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Bibliometric Survey on Biometric Iris Liveness Detection

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Abstract

Authentication is an essential step for giving access to resources to authorized individuals and prevent leakage of confidential information. The traditional authentication systems like a pin, card, a password could not differentiate among the authorized users and fakers who have an illegal access to the system. Traditional authentication technique never alerts about the unwanted access to the system. The device that allows the automatic identification of an individual is known as a biometric system. It is not required to remember a password, card, and pin code in the Bio-metric system. Numerous biometric characteristics like the fingerprint, iris, palm print, face is used for authentication and recognition. As compared to fingerprint and face the Iris based authentication provides stronger contactless identification of the user. Due to the contactless approach, it helps to prevent the spread of viruses and diseases like COVID 19. But the system faces issues related to spoofing attacks using contact lenses, replayed video, print attacks, etc., which make it unsafe to use for high-security applications. Thus, is there is an urge need to develop robust Iris Biometric system, which can discriminate between real and spoof Iris images. In this paper the bibliometric study of Biometric Iris Liveness detection performed by using the Scopus database. From this study it is observed that the majority of articles on Biometric Iris Liveness Detection were published from India, followed by the USA. The paper concludes that the area of study is recent and further research is required in the field of Biometric Iris Liveness Detection

Keywords: Biometric, Liveness Detection, Iris Recognition, Bibliometric survey, Bibliometric analysis, Authentication

1. Introduction:

Authentication is an important step for giving access to resources to authorized individuals. The conventional authentication systems like a pin, card, a password cannot distinguish between real users and imposters who have unethically got access to the system.(Khade & Thepade, 2018, 2019) The device that allows the automatic identification of an individual is known as a biometric system. The biometric authentication system is easy to used and no need to remember a password, card, and pin code. Several biometric characteristics like the fingerprint, iris, palm print, face is used for authentication and recognition

As compared to fingerprint and face the Iris based authentication provides stronger contactless identification of the user. Due to the contactless approach, it helps to prevent the spread of viruses and diseases like COVID 19. Iris has complex textures and unique features, so it is widely used in a person's identification and authentication in most of the applications (Su & Shimahara, 2019). For example, in the Aadhar card project for the identification of The Indian citizens of India, Amsterdam airport, and US Canadian border. (B. Kaur et al., 2019) Even though the iris has a unique texture pattern, there is a possibility to be spoofed by the imposter. People attack the biometric device to obtain the rights of others.

Iris identification system can be easily spoofed by using a different type of contact lenses such as transparent lenses, colored lenses, and textured lenses. By using the transparent lenses, the "imposter cannot modify the iris texture but can change the reflection property of the Iris recognition system" (Choudhary et al., 2019). With the help of textured color lenses, the real texture of an Iris can be hidden by an imposter. The system can also be quickly spoofed by replaying a video as well as a print attack (means the Iris pattern is introduced to the machine by printing an Iris image). Print attacks are performed in two modes. (J. Kaur & Jindal, 2019). First is Print and Scan in which high quality printed iris pattern is scanned and second is Print and Capture in which the snapshot is taken by the scanner.

The different types of attacks reduced the level of security of Iris liveness detection system. Therefore, in order to improve the security of systems to an appropriate degree, there is urge need to developed Iris Liveness Detection. This paper presents a bibliometric approach to analyze the number of efforts done in the past by researchers to study the Biometric Iris Liveness Detection. The purpose of this study is to evaluate the worldwide research action on Iris Liveness detection till date, which will be helpful for upcoming researcher in this domain.

Following are the high-level objectives for the Bibliometric Analysis

- To represent different types of academic publications in the area of research.
- Various languages in which the research papers are published.
- The trend of publication over a number of years.
- The Geographic analysis that covers the different countries depicting the past researches performed.
- Leading scholars who have made a significant contribution to the area of Science.
- The University or Organization-based publishing pattern
- Trend line based on the source type.
- Top ten highly cited papers.

This paper presents a Bibliometric Survey for "Biometric Iris Liveness Detection" to improve the accuracy of the Biometric System. Section 2, shows work related to Biometric Iris Liveness detection. Section 3, highlights the collection of data related to Biometric Iris Liveness Detection. Section 4, shows the data extraction from the Scopus database. Two kinds of analysis, like Network analysis, and Statistical analysis, were conducted in this section. Limitations are represented in Section 5, and the Conclusion of the paper is drawn in Section 6. References are cited in the last section of the paper.

2. Related Works:

Existing literature is classified into two types “The iris Liveness Detection techniques will be classified as Sensor-Level, Feature-Level. Sensor-level methods are known as hardware-based approaches and feature -level methods are known as software-based approaches.”

2.1 Sensor-Level Detection

“The main idea of Sensor-level methods is to integrate some equipment with the standard scanner. It collects the characteristics of a living biometric trait, like the optical properties of the eye, the pupil dynamic response to a sudden lighting event, the vein pattern of living iris. The feature is extracted from the eye itself, and not from the iris images.” This approach is relatively expensive and rigid. It requires extra hardware that results in more authentication steps. (Chen & Zhang, 2018).

2.2 Feature-Level Detection

In the software-based method, “the spoofing artifact is identified after the sample has been captured by a standard scanner”. Instead of using a real eye for the feature extraction, it works with the Images of an eye. This approach is sub-classified into many types. This research focuses on machine learning and on the deep learning approach.

2.2.1 Machine Learning-Based Detection

In Machine Learning approach (Agarwal et al., 2020a) uses fingerprint and iris identity for the liveness detection. “The standard Haralick’s statistical features based on the Gray Level Co-occurrence Matrix (GLCM) and Neighborhood Gray-Tone Difference Matrix (NGTDM) are used to generate a feature vector from the fingerprint. Texture feature from the iris is used to boost the performance of the system”. The author used a standard dataset to test if the performance of this model is better than the existing model. In the existing system, GLCM has a huge feature vector size. (B. Kaur et al., 2019) A

“rotation-invariant feature-set comprising of Zernike moments and Polar harmonic transforms that extract local intensity variations for the detection of iris spoofing attacks is introduced”. The spoofing attacks on various sensors also have a huge effect on the overall efficiency of the system. The system can detect only print and contact lenses attack.

(Agarwal et al., 2020b) used “feature descriptor, i.e., Local Binary Hexagonal Extrema Pattern for the fake iris detection. The proposed descriptor exploits the relationship between the center pixel and its Hexa neighbor. The hexagonal shape using the six-neighbor approach is preferable to the rectangular structure due to its higher symmetry”. The limitation of this approach is, it covers only print and contact lenses attack and complexity is very high. (Thavalengal et al., 2016) developed a system using a smartphone that “captures RGB and NIR Images of eye and iris”. Pupil localization techniques with distance metrics are used for the detection. For feature vector generation 4096 elements are considered, which are large in size. The author claims a good liveness detection rate, but he worked on a real-time database and no standard datasets are used.

