraries, such as intelligent search and visualization of search results, have been discussed in [20].

The expansion of JUCS publications highlights the importance of understanding readership and accessibility. The author identifies regions (cities and institutions) contributing more, less, or ceasing contributions altogether [21]. Many universities have developed web-based campus maps [20], often incorporating geographic information system (GIS) features to facilitate visual searches. One study focused on designing an interactive, user-friendly Beytepe Campus Map at Hacettepe University, integrating GIS for visual queries. The map categorizes campus locations into eight main categories: academic units, administrative units, sheltering, nutrition, health, transportation, entertainment, and sports centers.

In another application, the integrated comparison portal Vimo[5], launched in January 2006, allows users in the US to compare health insurance rates, purchase plans, and select physicians. Vimo also enables users to find physicians, compare hospital prices, and read or post reviews. Similarly, the Google Maps API has been applied to map health professional[6] offices, track infectious disease outbreaks, and provide exact hospital locations using latitude and longitude. However, these systems do not provide comparative evaluations of hospital performance.

JUCS, as described in [21], is a unique electronic computer science journal with over 1,500 publications across multiple domains. It has recently implemented new features, including semantic search, personal and public annotations, collaborative options, multi-format publications, and category classification. In [22], the author explored the global distribution of JUCS authors and editors, maintaining detailed data including country, city, and university information. Two visualization approaches were developed: 1) displaying author information on Google Maps, and 2) mapping geographic author distribution with zooming functionality. However, these visualizations required substantial manual effort, highlighting the need for automated techniques to efficiently process city and country data. There is still no comparative visualization of authors' research areas or publication counts.

Cartography [23], historically the art and science of map- making in geography, has evolved with new tools and media that enhance static maps with multiple layers. Geographic Visualization, or GeoVisualization (GVis), uses spatial data for problem solving across various layers. One study presented two applications of Google Maps API: overlaying health data from 48 Southwark General Practices in London and higher education data from a

UCAS extract from the 2004 application cycle. Data visualization techniques, including the use of colors, fonts, and layouts, help users interpret information effectively and avoid potential pitfalls [18].

The location of convenience stores, for example, is a critical factor in determining customer flow and store success. Data visualization and data retrieval technologies, combined with geographic spatial metadata, enhance analysis and decision-making [14]. Visual representations, including color and geometric cues, are quickly recognized by the human brain, and information-mining advances enable natural and intuitive interaction with complex datasets [15].

Although visualization is not a new concept, its use in presenting data graphically or pictorially has grown, especially with the rise of user-generated content on social media. Data visualization enables librarians and information professionals to generate annual reports, perform internal evaluations, and prepare to teach others to create engaging, data-driven visualizations [19].

2.3 Decision Support Systems

[1] In this paper, the author investigates the problem of girls' hostel site selection by incorporating multiple safety, accessibility, and environmental criteria using a multi-criteria decision-making (MCDM) framework. The study employs the entropy weighting method to determine the importance of each criterion and the WASPAS technique for site ranking. Sensitivity analysis confirms the robustness of the results.

[2] Another study examines how future university students differ in their university selection preferences and how these differences influence their trust in university communication channels. Using survey data from 605 students and latent class analysis, five distinct student segments were identified based on academic focus, economic concerns, independence, and information awareness. The findings show that these segments perceive universities' communication tools differently in terms of reliability. The study underscores the importance of student segmentation in higher education marketing and provides insights for designing more targeted recruitment and communication strategies.

[3] Site selection for establishing a university is a complex decision influenced by multiple socio-economic and infrastructural factors. In underprivileged regions, conservative family perceptions often make women's universities more appropriate than co-educational institutions due to safety concerns and social norms. This study proposes a decision-making model for selecting women's university sites in backward regions of West Bengal, India, considering ten key criteria under uncertainty. Trapezoidal neutrosophic numbers integrated with AHP determine criteria weights, while TOPSIS and COPRAS methods rank alternative sites. Comparative and sensitivity analyses validate the robustness of the approach.

[4] Family influence also plays a critical role in university choice. Students often rely on older siblings for guidance, as they provide firsthand and trustworthy insights about campus life, costs, and benefits. Aguirre and Matta (2021) found that having an older sibling already enrolled at a university increases the likelihood of choosing the same institution by about 42.

