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Evaluation of IPRs using Modern Sentimental Analysis Methods in the Law Domain

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Intellectual Property Rights (IPRs) provide a systematic medium to safeguard people's unique ideas. Various authors from all around the globe have contributed to the IPRs in the Law domain by publishing their research articles. Although the literature on the IPRs in the Law domain is found to be several decades old, no Sentimental Analysis has been conducted on it. Identifying this significant research gap, the authors of this research paper have evaluated the IPRs using modern Sentimental Analysis methods in the Law domain. The authors have used Sentimental Analysis methods of Microsoft Azure, Valence Aware Dictionary and Sentiment Reasoner (VADER), and International Business Machines (IBM) Watson to perform this Sentimental Analysis on over six thousand research articles from the past four decades, in which authors from over fifty countries have contributed to the IPR in the Law domain. The authors used significant research paper components, including the Title, Keywords, and overall Contribution of the authors, as input for conducting this Sentimental Analysis. The overall results obtained from Sentimental Analysis methods of Microsoft Azure, VADER, and IBM Watson convey that 83.25 % positive, 13.11 % neutral, and 3.64 % negative research was conducted in the IPRs research in the Law domain. These results convey that, to date, the research in the IPRs of the law domain has been going in a positive direction, thereby providing a solution-oriented positive approach for the upcoming researchers in the IPRs of the law domain.

Keywords: Sentimental Analysis, Intellectual Property Rights, Critical Analysis, Law

Intellectual Property Rights

Intellectual Property Rights (IPRs) have ensured that people's ideas are safe.[1] With newer inventions, IPRs in the law domain have become significant and used most in the modern era.[2] Artificial Intelligence (AI) today has ensured several industries undergo a transformative revolution, ensuring its sub-domains evolve and significantly contribute to solving several problems.[3] Sentimental Analysis, a sub-domain of AI, is a Natural Language Processing (NLP) method that has been in use since the 1950s to analyze and determine the sentiment in a particular text and understand the depth of emotions hidden in them.[3] Various Sentimental Analysis tools are used today to calculate a sentiment score, using which the text can be classified into either positive, neutral, or negative.[3] Once this classification is obtained, a critical review of the text can be performed. Various machine learning and statistical tools are used to identify and find sentiment from data. Today, Sentimental Analysis is carried out in every sector, including social media, customer feedback, brand management, and many more. This Sentimental Analysis can also be applied to the research conducted in the area of IPRs in the Law domain to understand in what direction the research is being conducted. To date, various authors from all around the globe have contributed to the IPR research in the Law domain, but research in terms of performing Sentimental Analysis in the area of IPR in the Law domain is absent.

Rationale for Sentimental Analysis in IPR

IPRs in the Law domain play a major role in protecting the development of new products or technologies and promoting innovations. Authors from various countries or territories around the globe have conducted various researches in this area by providing several techniques and methodologies to study these IPRs. Both qualitative and quantitative research has been conducted in the area of IPRs since 1982, covering more than four decades of literature. However, no work exists where this research is critically reviewed through a systematic Sentimental Analysis. Without any Sentimental Analysis, the

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currently published work by all the well-known publication agencies lacks research direction. With no research direction, critical review and additional thinking dimensions cannot be provided to all future researchers. With Sentimental Analysis of the IPRs in the law domain, the existing literature can be analyzed, some patterns can be found, and important conclusions can be drawn regarding whether this research is either positive, neutral, or negative, thereby creating a pathway to do a critical review. The absence of any such study allowed the authors of this research paper to conduct a critical review by performing a systematic Sentimental Analysis of the IPRs in the law domain. This conducted research will help the upcoming researchers to provide a thinking dimension and direction and ensure more positive IPR-based research is done in the future. This provided motivation and rationale for the authors of this research paper to conduct a Sentimental Analysis of the IPRs in the Law domain.