(Fathy & Ali, 2018) have not considered the segmentation and normalization phases typically used in the fake Iris detection systems. Wavelet Packets (WPs) are used to break down the original image into a wavelet. The author claims 100% Accuracy but it does not work with all types of attacks and it covered only limited spoofed attacks. In this paper (Hu et al., 2016)iris Liveness Detection is performed using the regional features. “Regional features are designed based on the relationship of the features in the neighboring regions.” During the experiment, the author has used 144 relational measure base regional features. The author(Czajka, 2015) designed the Liveness Detection System using the pupil dynamics. In this system, pupil reaction is measured with the help of the sudden changes in light intensity. If the eye reacts to light intensity changes then the eye is live otherwise it is spoofed. In this work “Linear and Non-Linear Support Vector Machine is used to classify the natural reaction and spontaneous oscillations”. The limitation of the system is measuring the diverse functions which take time. The data used in this analysis does not include any measurements from older people, so there is inaccuracy in the observation. From the existing literature, it is observed that the researcher have worked on a few Iris attack s and large feature vector size is considered.

2.2.2. Deep Learning-Based Detection

(Naqvi et al., 2020) developed a system to detect “Accurate Ocular Regions such as iris and sclera”. This system is based on Convolutional Neural Network (CNN) model with a lite-residual encoder-decoder network. “Average segmentation error is used to evaluate the segmentation results”. The publicly available databases are considered for the evaluation of the system (Kimura et al., 2020) designed a Liveness Detection System using “CNN which improves the accuracy of the model by tuning hyperparameter.” For measuring performances of the system “Attack Presentation Classification Error Rate (APCER) and Bonafide Presentation Classification Error Rate (BPCER) performances measured, are used. The hyperparameters considered in this paper are the Number of epochs (max), Batch size, Learning rate, and Weight decay hyperparameters”. This system works only for print and contact lenses attack. (Lin & Su, 2019) developed Face Anti- Spoofing and Liveness Detection system using CNN. The image is resized to 256 * 256 and RGB and HSV color spaces are used. The author claims better Iris liveness predictions.

(Long & Zeng, 2019) identified Iris liveness detection with the help of the “BNCNN architecture with eighteen layers. The batch normalization technique is used in BNCNN to avoid the problem of overfitting and gradient disappearing during training.” (Pala & Bhanu, 2017) detected iris liveness with the help of a Convolutional Neural Network. In this work, Performance is measured using Average Classification Error (ACE). Author claims 0 .0% ACE. This system is able to capture only photo and contact lens Attacks, other attacks are not captured. Different types of sensors are not taken into consideration for the acquisition of images (Yan et al., 2018) developed a “Hierarchical Multi-class Iris Classification system for liveness detection”. In this system, different parts of iris images are used to create various types of synthetic iris. Two models are used to identify “print iris image” and “iris image with contact lenses”. “HMC (Hierarchical Multi-class Iris Classification)” handles liveness detection of the hybrid pattern. GoogleNet is used for fine-tuning of the parameters and consider an image size of 224*224. The author claims a 100% accuracy rate. The work is focused on only the print and contact lenses attack. (Silva et al., 2015) designed the system for Iris contact lenses

detection, which used CNN with Softmax Regression function for classification." While working on CLDnet, the normalization operation is not considered". The result achieved by smaller input sizes is better than the larger input size. The author achieved a "30% performance gain over a State-Of-The-art Approach (SOTA)". Pre-processing of images and segmentation of the iris are not considered. It focuses only on the contact lenses Iris biometric attack. (Poster et al., 2017) developed a system for contact lens Detection using handcrafted "image features and neural network architectures". The system used "six features BSIF, LBP, CoA- LBP, HoG, DAISY, and SID) and CNN (the 8-layer VGG-based network)". The system offers better performances than SOTA. It works only for the texture contact lens detection and not with other iris biometric spoofing attacks.

(Gragnaniello et al., 2017) captured spoofing in biometric with the help of CNN. In this work, they have considered "face and iris liveness detection datasets". The regularizing techniques have been used to obtain a good performance. In this system, "Local Descriptors and Bag-of-Words" are used. Performances evaluated using "accuracy and Half Total Error Rate (HTER)" (He et al., 2016) "detect iris liveness using Multi-patch Convolution Neural Network (MCNN). The system learns the mapping feature explicitly between raw pixels of iris patches and the labels without any handcrafted features". Iris localization, segmentation, and normalization are performed on Iris images then it is "decomposed into 28 multi-block iris patches using a sliding window. These iris patches are used as the input of CNN" which classify fake and live iris. The system works with only "contact lens pattern, synthesis iris pattern, and print iris pattern"

3. Preliminary Data Collection.

There are many popular methods available to access the research papers and articles. The popular publication resources such as Research Gate, SCI Imago, DBLP, Google Scholar, Mendeley, Scopus, Clarivate, ScienceDirect are available to access the research data. The Scopus is a huge, prominent and most reputed dataset. Therefore, the Scopus database has been chosen for the Bibliometric analysis.(Kadam et al., 2020)

3.1 Search Procedure

Various keywords are used to search the articles in the Scopus database. The keywords used are split into two types: Master and Secondary keywords. The Master and Secondary types of keywords related to Iris Liveness Detection used, are given in Table 1. The Master keyword “Biometric " which is the common keyword, gives 49,689 (Access on 16th Oct 2020) of Scopus documents. (Philosophy & Dike, 2020)

Table 1: Selection of search keywords for Biometric Iris Liveness Detection

Primary keyword	" Biometric ".
Secondary keyword using (AND)	"Iris Liveness ".
Secondary keywords using (AND)	"Detection".

In this study, research is limited to the years starting from 2010 to 2020. The exact query fired for the search for the documents in the Scopus dataset is:

```
TITLE-ABS-KEY ( biometric  AND iris  AND liveness  AND detection )  AND
( EXCLUDE ( PUBYEAR ,  2009 )  OR  EXCLUDE ( PUBYEAR ,  2008 )  OR
EXCLUDE ( PUBYEAR ,  2007 )  OR  EXCLUDE ( PUBYEAR ,  2006 )  OR
EXCLUDE ( PUBYEAR ,  2004 )  OR  EXCLUDE ( PUBYEAR ,  2003 ) )
```

3.2 Preliminary Search Results

The query, which is indicated in Section 3.1, with the relevant search keywords used as a search strategy, found 82 publications on the Scopus Database. Table 2. shows different types of publications in Iris Liveness Detection research. 58.54% of the researchers have publicized their work in conference paper, followed by Articles, which contributes 29.27%. Conference review, book chapter, and review have very low contribution.

Table 2: Type of Publications in Iris Liveness Detection

Type of Publications	**Number of Publications**	**Percentage**
Conference Paper	48	58.54 %
Article	24	29.27%
Conference Review	2	2.44%
Book Chapter	4	4.88%
Review	2	2.44%
	Total	100%

Dataset access information source: http://www.scopus.com (accessed on October 16, 2020)

The result from the search also analyzed for the type of language used for publishing the documents. Table 3, summarizes the contribution based on the language of published documents for Biometric Iris Liveness Detection. In Table 3 it is observed that, English is the prominent language used by the researchers to publicize their papers and articles. Very few papers are written in the Chinese language.

