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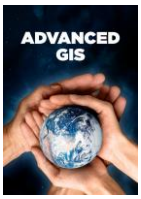

A Review: Detection types and systems in remote sensing

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Abstract

Remote sensing (RS) is the process of capturing, measuring, and digitally storing the reflection, radiation, and scattering values emitted by an object in one or more different band ranges of the broad electromagnetic spectrum and using this data to identify tools. RS is a method used by many professional disciplines and is frequently preferred today. Therefore, it has been the subject of this study. This study aims to conduct in-depth literature research on RS and present the results of related studies. For this goal, studies in the literature were reviewed. In addition, studies connected to RS or types were scanned in the Vosviewer application, and maps were constructed based on the locations, years, and keywords of the studies done. By developing remote sensing methods, researchers have achieved successful results in environmental analysis, increasing the productivity of agricultural areas, natural disaster management and many other fields. The rapid development of RS technology, improvement of data analysis algorithms and advances in satellite technologies show that this field will gain even more importance in the future. As the application areas of this method expand, it becomes important to use and interpret the data provided by RS more effectively.

1. Introduction

Remote sensing (RS) is the science of gathering information about objects without making direct physical contact, using various sensing methods. In greater detail, RS involves the detection, measurement, and digital storing of emission and scattering values that can be isolated from the object in one or more discrete band intervals across a large range of the spectrum (Lillesand & Kiefer, 2004). RS systems are classified into two types: active and passive. These are active systems in which objects or particles are artificially delivered to be analyzed and their energy changes as a result of reflection and analysis. It is included in this class Radio Detection and Range (Radar). Passive systems, on the other hand, differ from active remote sensing in that they interact with particles and surfaces to offer the needed information about the physical and chemical properties of naturally emitted radiation, such as solar radiation. (Kavak, 1998).

RS technique is based on perception, which is the process of determining correlations between electromagnetic radiation reflected or emitted by objects and their qualities. Passive systems detect naturally occurring electromagnetic radiation. Cameras that take aerial photos for photogrammetric evaluations are an example of passive systems. Active systems detect artificial radiation, while passive systems detect natural radiation emitted by objects and the atmosphere (Olgun, 2012). Active systems examples are radar and LiDAR.

RS system is made up of an energy source, energy/matter interaction, atmosphere, sensor, and data-gathering system components. RS is utilized in a variety of applications, including determining land cover and distribution, agriculture and forestry, urban planning, coastal area management, drinking water supply and irrigation, formation detection, and biodiversity. (Karthikeyan et al., 2020; Adjovu et al., 2023). The use of Geographic Information Systems (GIS) and RS in modeling land use and land cover (LLC) is also a suitable approach to understand the future pattern (Shafiq & Mahmood, 2022). This study focused on RS, which is a method utilized by many professional areas and is widely preferred nowadays (Çelik & Yakar, M., 2023; Çelik et al., 2024a, Çelik et al., 2024b). Because of its importance, it was determined that extensive literature research on RS was required, and the study concentrated on this topic. In this study, detailed literature research was conducted and the results of relevant studies were presented.

2. Literature review

Previous articles on RS and RS systems, which form the study's major axis, were reviewed, together with their features, methodologies, data, and so on. Table 1 shows the details of the researchers analyzed.

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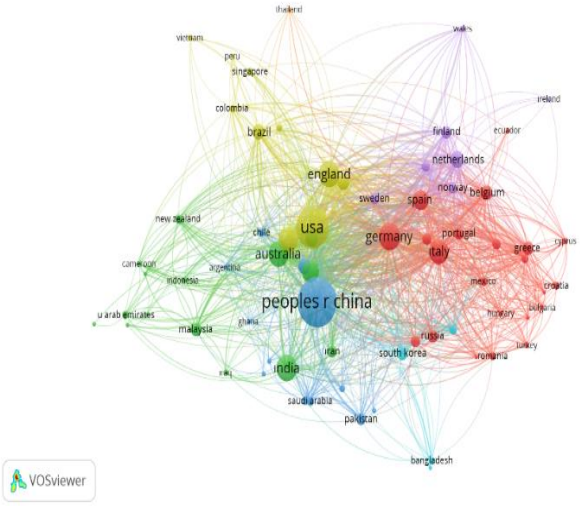
Table 1. Summary of literature

