

# 以智財法為基之美術著作及圖形商標相似度分析管理系統

## Similarity analysis system for pictorial works and trademarks - Using IP legal knowledge engineering and deep learning techniques

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Trademarks (TM) can be expressed by unique spelling, phonetic or image forms. The uniqueness of the TM can help companies build brand reputation. Infringers take advantage of using marks, same as or deceptively similar to the registered TMs to confuse the consumers, causing potential sales loss and goodwill impairment to the TM owners. TM infringement is a seriously rising issue with the rapid growth of e-commerce activities with huge number of TMs appeared online. To protect the TM rights, this research proposed machine learning based methodologies and implemented a prototype system for comprehensive TM similarity analysis, which can match and retrieve TMs with similar features in terms of (1) spelling-based, (2) pronunciation-based, and (3) image/pictorial-based. In this research project, we have developed a novel TM similarity analysis system that includes three key machine learning models, mainly the space vector model (SVM), Siamese neural networks (SNN), and convolutional neural network (CNN). We also refined the TM image retrieval model by developing triplet transfer learning to fine tune the CNN model with much improved results. Figures, shown in the next page, illustrate the key framework of the system, the spelling-based TM similarity analysis flow, the pronunciation-based TM similarity analysis flow, and the image-based (**LogoSimNet**) TM similarity analysis and case examples. The research has successfully produced two high-impact journal publications in *AEI* (IF=5.603) as listed below. This research has also successfully been extended to other research projects. In conclusion, the proposed intelligent automatic detection of similar TM similarity analysis has yield excellent results. The verification experiments (trained with 7,625 logos and tested with 3,221 logos) demonstrates that the Recall@10 of the test set can achieve 95% using the advanced convolutional neural network model (VGG19) adjusted with our novel transfer learning based on the characteristics and features from IP law perspectives.

### References

- [1] Trappey, C. V., Trappey, A. J., & Lin, S. C. C. (2020). Intelligent trademark similarity analysis of image, spelling, and phonetic features using machine learning methodologies. *Advanced Engineering Informatics*, 45, 101120. doi:10.1016/j.aei.2020.101120
- [2] Trappey, A. J., Trappey, C. V., & Shih, S. (2021). An intelligent content-based image retrieval methodology using transfer learning for digital IP protection. *Advanced Engineering Informatics*, 48, 101291. doi:10.1016/j.aei.2021.101291

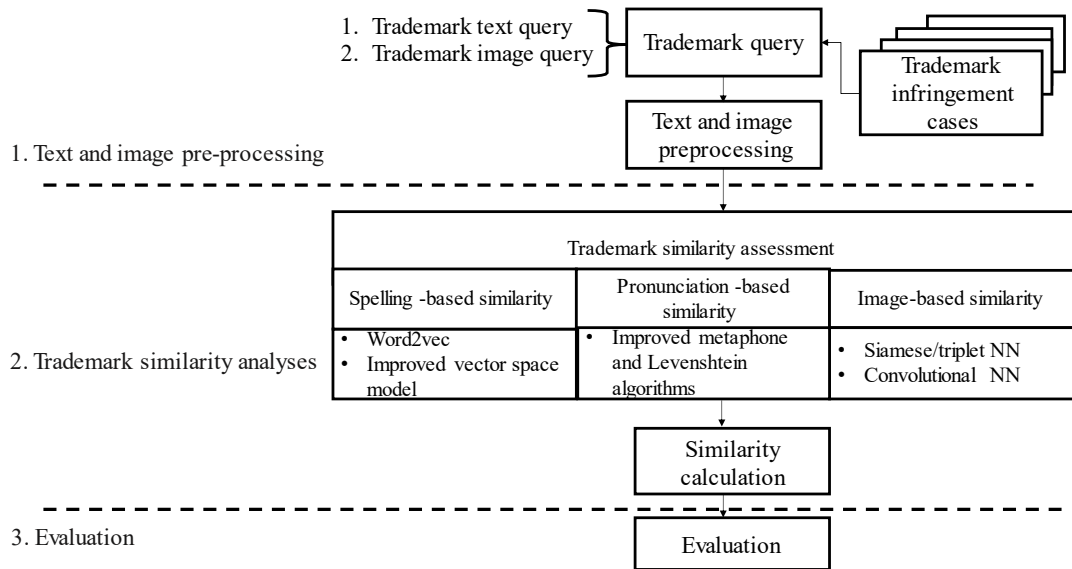


Figure 1. The overview of TM similarity analysis research framework.