Table 3: Languages trends used for publishing in Software Defect Prediction

Sr.No.	**Language used for Publishing**	**Count of Publications**
1	English	79
2	Chinese	3
Total		**82**

Data access information source: http://www.scopus.com (accessed on October 16, 2020)

3.3 Exploratory Data Highlights

Documents are collected on Biometric Iris Liveness Detection keywords starting from the year 2010 to 2020. Table 4, indicates the trend of the yearly publication count on Iris Liveness Detection. The interpretation of this data indicates that most of the research contribution

happened in the year 2019. In Table 4, it is observed that the contribution to the research was insignificant during the years 2010 to 2013.

Table 4: Yearly publishing trends in Iris Liveness Detection

Year	Publication Count
2020	7
2019	14
2018	10
2017	08
2016	11
2015	07
2014	12
2013	2
2012	5
2011	3
2010	3

Data access information source: http://www.scopus.com (accessed on October 16, 2020)

Figure 1, shows the result in the Radar chart for the publication count per year for Table 4. The chart represents the prominent year 2019, having the highest publication count of the total of 14 publicized documents in the area of Iris Liveness detection.

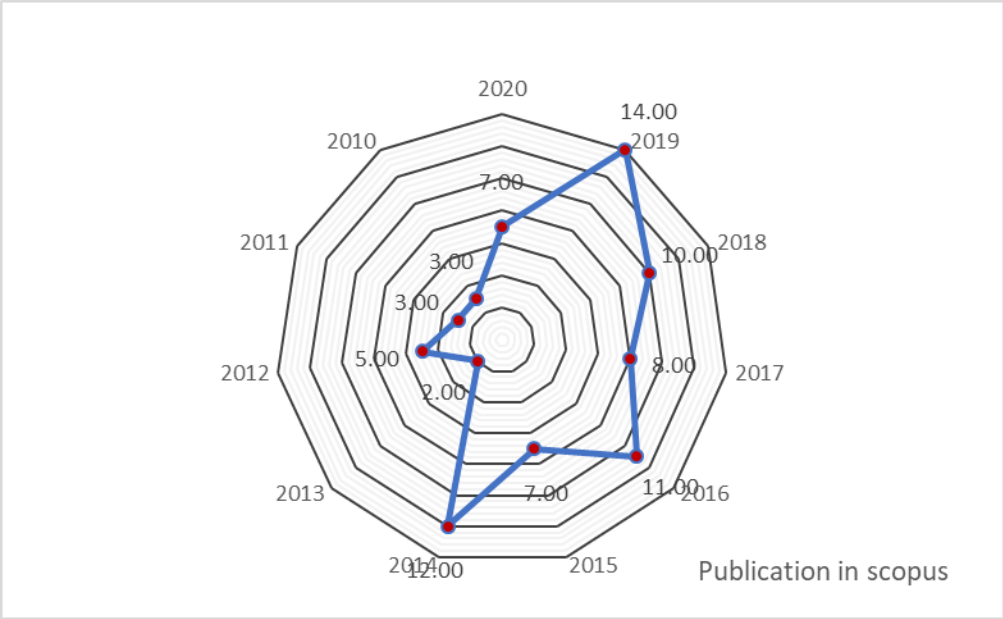

Figure 1: Yearly publishing trend in Iris Liveness Detection Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4. Bibliometric Survey

This section contains the detailed Bibliometric analysis to understand the literature in their diversity and to know more about the research and the researchers using the relevant keywords for Iris Liveness Detection. Different charts and graphs are created to showcase the depth and breadth of the research geographically and country-wise. It is also based on the affiliations to the organizations and the institutions

Two different methods are used to conduct the Bibliometric Survey for Iris Liveness Detection

- Network analysis of Research is majorly based on Geography, Publication Title, Keywords, Source Title, Year of publication and collaboration among the research authors, citation count, etc.
- The Statistical analysis is majorly based on the contribution of the country to the research area, contribution by the subject area, author's affiliations, source type, authors, and source titles.

4.1 Analysis Based on Geographic Locations

The analysis for the geographic location is carried out using the Microsoft Excel Map, which needs input as two columns like the country name and the research paper count for that country. Once this data is provided, it generates the geographical map based on the data, which shows the number of papers on the specific geo-location. According to the geographical map, India has published maximum papers.

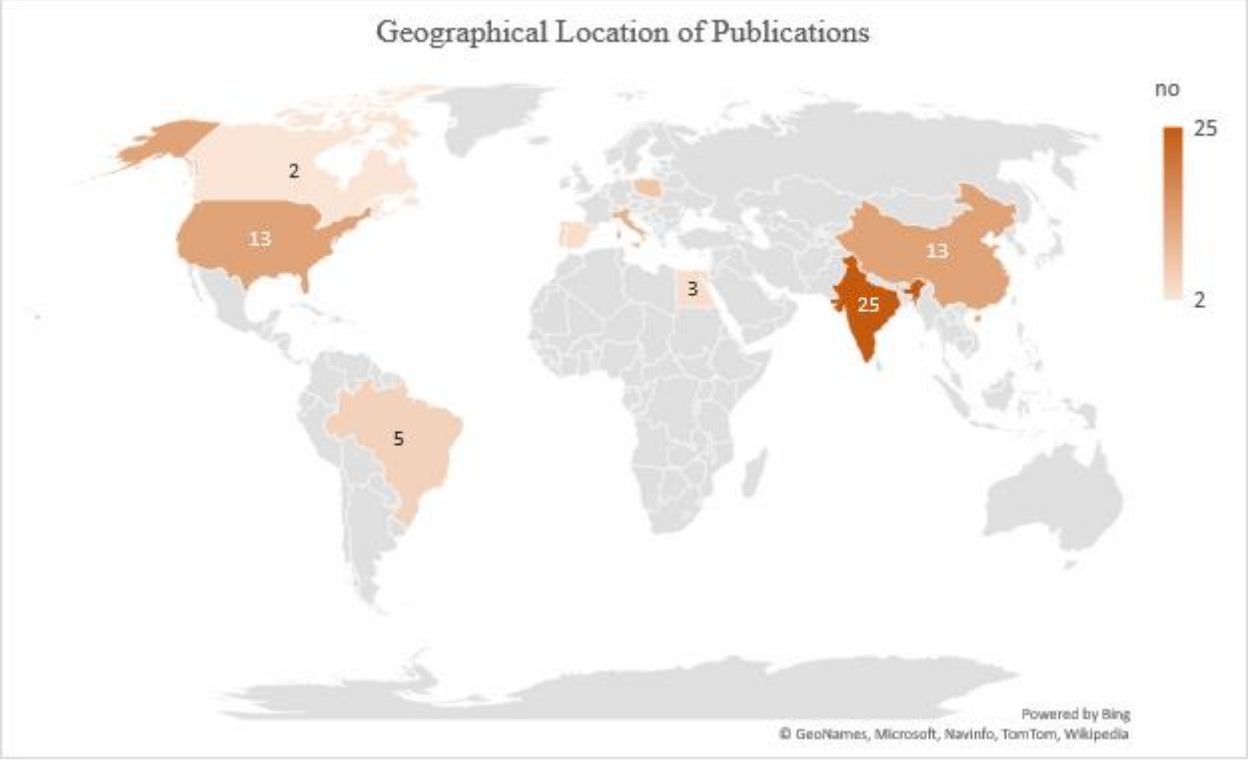

Figure 2. The geographical location of Iris Liveness Detection Data access information source: http://www.scopus.com (accessed on October 16, 2020)