Literature Review

This section includes a detailed review of the existing literature to understand the various contributions of authors all around the globe concerning IPRs in the law domain. The paper explores the impact of the New Education Policy (NEP) on higher education institutions, its integration with IPR, and the potential for significant systemic changes.[1] The authors of this research paper analyzed the customer reviews using Valence Aware Dictionary and sEntiment Reasoner (VADER).[2] This research includes using AI to understand Sentimental Analysis of results obtained from NLP models.[3] The International Business Machines (IBM) Watson has been used to classify small answers for educational purposes.[4] The research introduces a model for communal IPR, addressing challenges and emphasizing normative construction for its establishment.[5] The paper examines the extent of legal protection afforded to software and creative works in various global legal frameworks.[6]

The author delves into the impact of existing legislation on the lack of information concerning patenting practices within the realm of biological drugs in the US.[7] This study explores how human capital and IPR protection influence the location decisions of foreign direct investment.[8] The authors of this paper created a quasi-natural experiment utilizing China's IPR pilot city policy.[9] This paper also proposes potential recommendations concerning copyright exemption clauses within Indian copyright laws while protecting IPRs.[10] The authors' suggestions aim to prevent the economic exploitation of singers and contribute to the nation's income, thereby fostering public welfare. This review paper provides a comprehensive overview of its historical evolution, current state, and anticipated future trends.[11] It is a valuable resource for researchers and practitioners exploring the expanding landscape of sentiment analysis across various databases and domains.

This article offers insight into the intricate relationship between harmonized rules of unfair competition law within the European Union (EU) and the diverse national approaches adopted by member states.[12] It delves into case law, elucidates the objectives driving protection against unfair competition and explores the intersections with IPRs. The paper discusses IPR in various dimensions of armed conflicts and its role in economic sanctions.[13] In this chapter, a detailed, evidence-based analysis explores sentiments expressed in Kindle book reviews by applying deep learning techniques.[14] The authors have focused on the significance of patent protection concerning IPRs.[15] The article's findings highlight the importance of aligning institutional policies to foster technological innovation with national priorities and being adaptable to societal advancements.

This study aims to gain insight into the Indian standpoint regarding foreign IPR issues.[16] The researchers have contributed to the IPR research and surveyed the contributions published in the third decade of the 21st century.[17] The authors contend that the legal system might be better prepared for AI agents than commonly perceived.[18] The authors also strive to prohibit the advancement of potent AI technology, integrating AI within legal frameworks through AI governance. This paper examines the understanding of confusion and its implications for legal proceedings, evaluating its alignment with international standards and the case law of Member States of the African Intellectual Property Organization.[19] This study investigates critical aspects of Vietnam's legislation concerning the digital economy, mainly focusing on copyright and patent regulations in the context of digital transformation.[20] It examines how foreign and national regulations intersect regarding protecting IPR and promoting digital advancement.

The article assesses the significance of criminal law in light of international commitments and domestic

legal structures, offering an in-depth examination of the relevant criminal law provisions in Balkan countries.[21] This paper explores the distinctions and parallels within the IPR laws across multiple countries.[22] This article will examine the potential influence of AI on IPR.[23] Given the rapid progress of AI, existing IP regulations require significant revision. Currently, minimal or no legal frameworks address AI within IPRs. The authors have discussed the IPR in the context of NEPs.[24] This article highlights the importance of IPR in enhancing awareness of IPRs, empowering them to protect their innovations and business strategies effectively.[25] The authors have proposed protecting the IPRs during one of the major events in Barcelona.[26]

The authors discussed IPR concerning biodiversity in terms of conflicts or synergy.[27] The authors have discussed IPR in terms of cost in the EU.[28] The argument presented here underscores the significance of enforcement costs associated with IPRs, emphasizing the need for a more analytical framework. The primary aim of this study is to investigate the opportunities and challenges arising from the emergence of the meta-verse for IPRs.[29] It seeks to examine the IPR issues about the meta-verse within the specific context of India. The IPR study was conducted in developing countries, and the findings of this article indicate that developing countries are internally motivated to enhance the strength of their IPR levels.[30] The authors have emphasized managing trust and power dynamics among community members within a global innovation hub.[31]