[5] Additionally, students' university choices are often influenced by self-image, similar to selecting a prestigious brand. Survey results from two U.S. universities indicate that self-esteem and personal identity significantly shape preferences, sometimes outweighing academic quality. Universities that invest in facilities, branding, and image indirectly appeal to these self-image needs, highlighting the importance of effective university branding in a competitive global higher education market.

The expansion of schools and campuses has created a need for open and efficient online school administration systems. Existing resource management platforms face challenges in sharing educational resources due to structural differences. Study [26] proposes an information integration platform based on Service-Oriented Architecture (SOA) to unify enterprise application systems, enable information sharing, and meet cross-departmental business needs. The platform minimizes the impact of changing demands, enhances flexibility, and streamlines educational administration. By adopting SOA and Web services, it integrates existing resources, reduces development costs, and improves performance management quality. Loosely coupled, reusable modules allow seamless integration and simplify deployment and use.

In [27], the author highlights that technological advances require collaboration among universities, teachers, and students to restructure departments and courses; failure to do so risks reduced quality and competitiveness. A decision support system is proposed with three stages: data collection, conversion into meaningful information using natural language processing, and ranking alternatives via multi-criteria decision-making. Experimental validation using computer engineering job postings and course content from Turkish universities confirms the system's applicability and reliability.

Study [28] focuses on developing an online learning support system using location-based service architecture. By analyzing learning data and implementing an improved algorithm, the system enhances the quality of online education. It provides personalized guidance, tracks real-time progress, and incorporates geographic information, location preferences, and user decision-making in content recommendations. The combination of big data, learning analytics, and mobile Internet technology offers intelligent, humanized support and a new method for evaluating and teaching students.

Several studies [29,33] address low graduation rates at four- year state colleges. Despite using academic indicators like GPA and standardized test scores in admissions, graduation rates remain below 40

Other studies [29,34,35,36,37] focus on optimizing educational decision-making and administration. For instance, the analysis of students' physical education data using decision tree and forest algorithms generates classification rules to improve teaching strategies. Configurable service-oriented decision support systems enable rapid development of problem- specific tools with minimal training. Simple Additive Weighting (SAW) and other MCDM methods support university selection based on criteria like accreditation and job de- mand. Automation in timetable creation reduces costs and improves efficiency, as demonstrated by the BTTE application, which achieved significant time-savings and process optimization. The Data-Driven Education Decision Support System (DDEDSS) prototype evaluates learners' performance, optimizes curriculum design, and integrates data acquisition, storage, analysis, and mining effectively.

Overall, these studies emphasize the role of decision support systems, data-driven methods, and advanced algorithms in enhancing educational planning, administration, and student outcomes. The integration of MCDM, predictive analytics, visualization, and service-oriented architectures provides scalable, flexible, and practical solutions for challenges in higher education and school management.

PROPOSED TECHNIQUE

A Decision Support System for University Selection is shown in Figure 2. The overall architecture of the system is divided into four main layers such as 1) Data Collector, 2) University Data Files, 3) Mash-up, and 4) Visualization components. The Data Collector component consists of subcomponents that load the RDF triplets from the RDF store, and convert them to MySQL database format for SQL queries in the future. The RDF store has various properties like the subject, author, etc. The RDF Parser converts it and stores it in the MySQL database. This conversion enables us to build a user-friendly interface containing a query posting mechanism and searches for a total number of papers published in the universities. This information is extracted from UK universities' RDF, next Data stored in files, next using pre-processing the data and finally organized the data and stored in the MySQL database and then using Google map API and use the dojo tool to compare the universities. The last section is Visualization to visualize the data on Google Maps geographically so that it is easy for end users to locate the university.