Figure 3 shows the Top 10 contributing countries in the research of Iris Liveness detection. The result is shown using the Funnel chart, indicating that India contributes 20.5%. The second contributors are China and the USA with 10.66 % contribution in the research of Iris Liveness Detection. It is observed form the graph that Canada has the lowest Contribution, while considering the top 10 contributing countries.

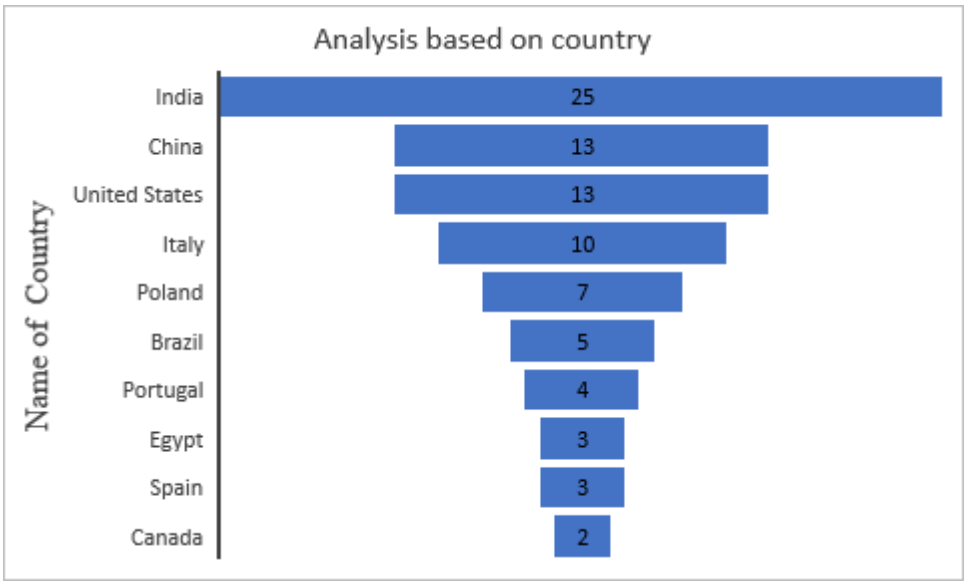

Figure 3: Ten topmost countries publishing papers on Iris Liveness Detection source: http://www.scopus.com (accessed on October 16, 2020)

4.2 Statistical Analysis Based on Keywords

Table 5, indicates the top ten keywords for searching the Scopus database for Iris Liveness detection. By applying the right combinations of the keyword, one can select and filter the papers for the specific research area. Table 5, shows that Biometric is the most widely used keyword.

Table 5: Top ten keywords for Iris Liveness Detection

Keywords	**Number of Publications**
Biometrics	69
Liveness Detection	59
Iris Recognition	20
Authentication	16

Feature Extraction	15
Iris Recognition Systems	15
Iris	11
Iris Liveness Detection	10
Biometric Systems	9
Textures	9

Data access information source: http://www.scopus.com (accessed on October 16, 2020)

Figure 4, shows Word Cloud visual representation of text data, generated for Biometric Iris Liveness Detection keywords. It indicates keywords metadata.

Figure 4. Word cloud of Keywords used in of Iris Liveness Detection Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.3. Network Analysis

Network analysis shows the association among the different attributes that add values in the computation. Network analysis shows the graphical diagram. The paper used VOSviewer for generating the various network analysis diagrams. Figures 5 and 6, show the network analysis diagrams having various computable parameters for Biometric Iris Liveness Detection.

VOSviewer is a free tool that can be downloaded from the VOSviewer [28] website. VOSviewer can analyze the computable parameters using a Bibliometric network. The input needs to be a comma-separated value file, also known as .csv file, to the VOSviewer. There are three kinds of visualization analysis using VOSviewer, such as Network visualization, Overlay Visualization, and Density visualization.

Visualization between the keywords and the source titles is shown in Figure-5, extracted from the Scopus database. The circles in the figure represent the keywords that are extracted from the title of the source. The size of the circle indicates the keyword occurrence. The links between the circle, shows the association among the keywords, less distance means the strong association, and more distance means the weak association. The closely related keywords are represented with the same colors. There are different colors to represent the different clusters. The labels represent the actual keyword, size of the circle, and the label depends on the weight of the keywords. The bigger label size represents the keywords with higher weight. The lines represent the links between the words.