This research explores the intersection of IPRs, public policy, and the impact of plain packaging on healthcare in India, considering its status as a developing country.[32] The IPRs of the country Peru, along with various pitfalls and shortcomings, have been addressed in this paper.[33] This paper explores how software product firms utilize IPR as an innovation strategy and its impact on performance.[34] In this paper, the researchers have hypothesized that IPR positively affects technological innovation solely in nations with substantial human capital.[35] The study investigates the interplay between IPRs, human capital, and technological innovation within emerging and developing countries. This article examines the challenges related to locus standi for initiating private prosecutions in intellectual property cases and proposes measures to reduce the potential abuse of this right.[36]

This article thoroughly evaluates recent advancements in the judicial enforcement of IPRs in China.[37] The researchers have studied the Azure platform in detail.[38] This article investigates the necessary alterations in intellectual property laws to foster accessible, affordable, and adaptable technology transfers.[39] These changes aim to aid host countries in preparing for potentially obligatory emission reductions. The author has discussed the domains of IPR and bio-economy to consider intersecting and different points.[40] This study underscores the importance of integrating biodiversity monitoring into India's pre-access and benefit-sharing mechanism.[41] The authors have studied Korea's patent system and propose that the primary focus in revitalizing the patent trust system should be acquiring high-quality patents that meet the needs of consumer corporations.[42] This article examines the correlation between IPRs and investment agreements across multiple dimensions to promote novelty.[43]

The authors contextualize the literature on IPR within the broader framework of institutional studies to understand how economic performance and historical political factors influence the development of IPR.[44] This paper analyses patenting activity to identify recent innovations in crop farming within India.[45] The findings reveal that the majority of granted patents are concentrated in the field of plant growth. The researchers have studied the significance of enforcement directives in the European IPRs, considering various parameters related to patents.[46] This research employs the cobweb theory as a time series model, utilizing binding power and legal effectiveness as the axes, to investigate how business managers navigate the fluctuations of overproduction or shortages within legal and economic rationality.[47]

The authors have interrelated IPRs with competitions.[48] Therefore, this economic inquiry provides empirical evidence supporting the theoretical notion of the synergy between IPRs and competition in the context of Foreign Direct Investment and assesses the extent of their synergy. The US plants are the primary focus of this research paper in the domain of IPR.[49] The paper examines the historical progression and comparative analysis of trade secret laws while also critically evaluating the potential influence of innovation legislation on trade secret protection within the framework of India's national innovation policies and regulations.[50] The author has discussed patent challenges and issues.[51] The paper

concludes with recommendations to balance the necessity to incentivize innovation in emerging technologies with the importance of safeguarding the public interest and ensuring unhindered access to patented knowledge.

This paper investigates how copyright hinders accessing and utilizing electronic resources within Africa's educational and research settings.[52] The authors have contributed to society by ensuring the significance of IPRs in various domains, especially education and provided future directions with respect to the same. The researchers have discussed the absence of extensive experience in cross-sectoral partnerships for research and development within the country hampers its progress and development under the IPR regime.[53] This necessitates the implementation of appropriate remedial measures. Additionally, the paper addresses concerns regarding equity and biosafety. The article explores the differentiation between IPRs and contractual matters associated with IPRs.[54] Additionally, key elements with respect to IPR are discussed by the authors and important conclusions with respect to the future of IPRs are discussed in detail. Some future directions are also provided to guide upcoming researchers.

From the above conducted literature, it can be inferred that authors from various countries or territories have contributed in the area of IPRs in the Law domain, but no work is found where Sentimental Analysis is performed.

Research Gap

The detailed Literature Review conducted by the authors on the currently existing work helped the authors to frame the following research gaps:

1 The existing work lacks a thorough critical review where no research has been conducted to perform a comprehensive evaluation of the work carried out by researchers with respect to IPRs in the Law domain.