Reference	Type of study	Aim of study
Jia & Ye (2023)	Review	Deep learning approaches were used to investigate data connected to seismic events and the things they affected.
Cuca et al., (2023)	Review	RS and earth observation methods were utilized to assess damage to European cultural heritage.
Zhou et al. (2023)		A general evaluation of existing techniques and methods for obtaining coastlines from RS data was made. A general evaluation of existing techniques and methods for obtaining coastlines from RS data was made.
Wang & Zhang (2023)	Review	Desert movement was assessed utilizing RS techniques.
Kurbanov et. al. (2022)	Review	The effects of forest fires were evaluated using RS methods.
Lan et. al. ((2022)	Review	The precursors of major landslides were researched via RS approaches.
Yu & Fang (2023)	Review	The role of remote sensing and large-scale spatial data has been examined in urban studies in recent years.
Tanniru, & Ramsankaran (2023)	Review	The microwave approach was used to determine snow thickness in the study.
Neyns & Canters (2022)	Review	The mapping of vegetation in urban areas using high-resolution satellite imagery was investigated.
Ma et. al. (2023)	Review	Remote sensing techniques were applied to investigate marine pollution on a worldwide scale.
Janga et. al. (2023)	Review	Existing literature on remote sensing and artificial intelligence methodologies was examined.
Anand & Deb (2023)	Review	The potential of RS and GIS techniques for urban building energy modeling tools was extensively evaluated in the study.
Xu et. al. (2023)	Review	Platforms for SAR, optical remote sensing, and laser technologies used in China were summarized.
Louw et. al. (2022)	Review	Variety of pandemic-related topics were handled through RS.
Zheng et. al. (2023)	Review	This study investigated the usage of NTL (Nighttime Light) data in basic urban applications.

When the research on RS listed in Table 1 was analyzed, it was clear that this issue was significant. At this point, it would be incredibly beneficial to review other research in the literature on RS, which is employed by many professional fields and today maintains a very important position. In this regard, research on RS and RS types was scanned in the Vosviewer tool, and maps were constructed based on the places, years, and keywords where the studies were conducted.

2.1. Analysis based on the place where the studies were conducted

Review articles on RS and its types, made within 3 years covering the years 2021-2023, were examined. With this analysis, it was revealed in which countries RS and its varieties are the subject of more scientific studies (Figure 1). Therefore, the subject of the study was addressed by researchers in 113 different countries as a whole. The country with the most studies was China with 580, followed by the USA with 85. The countries where the least amount of work has been done vary from Nigeria to Wales, from Senegal to Qatar. The number of articles on the subject of the study in these countries was determined to be only 1.



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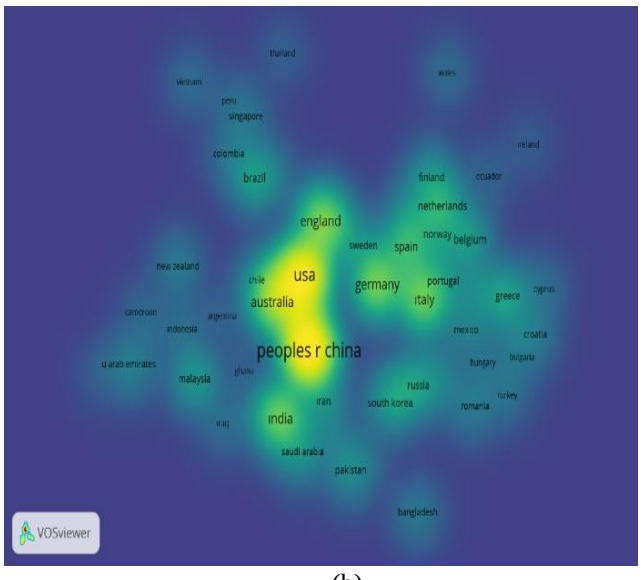

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Figure 1. Analysis of the countries studied

2.2. Analysis according to the year the studies were made

Review articles published in 2021, 2022, and 2023 regarding RS and RS types subject to the study were examined with this analysis (Figure 2). According to the analysis results, 168 studies were published in 2021, 182 in 2022, and 230 in 2023. It is observed that there is an increase in the number of studies conducted over the years. At this point, it is possible to say that the subject of study is becoming increasingly popular around the world and is oftentimes occurring in scientific publications.