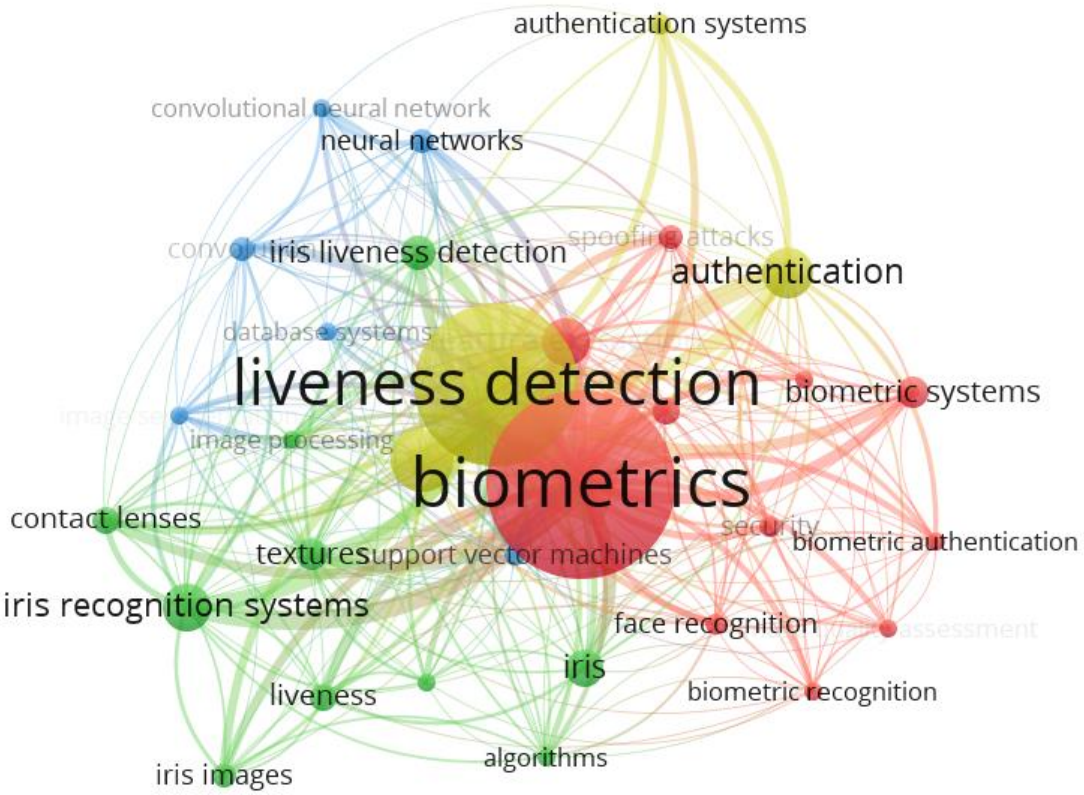

Figure 5: Network visualization diagram based on keywords and source title, keywords from Scopus dataset (accessed on October 16, 2020) (Image Source: https://www.vosviewer.com)

Figure 6, shows the visualization as well as the citations received by the documents. The analysis is conducted taking a minimum of two citations per document. The 51 number of documents were selected with this threshold value 2 and the calculation of the citation link was done accordingly.

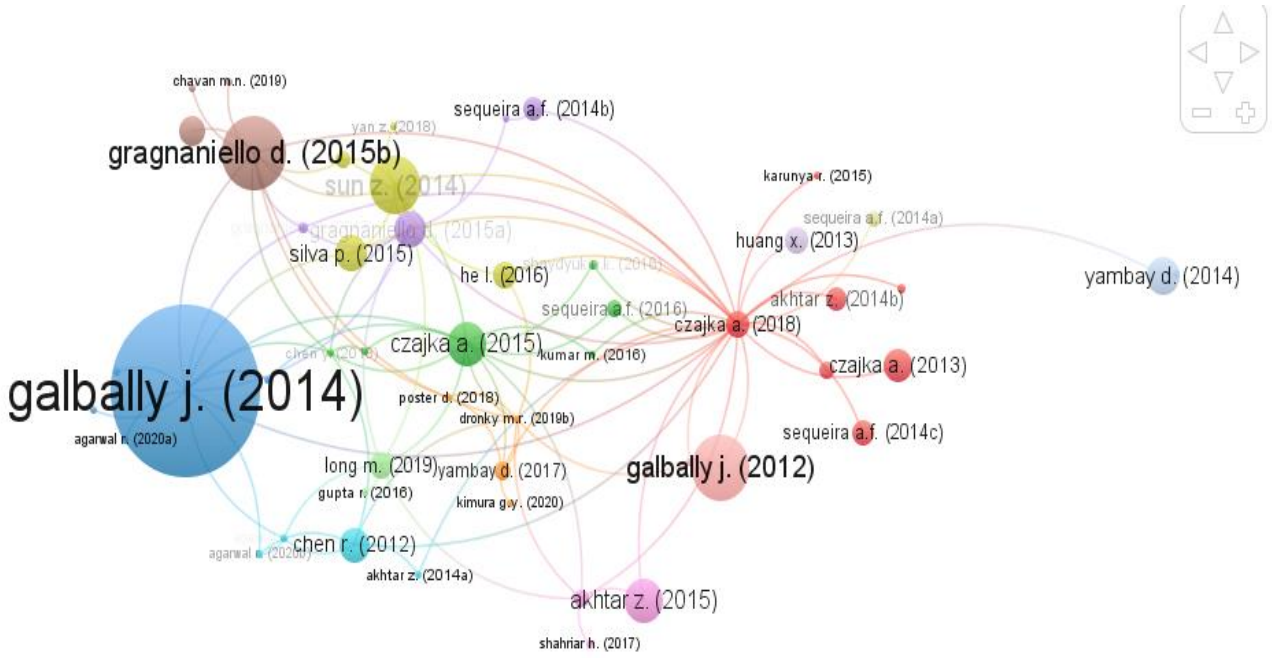

Figure 6: Network visualization of the document and the citations received by document using Scopus dataset (accessed on October 16, 2020) (Image Source: https://www.vosviewer.com)

4.4 Statistical analysis based on Affiliations

Figure 7, shows the contribution based on the universities and organizational affiliations. It shows the top ten universities which contributed to the field of Biometric Iris Liveness Detection. The 'Politechnika Warszawska' from Poland shows the maximum contribution towards the research in the field of Iris Liveness Detection, followed by the 'Chinese Academy of Sciences' from China.

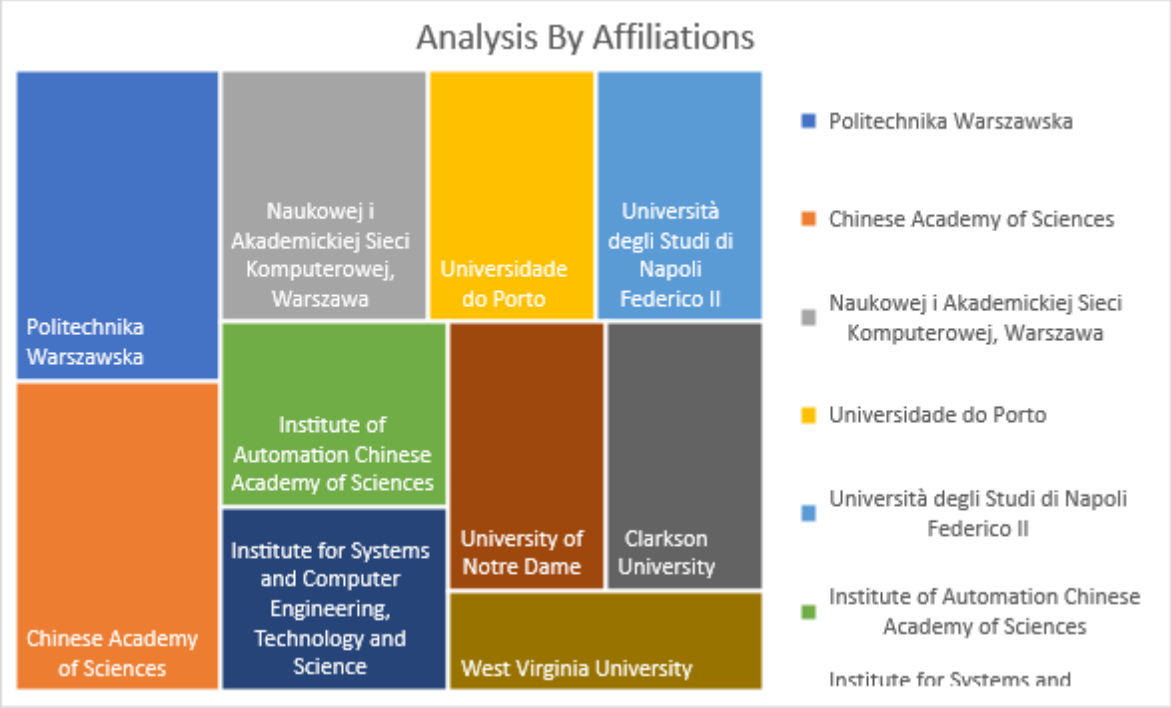

Figure 7: Affiliation statistics for Iris Liveness Detection
Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.5 Statistical Analysis Based on Subject Areas

Figure 8, shows the distribution of the publications in various disciplines extracted for Iris Liveness Detection publications. It can be easily concluded that most of the research is conducted in the Computer Science area, followed by Engineering and Mathematics. It is also observed that a smaller number of documents is published in the area of Energy.