2 The existing work lacks Sentimental Analysis, as no research has been conducted to analyze the sentiments expressed in the research work carried out by researchers with respect to the IPRs in the Law domain.

3 The existing work lacks with respect to whether the research conducted is positive, negative, or neutral.

4 The existing work lacks with respect to research direction, as no specific thinking research dimensions have been provided for future researchers.

Dataset for Sentimental Analysis

This section includes the dataset used for performing the Sentimental Analysis. The dataset components such as year-wise count of research papers, documents country or territory, and the various agencies who have published the research on IPR, have been included in this section.

Year-wise Research Paper Count

The authors have considered using 6370 Scopus-indexed research articles as a dataset for performing the Sentimental Analysis. These papers are strictly restricted to the research conducted on IPRs in the Law domain, ranging from 1982 to 2024, covering 43 years of research on IPRs in the Law domain all over the globe (Fig. 1).

Document Count by Country or Territory

A total of 57 countries or territories have contributed to the research on IPRs in the Law domain all around the globe. In this, the United States dominates the research conducted, contributing approximately 21 % of the entire research of IPRs in the Law domain. The UK and China are in second and third place, contributing 11 % and 10 %, respectively. India ranks fourth in this list, contributing approximately 8 % of this research globally. Figure 2 represents the graph of documents count by country of territory.

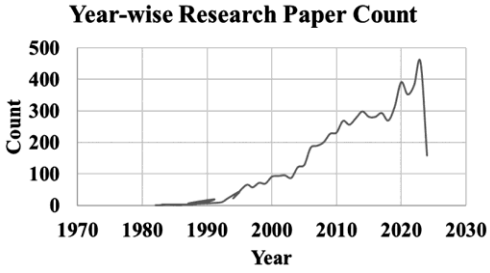

Fig. 1 — Year-wise count of research papers

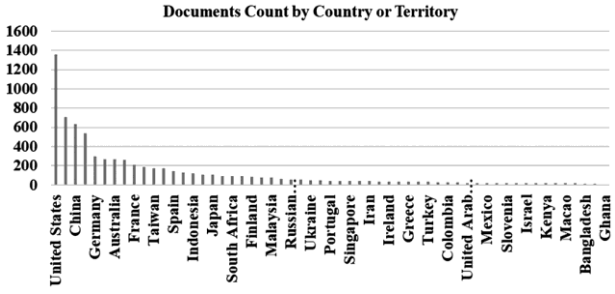

Fig. 2 — Documents by country or territory

Publication Agencies

A total of 112 agencies have published the contributions of researchers in the area of IPRs in the Law domain worldwide. Among these publication agencies, the Elsevier agency has the highest publication, contributing to 28.57 % of the total publications, followed by Springer with 8.04 % and Emerald Publishing with 7.14 %. Figure 3 represents the publication count with respect to the agency.

Sentimental Analysis of IPRs in the Law Domain using Microsoft Azure, VADER and IBM Watson

This section includes the how Sentimental Analysis is conducted using Sentimental Analysis methods of Microsoft Azure, VADER and IBM Watson. [2,4,38]

Sentimental Analysis using Microsoft Azure

Sentiment analysis conducted by Microsoft Azure typically involves leveraging Azure Cognitive Services, specifically the Text Analytics service. The process begins by sending text data to the Text Analytics Application Programming Interface, where advanced NLP techniques are applied to analyze the sentiment expressed within the text. Azure Text Analytics utilizes machine learning algorithms to assess overall sentiment, assigning scores ranging from 0 to 1 for each piece of text. These scores indicate the level of positivity or negativity, with 0 representing very negative sentiment and 1 representing very positive sentiment. Additionally, the service provides sentiment labels, such as positive, negative, or neutral, along with confidence scores that indicate the certainty of the sentiment analysis results. This approach enables businesses to gain valuable insights into customer opinions, product reviews, social media conversations, and more, facilitating data-driven decision-making.