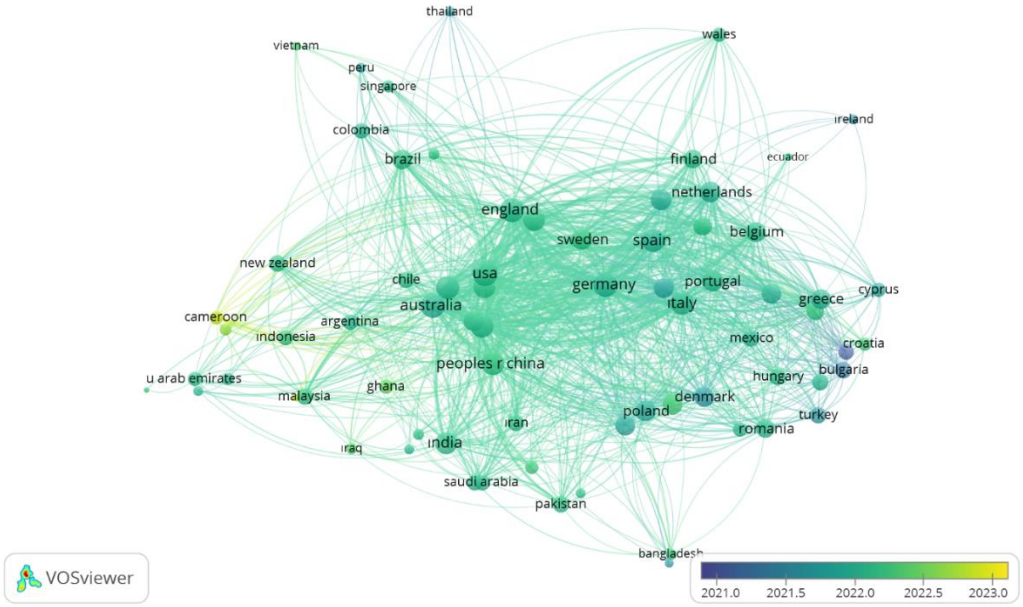
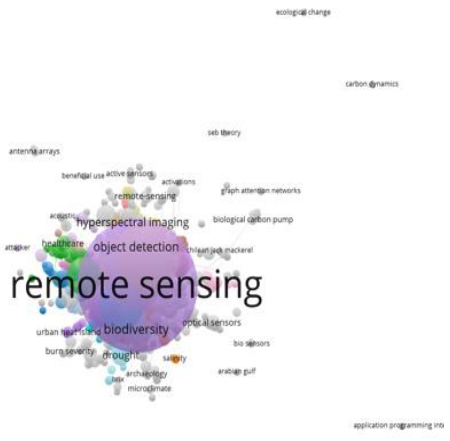


Figure 2. This is the example of figure formatting

2.3. Keyword Analysis

Keyword analysis is an analysis method employed to apprehend, classify, or summarize a text or document. With this analysis, other keywords related to the words "RS and RS types", which are the topic of the study, were found. It was determined which field UA was most frequently discussed (Figure 3). In light of the findings obtained from the analysis, it was determined that the keywords "object detection", "biodiversity" and "hyperspectral images" were frequently used together with RS.



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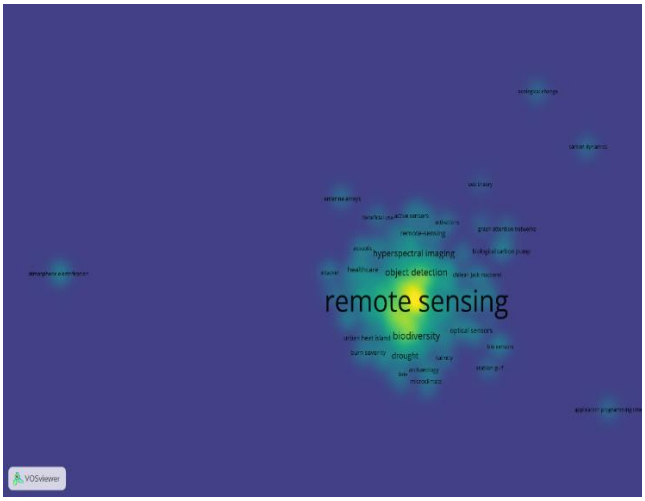

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Figure 3. Analysis of the keywords used

3. Discussion

In the study, studies conducted with RS and RS types and published in the literature were examined. In these studies, applications were carried out using mainly RS methods.