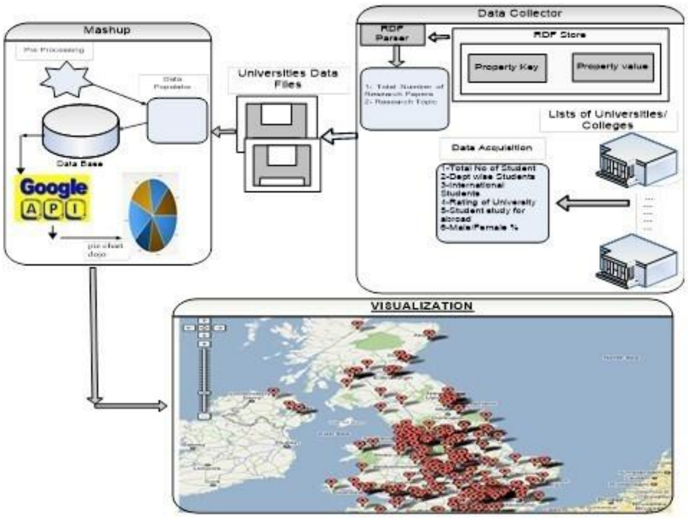

Figure 2. System Architecture

3.1 Data Collector

The Data Collector component is responsible for collecting data from the Universities/colleges web site[7]. The Data Collector component is currently a manual process. We have to automate it in the next releases. We have collected data from UK universities' websites. We have also collected RDF from RKB Explorer. The whole component in our architecture has been divided into the following sub-components 1) RDF Store 2) RDF Parser 3) List of Universities/Colleges.

A. RDF Store

We have collected and stored UK universities and colleges' RDF from the Linked Open Data project[8]. The RDF means Resource Description Framework which stores semantically rich resources. In our dataset, and understandable by machines in this RDF different kinds of information are stored and the structure is very complex and difficult for users to understand. In RDF Document holds the following properties figure-3. In our collected RDF the major attributes are the University Name, Number of research papers topic of the research papers, etc. To extract this information from the collected RDF files we wrote a script that is described in the next section.

```
<?xml version="1.0" encoding="UTF-8"?>
    <?oxygen RNGSchema="rdfxml.rnc" type="compact"?>                <!DOCTYPE RDF [
ENTITY wc "http://www.iro.umontreal.ca/lapalme/WineCatalog#" >
        <!ENTITY cb "http://www.iro.umontreal.ca/lapalme/CellarBook" >
    ]>    <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
           xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
           xmlns:wc="&wc;"
           xmlns:cb="&cb;#"
           xml:base="&cb;">
         <rdf:Description
        rdf:about="http://www.iro.umontreal.ca/lapalme/CellarBook#theCellar">
            <cb:ownedBy>                         <!-- 1 -->
                <rdf:Description  rdf:about="&cb;#JudeRaisin"/>
            </cb:ownedBy>
        </rdf:Description>
        20     <rdf:Description
rdf:about="http://www.iro.umontreal.ca/lapalme/CellarBook#JudeRaisin"
            cb:street="1234 rue des Châteaux" cb:city="St-George">
            <cb:named rdf:parseType="Resource">  <!-- 2 -->
                <cb:first>Jude</cb:first>
                <cb:family>Raisin</cb:family>
            </cb:named>
        </rdf:Description>
                <rdf:Description rdf:about="#JudeRaisin"><!-- 3 -->
            <cb:loved rdf:resource="&wc;C00043125"/>
            <cb:loved rdf:resource="&wc;C00871996"/>
            <cb:comment rdf:parseType="Literal">this is <b>great</b>!</cb:comment>
        </rdf:Description>
            <rdf:Bag rdf:ID="theCellar">             <!-- 4 -->
            <rdf:li rdf:resource="&wc;C00043125"/>
            <rdf:li rdf:resource="&wc;C00042101"/>
            <rdf:li rdf:resource="&wc;C00871996"/>
        </rdf:Bag>
                <rdf:Description rdf:about="#theCellar"><!-- 5 -->                    <cb:locatedAt rdf:nodeID="loc"/>
        </rdf:Description>

          <rdf:Description rdf:nodeID="loc">      <!-- 6 -->                    <cb:street>4587 des Futailles</cb:street>
        <cb:city>Vallée des crus</cb:city>
      </rdf:Description>
              <!-- Schema definition -->                                          <!--   Classes -->
      <rdfs:Class rdf:ID="Person"/>            <!-- 7 -->
      <rdfs:Class rdf:ID="Cellar"/>
      <rdfs:Class rdf:ID="Wine"/>
          <!--   Properties -->
      <rdf:Property rdf:ID="loved">            <!-- 8 -->
          <rdfs:domain rdf:resource="#Person"/>
          <rdfs:range rdf:resource="#Wine"/>
      </rdf:Property>
         <rdf:Property rdf:ID="ownedBy">          <!-- 9 -->
          <rdfs:domain rdf:resource="#Cellar"/>
          <rdfs:range rdf:resource="#Person"/>
      </rdf:Property>

    </rdf:RDF>
```

Figure 3. Resource Description Framework (RDF) from Linked Open Data.