Sentimental Analysis using VADER

VADER is a model used for text sentiment analysis that is sensitive to both polarity (positive/negative) and intensity (strength) of emotion. Unlike other methods, VADER relies on a lexicon-based approach. It utilizes a pre-built lexicon containing words that are scored for their sentiment polarity (positive, negative, or neutral) based on human judgment. When analyzing a piece of text, VADER aggregates the sentiment scores of individual words, considering their intensity and context within the text. Additionally, VADER incorporates rules and heuristics to handle sentiment intensifiers, negations, and punctuation. This approach enhances its accuracy in analyzing sentiment expressed in social media text. Using its lexicon-driven nature VADER can efficiently process any text.

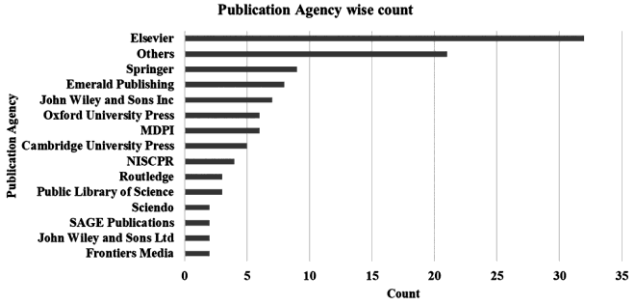

Fig. 3 — Publication agency wise count

Sentimental Analysis using IBM Watson

IBM Watson Natural Language Understanding (NLU) employs advanced machine learning algorithms and linguistic analysis techniques to evaluate the sentiment expressed within text. Users submit text data to the NLU service, which utilizes deep learning models to analyze the text and extract sentiment information. IBM Watson NLU can identify sentiment polarity (positive, negative, or neutral) and provide a sentiment score that quantifies the intensity of the expressed sentiment. This process involves analyzing linguistic cues, context, and relationships between words. The sentiment analysis capabilities of IBM Watson NLU empower businesses to gain insights into customer opinions, brand perception, and market trends, facilitating data-driven decision-making processes. Figure 4 shows

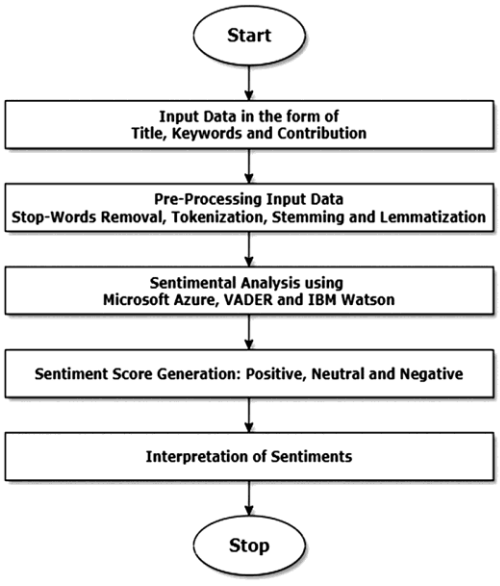

Fig. 4 — Flowchart of sentimental analysis using Microsoft Azure, VADER and IBM Watson

that in the first step, the input data i.e. research paper components Title, Keywords and Contributions is made ready, which act as an input for pre-processing. The pre-processing includes activities including removal of stop-words, tokenization, stemming and lemmatization. Later, Sentimental Analysis is conducted using Microsoft Azure, VADER and IBM Watson and scores are generated. These scores depict the positive, neutral and negative percentages of the Sentimental Analysis, paving way for further interpretations.

Results and Discussion

This section includes the Results and Discussions of the Sentimental Analysis, which is performed on the significant research paper components including Title, Keywords, and Contributions of all the research carried out by all the authors in the area of IPRs in the law domain to date. These results include positive, neutral, and negative sentiment percentages performed using Sentimental Analysis methods of Microsoft Azure, VADER, and IBM Watson.