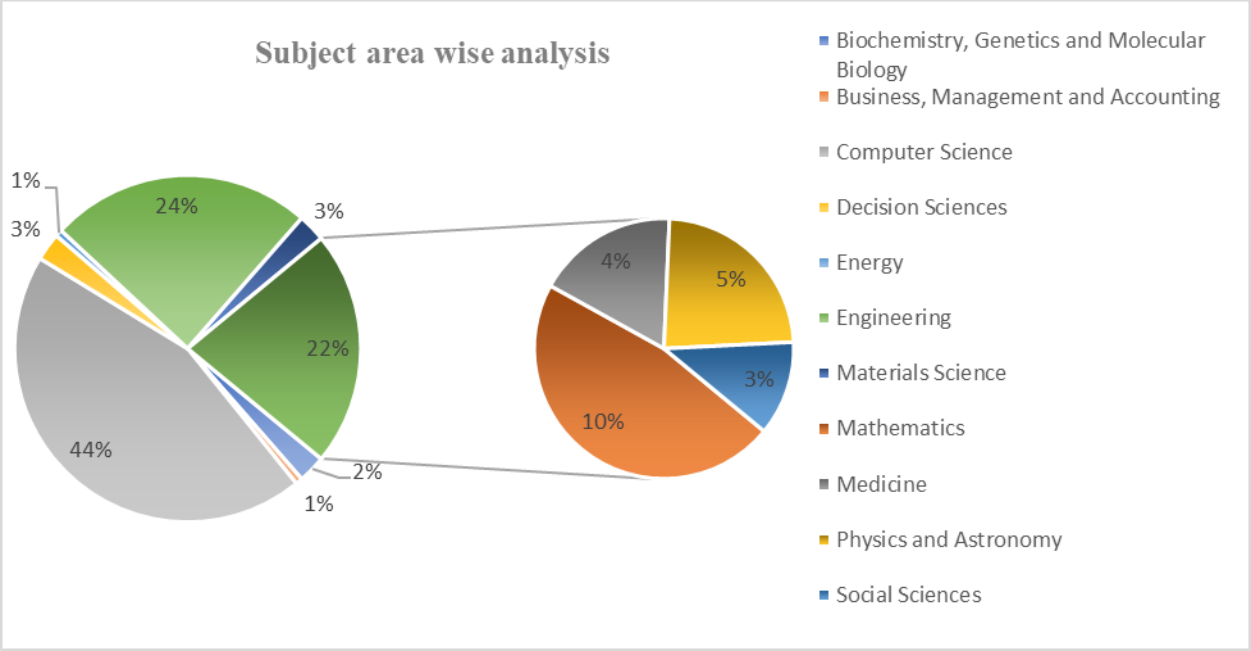

Figure 8: Subject area wise analysis of extracted literature for Iris Liveness Detection.
Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.6 Statistical Analysis Based on Authors

Figure 9, shows the first Ten authors, who contributed to the area of Iris liveness detection. The author Czajka Adam from the Notre Dame University, United States, published Seven papers followed by the author Sun Z. from the University of Chinese Academy of Sciences, Beijing, China. He published five papers.

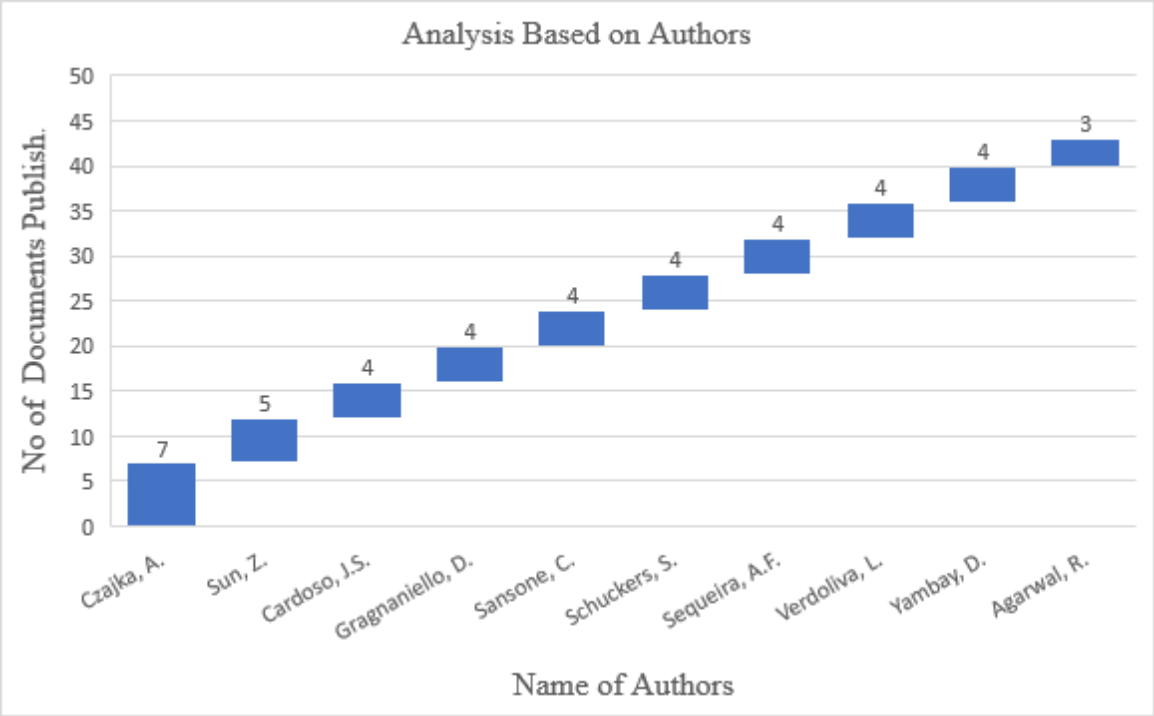

Figure 9: Top ten authors contributing to the research area of Iris Liveness Detection
Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.7 Statistical Analysis Based on Source Types

Figure 10, shows the source types of documents published in the area of Iris Liveness detection. Source types of scholarly articles mean the source of the publishing of the original research work. From the Scopus extracted literature of Iris Liveness Detection, it can be clearly stated that 58.5% of the publications are from The Conference proceedings followed by 29.3% publications in Articles. It has been observed that review publications are quite low for the Iris Liveness Detection