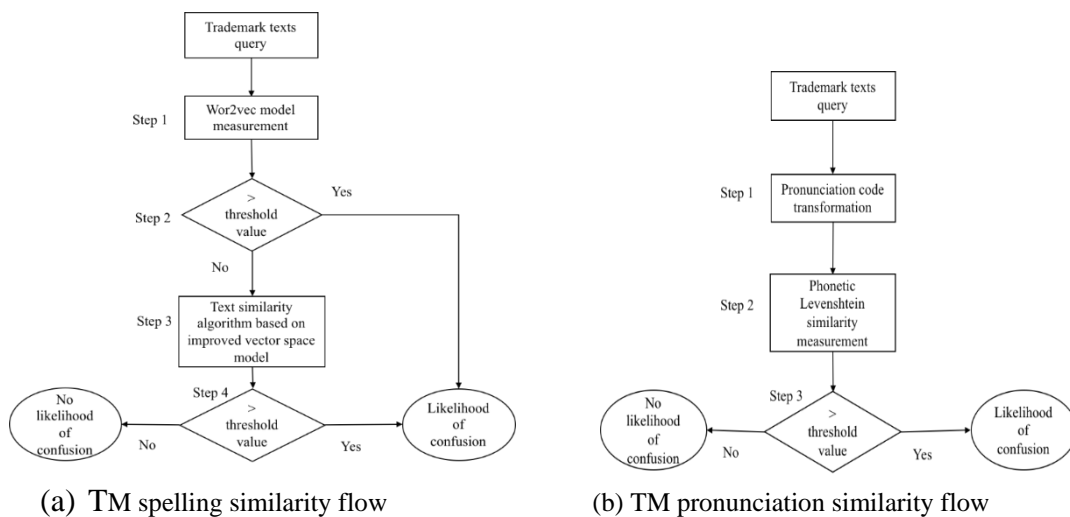


Figure 2. The process flows of TM spelling and pronunciation similarity analysis modules.

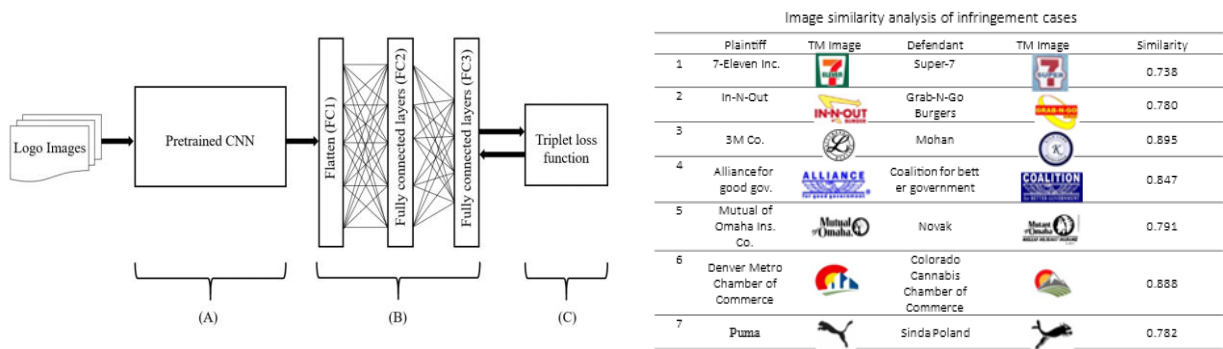


Figure 3. TM image retrieval model and example case results.