Sentimental Analysis Results using Microsoft Azure

Table 1 depicts that Microsoft Azure Sentimental Analysis method outputs the research of IPRs in the Law domain to be aggregately 87.84 % positive, 9.23 % neutral, and 2.93 % negative considering research paper components *Title, Keywords, and Contribution* (Figs 5-7).

Table 1 — Results of sentimental analysis conducted in the research of IPRs in the law domain using Microsoft Azure

Particulars	Positive, %	Neutral, %	Negative, %
Title	86.26	11.95	1.79
Keywords	92.04	6.16	1.8
Contribution	85.23	9.57	5.2
Average	87.84	9.23	2.93

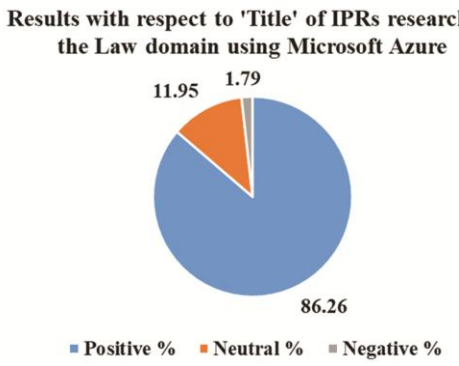

Fig. 5 — Results concerning *Title* of IPRs research in law domain using Microsoft Azure

Sentimental Analysis Results using VADER

Table 2 depicts that VADER Sentimental Analysis method outputs the research of IPRs in the Law domain to be aggregately 79.93 % positive, 17.44 % neutral, and 2.64 % negative considering research paper components *Title, Keywords, and Contribution* (Figs 8-10).

Sentimental Analysis Results using IBM Watson

Table 3 depicts that VADER Sentimental Analysis method outputs the research of IPRs in the Law domain to be aggregately 81.99 % positive, 12.65 % neutral, and 5.36 % negative considering research paper components *Title, Keywords, and Contribution* (Figs 11-13).

Table 2 — Results of sentimental analysis conducted in the research of IPRs in the law domain using VADER

Particulars	Positive, %	Neutral, %	Negative, %
Title	81.33	15.94	2.73
Keywords	74.50	23.69	1.81
Contribution	83.95	12.68	3.37
Average	79.93	17.44	2.64

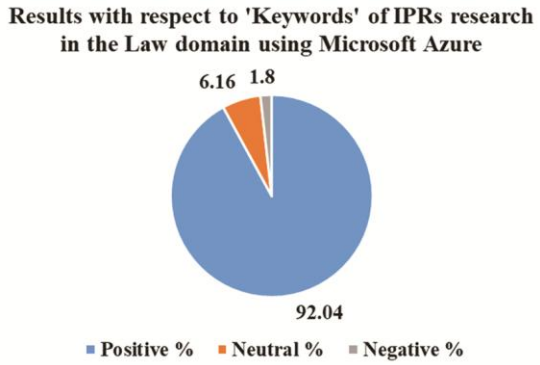

Fig. 6 — Results concerning *Keyword* of IPRs research in law domain using Microsoft Azure

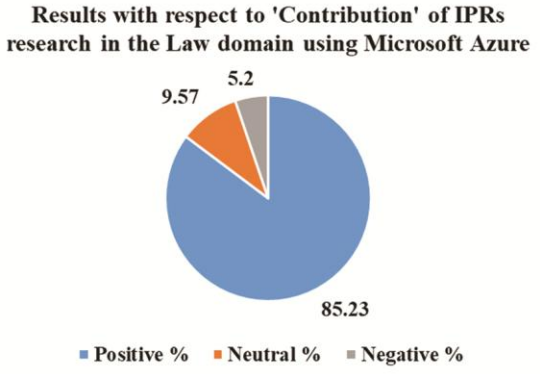

Fig. 7 — Results concerning *Contribution* of IPRs research in law domain using Microsoft Azure

Table 3 — Results of sentimental analysis conducted in the research of IPR using IBM Watson

