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Artificial Intelligence and its Associated Application at Prediction in Medical Field

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ABSTRACT: In the Future, Artificial Intelligence has the potential to replace or enhance human capabilities in several areas. Artificial Intelligence is basically the intelligence exhibited by machines to reduce human efforts. Artificial Intelligence is the way through which a machine or basically a computer can think and function like human. It helps to take technology to a new level altogether. Artificial intelligence allows machines to perform tasks which require human intelligence such as visual perception, decision making as well as speech recognition. Artificial Intelligence has several applications like in gaming and also medical applications. Specifically as our interest in the paper we would like to consider the unique application of Artificial Intelligence in medical prediction. This application will play an important role since prediction is an important aspect in medical domain. This application basically concerned with providing decision making ability in medical life as a technological support using the concept of Artificial Intelligence. Health has a strong impact on an individual's life and human experts should have the capability to diagnose a particular health issue and decide an adequate treatment for the same. This application will lead to evolution in the field of medical treatment. Artificial Intelligence will help in assisting human intelligence in decision making. Furthermore the precision of mathematics and the capabilities of current technologies, are the two strong qualities and factors in the system which are combined to give these positive features as a result

KEYWORDS: Artificial Intelligence, Decision Making System, Bayes Theorem, Application of Artificial Intelligence

I. INTRODUCTION

Artificial Intelligence plays a vital and increasing role in research of management science and operational research areas. Basically, intelligence is considered as the ability to collect knowledge and information and aims to solve complex problems with proper reasoning. In the near future intelligent machines will replace human efforts and capabilities in many areas. Artificial intelligence is the study and developments of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate and perceive the objects. It is the study of the computation that makes it possible to perceive reason and act accordingly. Artificial intelligence is different from psychology and computer science because it emphasis on computation and on perception, reasoning and its corresponding actions respectively. Its aims and helps to make machines more powerful, smarter and useful. It works with the help of artificial neurons and scientific theorems. Major areas of Artificial Intelligence are Expert Systems, Natural Language Processing, Speech Understanding, Robotics and Sensory Systems, Computer Vision and Scene Recognition, Intelligent Computer Aided Instruction, Neural Computing. The various techniques applied in artificial intelligence are Neural Networks, Fuzzy Logic, Evolutionary Computing, and also Hybrid Artificial Intelligence. Artificial intelligence is more consistent, permanent and less expensive. Also, it has the ease of duplication and dissemination. Its helps perform the tasks relatively faster and all this factors provides it an edge over natural human intelligence. Application Intelligence has many applications but considering its application specifically in medial prediction some of the discussions are supposed to be taken in to consideration. The final medical decision belongs to humans and in this case having a automatic system which can make the required decision will be more beneficial and accurate. Some of the advantages of having the automatic system are that it will eliminate the difficulty in estimating

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risk of diseases and its adverse effects. Furthermore it will help to have possible positive effects on health outcomes and institutional resource utilization. Also some of the other advantages of having a automation decision making systems are that it is not perturbed by the causes that are specific to human beings, it has a higher speed and is very efficient. It is also capable of storing large number of data and making complex connections between them. These systems can select or can generate important data, very useful for the physicians. In medical field and life the risk of error apparition is being tried to reduce with help of various tools. Diagnosis, which is the first step from a set of therapeutic actions, has a very important role to be played in this case. An error at this level can have dramatic consequences. The advantages of the technology in diagnosis phase are pragmatism, repeatability, efficiency, immunity towards perturbation factors specifically related to human beings

II. PROPOSED SYSTEM AND METHODOLOGY

The artificial intelligence domain provides a large variety of solutions for problems that require reasoning. Specifically in this paper we are concerned with providing an approach suitable for medical predictions and for this a system based on probabilistic reasoning is suitable and preferable.

2.1 PROBABILISTIC REASONING

Probabilistic Reasoning is used in the case where in the information to be handled by the system is very large and complex. It can be of two types and the two types are Knowledge based reasoning and reasoning based on statistical methods. Knowledge-based reasoning cannot handle complex databases easily. For example, if a patient is positive in hepatitis B, his or her medical investigations will have to be continued. The problem that rises is basically directly connected to the evolution of the patient's medical condition and health. There are three evolutionary types of this disease and six severity levels. It would be very useful to have some predictions regarding the evolution of the patient during the treatment, but unfortunately the influence of premises on the patient's evolution is difficult to be represented in clear rules as those that are required by a knowledge-based system. The solution to this can be provided by statistical methods. Thus, in a database all the standardized premises for as many patients as possible will be stored. Furthermore for a new patient, the database is processed by statistical methods in order to calculate the probability of each evolutionary type and severity level of hepatitis B and so the solution offered by this method is way more accurate than the previous mentioned type which is basically based on logic. The major advantage of statistical approach is that it associates a probability to each possible output. Bayes' theorem is one of the most important concept for implementing probabilistic approach and formula for it if given below.