B. RDF Parser

RDF parser is a general type of script that takes RDF as input and populates the MySQL database. We need to define the script that which attributes need to be extracted from the RDF file. Therefore, our script loads in RDF from the RDF store, and for the mentioned attributes the data is populated in databases. The conversion reason is simply that we can play with relational databases in a lot of more different ways conveniently.

C. List of Universities/Colleges

We have collected and stored all the UK universities and colleges data from UK universities/college websites. There are different kinds of information stored in this dataset. For example, how many students are there in the university? how many mature students? How many International students? Male/female percentage? How many Students are enrolled in different subjects? Etc.

3.2 University Data Files

We have stored all the UK data in different files, some data is stored in a Word file and some is stored in an Excel file. The fee structure is stored and university faculty is stored in a Word file and other data and the university latitude and longitude are stored in an excel file and all the data collected from collector section in which all the UK universities and colleges data stored.

3.3 Mashup

We have to use a mash-up section in which we combine all the data, visualize this data, and aggregate the data it is very important to make existing data more useful, and efficient moreover for personal and professional use. This section is further divided into different parts Pre-Processing 2) Data Populator 3) Database 4) Google Map API 5) Dojo (Pie chart).

A. Pre-Processing

Real-world data are generally Incomplete lacking attribute values, lacking certain attributes of interest, or containing only aggregate data Noisy: containing errors or outliers In- consistent: containing discrepancies in codes or names. We are doing data preprocessing and Data cleaning and we have corrected and filled the missing values, smooth noisy data, identified or removed outliers, correct the given code given for universities in ascending order and resolved inconsistencies. Data is integrated using multiple files.

B. Data Populator

The Data Populator Application extracts the available information from the Customized RDF file with the help of an RDF parser to populate the data and store it in the database.

C. Database

In the database, all the data related to UK universities and colleges are stored. We export 1st all the data from an Excel file into a CSV file (which is generally a text file) and then import it into the MYSQL Database.

D. Google Map API

The database provides the name of universities and cities and their latitude and longitude information. After that, we created a marker and placed the data geographically on the Map on the exact latitude and longitude.

E. Dojo (Pie Chart)

Dojo Toolkit is an open-source modular JavaScript library (or more particularly JavaScript toolkit) designed to ease the speedy progress of cross-platform, JavaScript/Ajax-based applications and websites. For comparison of universities, we draw a pie chart in Dojo Tools to compare different universities.

VISUALIZATION

Information visualization is the art of presenting data in a visual way that users can understand and enjoy. Dashboards, scatter plots, and Good Map API are common examples of information visualization. The basic purpose of Information visualization is to represent the data in a meaningful way that a user can understand better. Information visualization allows users to draw insights from abstract data efficiently and effectively. Information visualization plays an important role in making data more useful and turning unrefined information into actionable insights.

4.1 Overall Picture of the Decision Support System for University Selection

The comprehensive and overall visualization of UK universities and colleges is presented in Figure 4, offering both an overview and a detailed view. Each university and college are accurately positioned on Google Maps based on their longitude and latitude coordinates. Users have the flexibility to select a specific institution by either using the mouse cursor or opting from the available options in the drop-down menu. Furthermore, for users who wish to search for a particular university, there is a search functionality provided in the drop-down menu, allowing them to easily locate and select their desired institution. To enhance accessibility to university and college information, we have implemented a highlighter feature within our Graphical User Interface (GUI), which enables users to easily identify and access specific sections of interest. Additionally, we have incorporated Zoom In functionality on Google Maps in Figure 5, enabling users to obtain a clearer understanding of the distribution and placement of universities and colleges.

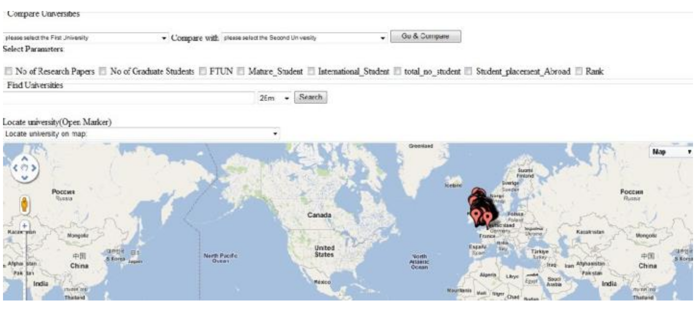

Figure 4. The overall picture of Visualization of UK universities/colleges.