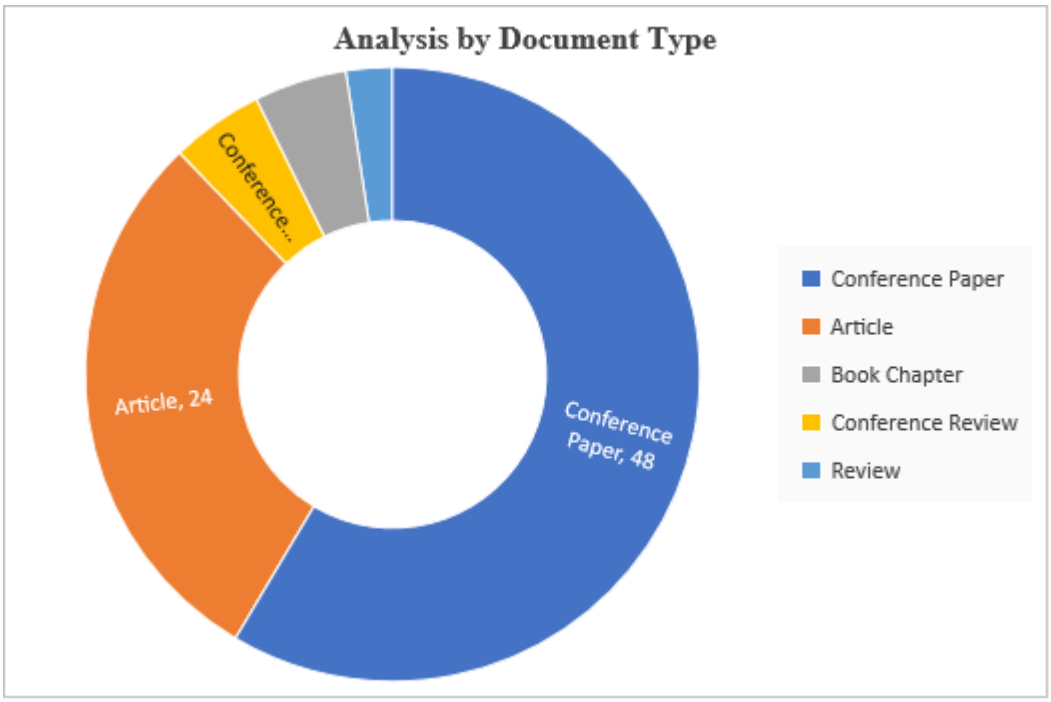

Figure 10: Source types for publications in Iris Liveness Detection (Source: http://www.scopus.com (accessed on October 16, 2020)

4.8 Statistical analysis based on source titles

Statistics based on the top ten source titles are represented in Figure 11, for the publications in Iris Liveness Detection. It is observed that the maximum numbers of publications are done in the source title which is from " IEEE Transactions on Information Forensics and Security “, “IJCB 2014 2014 IEEE IAPR International Joint Conference on Biometrics” and “Pattern Recognition Letters”.

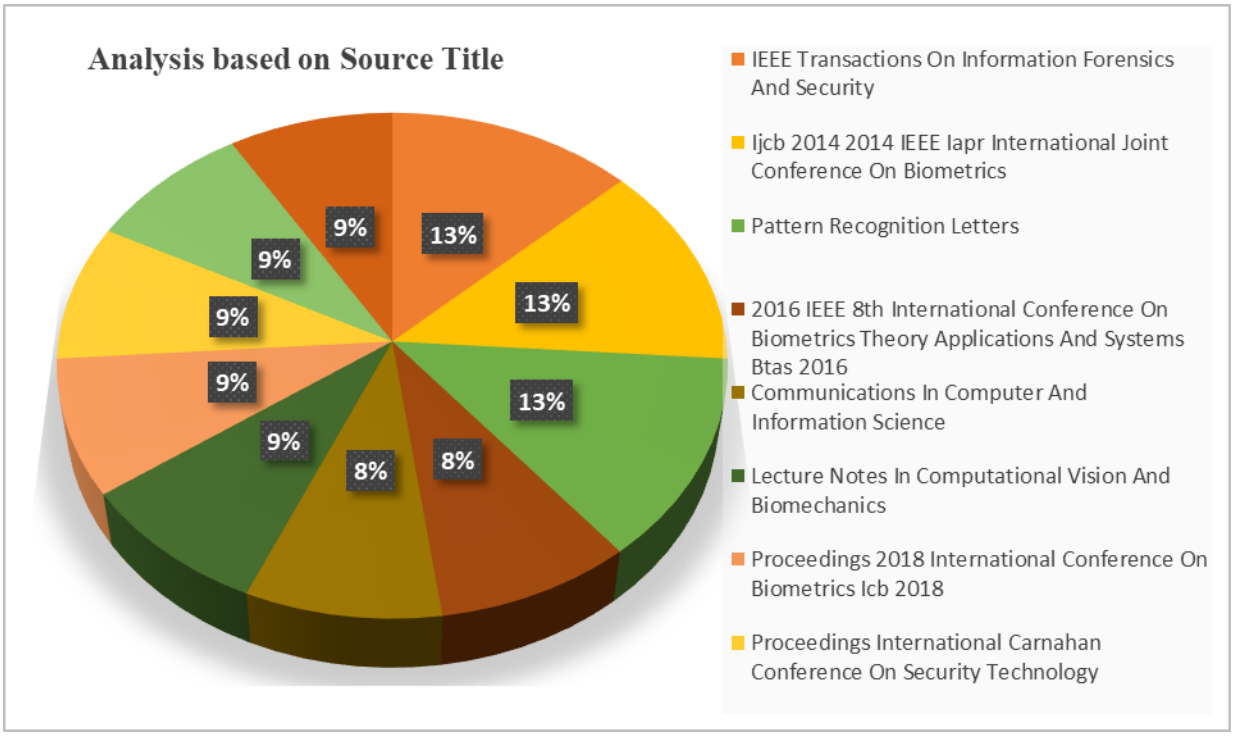

Figure 11: Source statistics for publications in Iris Liveness Detection Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.9 Analysis based on Funding Sponsors

The statistical analysis based on Funding sponsors in the Iris Liveness Detection research area is shown in Figure 12. The top 10 funding sponsors are considered, based on the statistics. It can be inferred that the “National Natural Science Foundation of China” and “The National Science Foundation” are the highest funding Foundation.