Particulars	Positive, %	Neutral, %	Negative, %
Title	83.25	12.95	3.8
Keywords	80.01	14.56	5.43
Contribution	82.71	10.45	6.84
Average	81.99	12.65	5.36

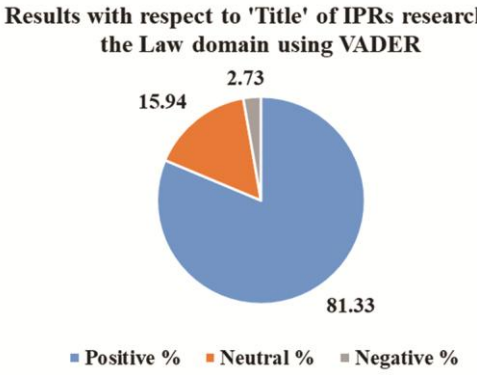

Fig. 8 — Results concerning to *Title* of IPRs research in the law domain using VADER

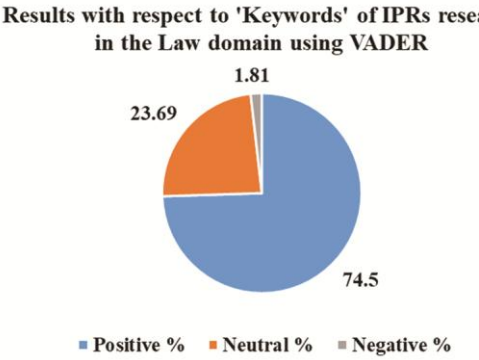

Fig. 9 — Results concerning *Keywords* of IPRs research in the law domain using VADER

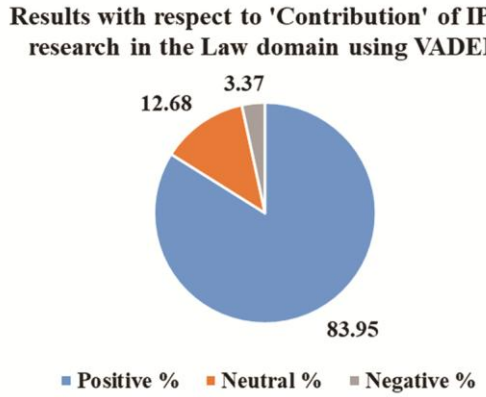

Fig. 10 — Results concerning *Contribution* of IPRs research in the law domain using VADER

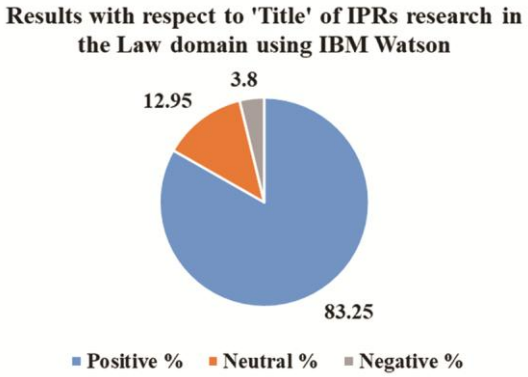

Fig. 11 — Results concerning *Title* of IPRs research in the law domain using IBM Watson

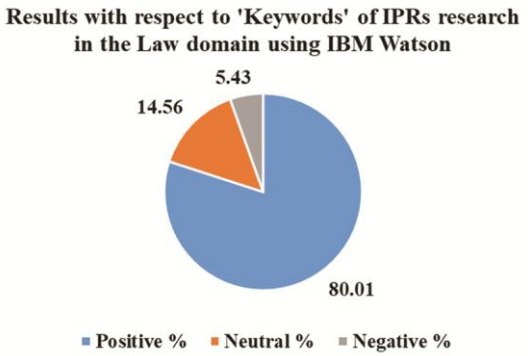

Fig. 12 — Results concerning *Keywords* of IPRs research in the law domain using IBM Watson