4.2 Click on University or Search University from the Drop-Down Menu

The Google Maps interface displays universities in a zoomable manner, as depicted in Figure 5. By clicking on any university, the user can access relevant information located at the top of the screen. This information includes the university's name and address, the total number of students, the break- down of undergraduate students, the availability of sandwich programs, the presence of international and mature students, student placements abroad, male-to-female percentage, and the university's ranking. This wealth of information allows users to make informed decisions based on various criteria. Users can choose a university based on its proximity to their location, utilizing the address provided on Google Maps. Additionally, users can select a university based on specific parameters, such as the best option for them, as indicated by the ranking provided. To facilitate ease of use, a drop-down menu is available for users to quickly access detailed information about a specific university. This eliminates the need for users to individually search and click on multiple universities on Google Maps. By selecting their desired university from the drop-down menu, users can view the precise information they seek, mirroring the details presented in Figure 6.

Figure 5. Universities are shown in a Zooming way on Google Map.

4.3 Comparison of Two Universities with Different Parameters

Figure 7 displays two drop-down menus allowing users to choose university X1 from one search box and university X2 from another. After making their selections, users can click on the "go & compare" option. First, they need to select the relevant parameters and check the corresponding check boxes. Upon clicking "go & compare" Figure 7 presents a comparison between Oxford University and the University of Leeds based on different parameters, as per the user's request. Clicking on the" go & compare" option opens another window, shown in Figure 8, where two dojo pie charts present the information in distinct colors. When the cursor is placed over a color, it separates from the chart, which is known as hoaring. This allows users to obtain the desired information while hoaring over the chart.

4.4 Comparison of Two Universities with All Parameters

When a user wishes to compare a university using all parameters, they will select one university from a dropdown list and another from a separate dropdown list. After checking all the parameters, they will click on the" go & compare" button. This action opens another window, depicted in Figure 8, where two dojo pie charts present the information using distinct colors. When the cursor is placed over a color, it separates from the charts, a phenomenon known as hoaring.

This feature enables the user to obtain the desired information while hoaring over the chart. Figure 8 displays a comparison between the London School of Science and Technology and the European School of Economics.

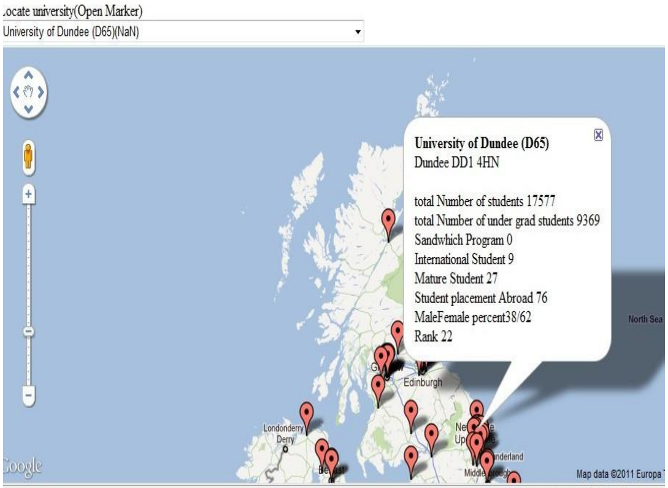

Figure 6. Clicking or searching any UK university from the drop-down menu on Google Maps.

4.5 Comparison with Other Systems

Table 1.1 provides a comparison between the proposed university discovery and visualization system and several commonly used university information platforms. The comparison focuses on how effectively each system responds to typical user queries related to student characteristics, institutional features, and university comparison. The analysis shows that most existing platforms offer only limited functionality, mainly supporting basic location-based searches, while lacking important information needed for informed decision- making, such as student demographics, research-related data, and cross-university comparison. In contrast, the proposed system offers broader query support and allows users to compare universities based on their individual preferences, making it more suitable for informed university selection. The results further highlight that existing systems largely operate as static information sources with restricted query-handling capabilities. Although geographical information is commonly available, deeper insights into areas such as research output, student composition, and comparative analysis across institutions are generally absent. Notably, among all the evaluated platforms, only the proposed system enables comprehensive inter-university comparison across multiple academic and demographic dimensions. Overall, the proposed system clearly outperforms existing solutions by providing an integrated, preference-driven query mechanism supported by semantic data integration and interactive visualization. This allows users to address practical and complex questions, such as identifying universities that best align with specific academic goals, demographic considerations, or geographical preferences—capabilities that are not adequately supported by current platforms. These results confirm the effectiveness, practical value, and innovative nature of the proposed system as a robust decision support tool for higher education selection.