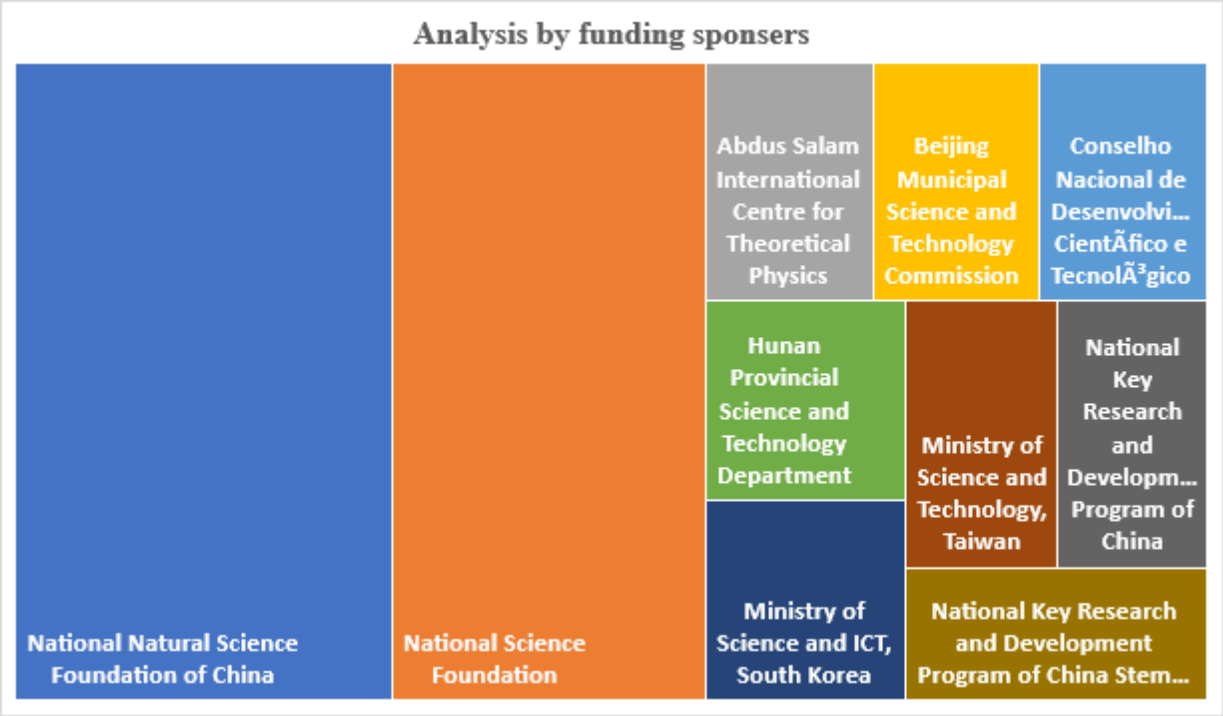

Figure 12: Funding Sponsors statistics in Iris Liveness Detection Research Area Data access information source: http://www.scopus.com (accessed on October 16, 2020)

4.10 Analysis based on publication citations

The list of the first twenty papers along with the citations received till the date for this research is shown in Table 6. It shows year-wise citations for the documents published, related to Biometric Iris Liveness Detection. The total citations are 1443 for 82 documents to date. In 2019, the research papers related to this area got 371 citations. It is observed from Table 6, that the citation counts are low up to 2017. The maximum number of citations is observed in year 2018 and 2019.

It can be inferred that the research work with the title "**Image quality assessment for fake biometric detection: Application to Iris, fingerprint, and face recognition** "got the maximum number of citations in this field of Iris Liveness Detection.

Table 6: An analysis of top Twenty publication based on citations in Iris Liveness detection

	<2016	2016	2017	2018	2019	2020	subtotal	>2020	total
Document Title	188	153	173	305	371	243	1245	10	1443
"Image quality assessment for fake biometric detection: Application to Iris, fingerprint, and face recognition"	34	32	50	63	74	55	274	1	309
"Brain waves for automatic biometric-based user recognition"	14	15	22	20	33	15	105	1	120
"An Investigation of Local Descriptors for Biometric Spoofing Detection"	3	15	15	32	19	15	96	0	99
"Iris liveness detection based on quality related features"	32	12	6	14	16	5	53	0	85
"Iris image classification based on hierarchical visual codebook"	14	6	9	17	19	7	58	0	72
"Biometric Liveness Detection: Challenges and Research Opportunities"	2	4	9	12	9	14	48	1	51
"Pupil dynamics for iris liveness detection"	1	9	9	9	16	5	48	0	49
"LivDet-iris 2013 - Iris Liveness Detection Competition 2013"	7	4	5	11	9	3	32	1	40
"An Approach to Iris Contact Lens Detection Based on Deep Image Representations"	0	2	3	16	9	9	39	0	39
"Iris liveness detection for mobile devices based on local descriptors"	2	6	5	14	5	6	36	0	38
"Liveness detection for iris recognition using multispectral images"	9	8	4	5	7	3	27	0	36
"Database of iris printouts and its application: Development of liveness detection method for iris recognition"	11	5	5	5	8	1	24	0	35

“LivDet iris 2017 - Iris liveness detection competition 2017”	0	0	0	11	8	9	28	1	29
“Signal validation for cardiac biometrics”	13	3	5	3	3	1	15	0	28
“Detecting iris liveness with batch normalized convolutional neural network”	0	0	0	0	5	21	26	0	26
“Multi-patch convolution neural network for iris liveness detection”	0	0	1	8	13	4	26	0	26
“Presentation attack detection for iris recognition: An assessment of the state-of-the-art”	0	0	0	1	12	11	24	1	25
“An experimental study of pupil constriction for liveness detection”	8	3	2	3	8	1	17	0	25
“MobILive 2014 - Mobile Iris Liveness Detection Competition”	4	4	3	5	5	2	19	0	23
“Iris liveness detection methods in mobile applications”	6	6	1	4	4	1	16	0	22

source: http://www.scopus.com (accessed on October 16, 2020)

5. Limitations of The Present Study

In the current study, only the Scopus database is considered for selecting the literature. In contrast, more database could be taken into consideration, like Google Scholar and Web of Science. The listing of the existing research changes dynamically as per the arrangement of the keywords. The current research took care of the defined order of the keywords by the research authors. Hence, it could also be tried with various combinations and add or exclude a few synonyms representing a similar meaning as per the research subject. This research paper has considered the publications with a limited set of years that is the decade (2010-2020), which surely excludes the research conducted before 2010. Hence this has the scope for the further exploration.

6. Conclusion

From the bibliometric study it is observed that many researchers are working in area of Biometric Iris Liveness Detection. It is identified from analysis that Biometric Iris Liveness Detection is one of the challenging topics of research among the research community, especially in China and India. This analysis is based on the information retrieved from 82 documents published between in the span of the year 2010-October 2020 which uses the Scopus database. The Scopus database is used for this analysis. To retrieve the documents related to this topic, the keywords “Biometric” and “Iris Liveness Detection” were used. The present analysis reveals that the previous research is primarily in the field of Computer science, with the highest number of the publications in the Pattern Recognition Letter journal. The Chinese Funding Agency provides maximum funds for the research in this area. India leads this publication followed by the USA. The number of publications indicates a growing pattern from 2019, Suggesting the increase in the study field in the future. However, a wide range of ideas can be executed in this area and it is the need of the time that there should be persistent development of research.

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