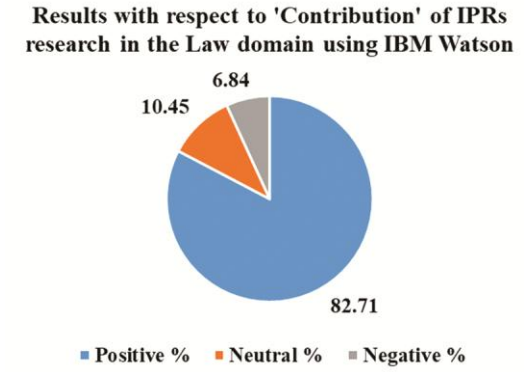

Fig. 13 — Results concerning Contribution of IPRs research in Law domain using IBM Watson

Results

Table 4 shows that the overall Sentimental Analysis, considering Sentimental Analysis methods of Microsoft Azure, VADER and IBM Watson, is 83.25 % positive, 13.11 % neutral and 3.64 % negative.

From all the results obtained, considering the Sentimental Analysis methods of Microsoft Azure, VADER, and IBM Watson, the overall research

Table 4 — Overall sentimental analysis results

Sentimental Analysis method	Aggregate Positive, %	Aggregate Neutral, %	Aggregate Negative, %
Microsoft Azure	87.84	9.23	2.93
VADER	79.93	17.44	2.64
IBM Watson	81.99	12.65	5.36
Overall results	83.25	13.11	3.64

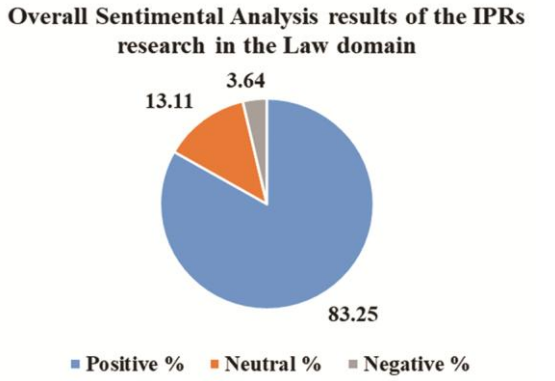

Fig. 14 — Overall results of sentimental analysis

conducted is more positive (Fig. 14). With respect to the results obtained in terms of neutral percentage, the results convey a proper balance of IPR research in the Law domain, ensuring an appropriate amount of transparency. Lastly, with respect to the results obtained in terms of negative percentage, the numbers are meagre, indicating that the authors have avoided biased research in the negative direction and reported only non-negative findings to advance understanding and knowledge in various disciplines collectively.

Conclusion

The main objective of this research paper was to conduct a sentimental analysis of the research on IPRs using modern methods and provide a critical review of the same. To meet this, the authors performed a detailed sentimental analysis using three prominent methods of sentimental analysis: Microsoft Azure, VADER, and IBM Watson. The entire research conducted by all the authors all around the globe is considered for conducting this Sentimental Analysis. This includes taking into consideration more than six thousand Scopus-indexed research articles from the past four decades, covering authors from more than fifty countries and more than a hundred publication agencies. The results of this Sentimental Analysis from all the methods convey that research in the area of IPRs has been aggregately 83.25 % positive, considering the Title, Keywords, and Contributions of authors all around the world. Also, the research in the area of IPRs is aggregately 13.11 % neutral considering Title, Keywords, and Contributions, thereby providing a balance between positive and negative research. Lastly, the research conducted to date in the area of IPR is aggregately 3.64 % negative, which is negligible. Another objective of the authors was to find the direction in which the research was conducted in the area of IPRs in the law domain. With the results obtained, this objective was also met, and the authors can conclude that the research conducted in the area of IPR is mostly in a positive direction and negligibly negative, which will act as a driving force for upcoming researchers. With this, the authors would like to conclude that all the objectives framed were addressed individually and specifically. Lastly, the authors would suggest that future researchers revisit the identified neutral and negative percentages of research to ensure skewness with positive sentiments so that IPRs can be viewed with a single positive mind-set sentiment.

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