The Application of Convolutional Neural Networks to Improve the Efficiency of Lung Cancer Detection

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Abstract

The effectiveness of various methods of lung cancer diagnosis was analyzed and used in order to compare the effectiveness of convolutional neural networks (CNN) combined with computed tomography (CT) to evaluate whether convolutional neural networks should be implemented in the near future. Papers included in this systematic review recorded metrics of speed, false positive rate, and sensitivity of lung cancer diagnosis. Findings suggest that the method of using convolutional neural networks with computed tomography scans may be more effective than current methods of a lung cancer diagnosis.

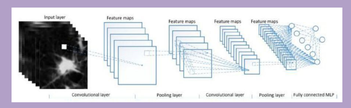

Figure 1. A visual representation of a convolutional neural network

Introduction

Lung cancer is one of the most prevalent causes of cancer-related death all over the world, and it is the most common cause of cancer death in the United States (World Health Organization, 2017). There are many different causes of lung cancer, notably smoking and radon exposure. Because of how common and deadly lung cancer is, this makes it essential to get an effective diagnosis to know whether treatment is necessary.

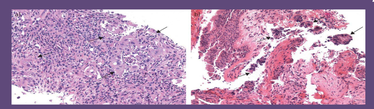

Fig 2. A magnified image of lung cells before and during early cancer development

Purpose

The purpose of this study was to evaluate the most effective method of lung cancer diagnosis by comparing different methods methods. In addition, convolutional neural networks will be evaluated to test whether they will be beneficial to future lung cancer detection methods.

Research Question

Is the use of CT scans with CNN a more effective method of diagnosis, to be used as an alternative to currently used methods?

Hypothesis

The use of convolutional neural networks in combination with computed tomography scans is beneficial enough to be implemented currently.

Methods

The raw data that was extracted was taken of percentages of their respective test study size. In order to compile the data within even parameters, I took the percentages and transferred the percentages into total members of a population. By doing this, it allowed me to formulate total sensitivity rates and false positive rates, that were formed with equal parameters, and also combined many papers.

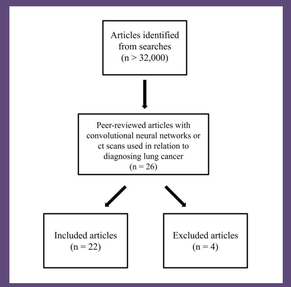

Fig 2. A diagram of the flow of studies during the systematic literature review.

The effectiveness of convolutional neural networks and chest X-rays was evaluated and compared by observing the sensitivity rates and false positive rates concerned with their respective method of lung cancer detection. Paired sample t-tests were run on each study to calculate the significance of the differences in sensitivity rates or false positive rates. The t-tests allowed me to determine the validity of the research. By doing t-tests, you can acquire p-values which tell the probability that experimental results happened by chance.

Results

As a result of my research, data was taken from 14 different trials per researched method of lung cancer detection to find the most effective method. As indicated by the trials, the average sensitivity rate of CNN with CT scans was 84.4%, while the average false positive rate was at 7%. This means that while CNN with CT scans could accurately detect lung cancer at 84.4% accuracy, 7% of those scans would pick up false positives. In contrast, the sensitivity rate of chest X-rays was considerably lower, at 76.9%, with a false positive rate of 11.1%. While chest X-rays are far more common, they are also less accurate overall. However, for chest X-rays, radiologists are able to review the information multiple times, while artificial intelligence methods are less effective at reviewing scans for mistakes.

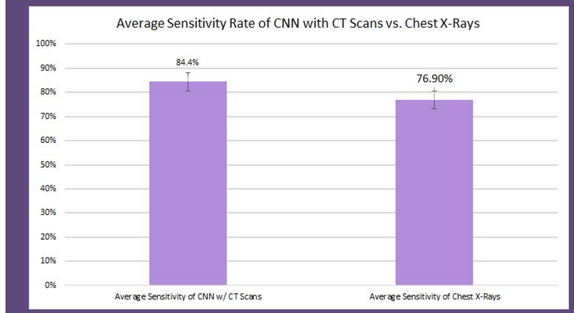

Fig 3. This graph shows a comparison between the average sensitivity rates of convolutional neural networks with CT scans and chest X-rays.

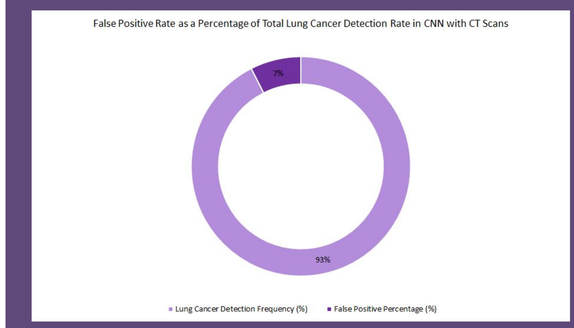

Fig. 4. This graph shows the average false positive rate as a percentage of the total amount of lung cancer detections made by

Conclusion

Overall, the systematic literature review conducted on this research supports the hypothesis that convolutional neural networks in combination with computed tomography scans are not currently beneficial enough to be widely implemented in place of current methods of diagnosis. While CT w/ CNN scans look like an appealing option, the overall speed and efficiency of the artificial intelligence system are offset by the lack of credibility and potential for life-threatening mistakes. While adding a scientist to observe the findings of the AI and check to make sure everything is correct, that would compromise the speed, which makes this method of diagnosis appealing, to begin with. For those reasons, while CNN w/ CT scans are a very appealing option, more research must be done on them, in order to ensure that they are safer than current options before they can be widely implemented into society.

Further Work

To further contribute to this research, there are more applications of artificial intelligence in the medical field than researched in this paper. Especially in the detection of other cancers, such as breast cancer or colon cancer, the integration of artificial intelligence could be highly beneficial to the improvement of their detection methods. Additionally, because convolutional neural networks is still a developing technology, data concerned with it actually being applied to test real patients that needed a lung cancer evaluation was unavailable. Artificial intelligence like CNN is always being innovated and developed, so further work could be done with the AI discussed in this research is improved upon, or there is another form of AI that is superior to CNN.

Acknowledgements

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