Cuca et al. (2023) integrated RS techniques and terrestrial measurement methods to detect deformations occurring in cultural heritage in Europe. Kurbanov et al. (2022) examined fires occurring around the world with RS methods in the study. Both studies are review articles and research the topics they focus on in depth. In this study, the issue of RS and RS types was discussed, and

Cuca et al. (2023) and Kurbanov et al. (2022) detailed research was carried out, as in the work of. As a result, a review article was created.

Cuca et al. (2023) investigated studies between 2000 and 2022, while Kurbanov et al. (2022) examined publications within 20 years covering the years 2000-2020. In this study, we wanted to analyze more current and newly conducted studies, and in this direction, publications from 2021, 2022, and 2023 were examined and the study was carried out. In this regard, it differs from the other two studies mentioned. Sutherland et al. (2023), Hu & Minner (2023) and Zheng et al. (2023). Cuca et al. (2023) differentiated RS systems were used to divide the architectural space in the upper and lower dimensions. In the research conducted by Cuca et al. (2023) and Sutherland et al. (2023), RS methods were used on issues related to cultural architectural heritage.

In the studies carried out by Jia & Ye (2023), Kurbanov et al. (2022), Lan et al. (2022) and Xu et al. (2023) data about disasters, the objects they affected, and the areas where disasters occurred were investigated with RS methods.

Other articles utilized techniques in coastline extraction, desert mobility assessment and desertification review, urban studies, marine pollution monitoring, urban building energy modeling, and research on unmanned aerial vehicles for search and rescue. In this study, RS and RS types were the subjects, and research was carried out in this direction. In addition, in the mentioned articles, articles related to the study subject in the literature were examined. In this study carried out by the authors of the article, studies in the literature were examined, as in the articles mentioned above. In this respect, it is possible to express that they are similar. Nevertheless, the popular Vosviewer Bibliometric (VB) analysis method, which is frequently used in review articles today, was not used in the studies examined. In this review article, to analyze the studies in the literature in depth and to make the study academically stronger, Sutherland et al. (2023) as in the study conducted by, the VB analysis method was preferred. In this context, it differs from other studies.

4. Conclusion

The primary focus of the research is RS and RS types. The authors of the article intend to create a review article to explore and determine the importance of this topic. In this regard, prior compilation studies on RS published in the literature were reviewed, and Table 1 was developed. This style of table is commonly used in review articles. However, research was undertaken using the Vosviewer program to further investigate the subject of the study and establish its trend in recent years. In this context, the VB Bibliometric analysis method was utilized, and several analyses were conducted on the study's topic (Figure 1-3).

In light of the experiences obtained during the research and writing process for this study, a few recommendations might be provided to researchers who will publish review articles on this or other topics.

- It is critical to thoroughly review the research in the literature on the topic of the study.
- Although learning the whole literature is extremely challenging, reviewing current studies, particularly those published in recent years, will help you gain a better knowledge of the topic.
- Finally, besides traditional scanning methods, the VB Bibliometric analysis method will be very useful in determining where, when, and in what types of publications the subject of the study is most commonly covered. The results of the analysis will allow for in-depth inferences about the subject. It is suggested that researchers focus on these topics.

The general purpose of this product is to compile and analyze the research on RS and RS types and to present the current knowledge and content of this subject. Based on the findings of the VB Bibliometric analysis conducted in this study, it is evident that RS and its various types have been gaining significant attention in recent years. Researchers venturing into the realm of review articles on this subject are advised to delve deep into the current literature, particularly recent publications, to grasp the latest advancements and trends in RS research. By employing advanced analysis tools like Vosviewer and the VB Bibliometric method, comprehensive insights into the coverage and prominence of the topic in academic publications can be acquired, paving the way for more informed and impactful scholarly contributions on this subject.

Evaluating the strengths and weaknesses of this study is important to better understand the scope and findings of the study. The study compiles and presents the current knowledge in this field by conducting a comprehensive literature review on RS (Recommender Systems) and RS types. In the study, comprehensive and detailed analyses were conducted among the publications in the literature using the Vosviewer program and the VB Bibliometric analysis method. Despite the wide scope of the literature review, there is always a risk that some important studies may be overlooked. The results of the study are based on the existing literature and it is possible that new research that emerged after the publication date was not taken into account.

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