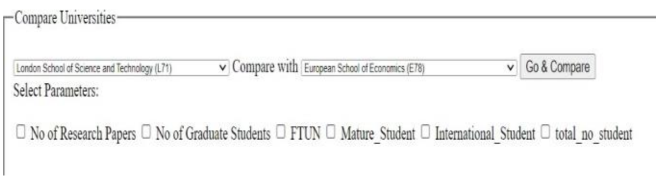

Figure 7. Comparison of two universities/colleges

Figure 8. Comparison of two universities/colleges with all parameters

CONCLUSIONS

This study successfully developed and validated an intelligent decision support system designed to tackle the growing complexity of university selection in the context of fragmented, unstructured, and semi-structured online academic data. By leveraging semantic web technologies alongside advanced data aggregation and interactive visualization techniques, the proposed system enables personalized, multi- criteria comparisons of universities based on critical parameters such as research output, student demographics, geographical location, and institutional rankings.

The comparative evaluation clearly demonstrates the limitations of existing university information systems, which predominantly support only basic queries like geographical location, while neglecting essential attributes such as total student strength, international and mature students, gender distribution, research publications, and inter-university comparisons. In contrast, the proposed system effectively fills these gaps, offering a broader and more user-centric query support framework, allowing direct, multi-parameter comparisons that align with diverse user preferences.

Validation using data from 301 universities in the United Kingdom confirms the system's practical effectiveness. By transforming complex datasets into intuitive and interactive visualizations, the system simplifies the decision-making process, improves accuracy, and reduces user effort. These results underscore the system's superiority over existing platforms in delivering comprehensive, scalable, and actionable insights for higher education decision-making.

Overall, the proposed approach represents a significant advancement in university selection tools, providing a reliable and robust platform for students, academic staff, and institutional stakeholders. Future work will aim to further enhance the system through real-time data integration, advanced analytics, and immersive visualization technologies, thereby expanding its capabilities and impact in supporting informed, data-driven decisions in higher education.

Statements of Declaration

Conflicts of Interest

The authors hereby state that there are no conflicts of interest to disclose regarding the current study.

Ethics Approval

This article does not contain any studies with animals performed by any of the authors. The authors extracted data with the assistance of domain experts.

Data Availability and Materials

The corresponding author can provide the data supporting the findings of this study upon request.

Notes:

[1]http://www.schoolfinder.com/
[2]http://www.collegeview.com/articles/article/college-finder
[3]http://www.euniversityfinder.com/
[4]http://unistats.direct.gov.uk/
[5]http://www.vimo.com
[6]http://healthmap.org
[7]http://www.ucas.com/students/choosingcourses/choosinguni/instguide/
[8]www.rkbeplorer.com

TABLE I

COMPARISON OF QUERY/FEATURE SUPPORT ACROSS SYSTEMS

S. No.	Query / Feature	Proposed System	System 1	System 2	System 3	System 4	System 5	System 6	System 7
		Integrating Semantic Web Technologies in Higher Education: A Decision Support System for University Selection	www.schoolfinder.com/	www.collegeview.com/articles/article/college-finder	www.euniversityfinder.com	unistats.direct.gov.uk	www.beytepecampus.com	www.uwc.org/	www.educationconcern.com/universities.htm
1	Total students	✓	×	×	×	×	×	×	×
2	Geographical location	✓	✓	✓	✓	✓	✓	✓	✓
3	Research articles	✓	×	×	×	×	×	×	×
4	University ranking	✓	×	×	×	×	×	×	×
5	International students	✓	×	×	×	×	×	×	×
6	Mature students	✓	×	×	×	×	×	×	×
7	Male/Female ratio	✓	×	×	×	×	×	×	×
8	Students for abroad studies	✓	×	×	×	×	✓	×	×
9	Undergraduate students	✓	×	×	×	×	×	×	×
10	Inter-university comparison	✓	×	×	×	×	×	×	×

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