$$p(D_k) = \frac{cardinal\{r \in \Omega \mid D_k(x) = 1\}}{cardinal\ \Omega}$$

Fig.1: Formula for Bayes' Theorem with conditional probabilities

This theorem describes the connection between two events Dk and S where Dk is the diagnosis and S is the available evidence which in this case is the vector that stores the patient's symptoms and laboratory test results in a very standardized form. Some of the patient's features have a binary form from the beginning: sex (M/F). Other features must be processed in order to decide whether they belong to a particular range or not such as like Age. It is a feature that was divided into four intervals and intervals were in the following range like less than 20 years, more than or equal to 20 and less than 30 years, more than or equal to 30 and less than 45 years and more than or equal to 45 years. (< 20 years old / [20, 30) / [30, 45) / > 45). Therefore, a patient who is 34 years old will have the following binary values stored in the fields that belong to the feature as shown: 0, 0, 1, 0. Starting time was split into three ranges (?7 days / [8, 21] / ? 22). Bayes's theorem expresses a probability based on three other probabilities which could be considered as a disadvantage but however it is considered very useful because the probabilities could be easily calculated using the below mentioned formulations. This is because the probability in the causal direction ($p(S|Dk)$) is more evident than the probability in the diagnosis direction ($p(Dk|S)$). It is very easy to calculate the probability $p(Dk)$. It is the frequency of a disease in the statistical population Ω

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$$p(S \mid D_k) = \prod_{i=1}^{n} p(\sigma_i \mid D_k) = \prod_{i=1}^{n} \frac{p(\sigma_i, D_k)}{p(D_k)}$$

Fig.2: Formula for calculating probability.

The probability *p(S|Dk)* is calculated assuming the conditional independence of all symptoms for a disease *Dk*. This is an important restriction that Bayes' theorem imposes. It may however be sometime difficult to fulfill it. The below mentioned formula is used for calculating the probability, *n* is the number of symptoms stored as binary values in the input vector *S* (34 for this case), and σi is a symptom.

$$p(\sigma_i, D_k) = \frac{cardinal\{r \in \Omega \mid D_k(r) = 1, \sigma_i(r) = 1\}}{cardinal\ \Omega}$$

Fig.3: Formula for calculating probability.

The probability *p (σi,Dk)* is called compound probability and means that both events σi and *Dk* happen at the same time (a patient with the symptom σi also has the disease *Dk*). This probability is calculated by the following formula and it is the frequency of σi and *Dk* in the statistical population Ω i.e. numbers of records *r* that have these two parameters equal to 1.

$$p(S) = p(S \mid D_k) \cdot p(D_k) + p(S \mid \neg D_k) \cdot p(\neg D_k)$$

Fig.4: Formula for calculating probability.

The last probability, *p(S)*, is calculated considering that the diseases are mutually exclusive (only one disease is present at a moment) and that it is sure that one disease is present. The formula for calculating the required probability is given below

$$p(\neg D_k \mid S) = \frac{p(S \mid \neg D_k) \cdot p(\neg D_k)}{p(S)}$$

Fig.5: Formula for calculating probability.

It should be noticed that both Fig.1 and Fig.5 contain the term 1/p(S*)*. It is considered normalization constant and it ensures that the sum of probabilities is 1. This should be 1, because it represents all possible cases, the certain event, which has the probability 1. For the system presented, the hepatitis B has three evolutionary types; the patient will evolve to one of these and nothing else is possible. Therefore, if the term 1/p(S) is ignored in Fig.1 and Fig.5, the obtained partial probabilities are still in the correct relative proportion. Their sum is not 1 anymore, but this can be solved dividing each one by their sum. Thus, this sum can replace *p(S)* as shown in Fig.6.

$$p(S) = p(S \mid D_k) \cdot p(D_k) + p(S \mid \neg D_k) \cdot p(\neg D_k)$$

Fig.6: Formula for calculating probability.

The final form of Bayes' theorem is shown in the Fig.7. It can be used to be applied for each of the three evolutionary types of hepatitis B and for each of the six severity levels of this disease. The results will be numbers in the range [0, 1] (because they are probabilities). Their sum will be 1 for all the evolutionary types and also 1 for all the severity levels of hepatitis B.

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$$p(D_k \mid S) = \frac{p(D_k) \cdot \prod_{i=1}^{n} p(\sigma_i \mid D_k)}{p(D_k) \cdot \prod_{i=1}^{n} p(\sigma_i \mid D_k) + p(\neg D_k) \cdot \prod_{i=1}^{n} p(\sigma_i \mid \neg D_k)}$$

Fig.7: Final form of the Bayes' Equation

A physician is able to decide, according to the medical domain about where the system is used, whether this accuracy is acceptable or not. If the proposed decisional system is used to predict the evolution of a particular medicine store in a pharmacy, then the accuracy could be enhanced further making it enough for the suitable cause. But if the system should predict a diagnosis for a patient, then its performances must be improved. Such improvements can be done through a couple of ways. First, the statistical population Ω should be large enough in order to include uncommon diseases. Second, a better accuracy is obtained if the number of analyzed inputs (symptoms and laboratory test results) is increased. These two features of the database are connected and a compromise is usually necessary. The reason is that not all the patients need (or have) all the laboratory tests; therefore, their records are not completed. There are two choices here: to ignore those patients or to ignore those missing laboratory tests for all the other patients. The database cannot contain blank locations. An important feature of this decisional system is that it doesn't provide a clear result, but a probability. Its output quantifies uncertainty, offering a degree of belief. For instance, it is not sure that a patient will develop a serious level of severity regarding hepatitis B, but it is more probably because the system says 0, 0.2777, 0.7223, 0, 0, 0. Furthermore, after such prediction it is the physician's responsibility to decide how will be treated a patient with 72.23% risks to develop a serious form of hepatitis B.

III. FUTURE SCOPE

Considering the future scope required enhancement could be done to increase the efficiency of the system. Furthermore, the system can be made digitally automated providing the prediction and final reports to the family of the patients via emails or messages keeping them updated and aware of the situations.

IV. CONCLUSION

The field of artificial intelligence gives the ability to the machines to think analytically, using concepts. Tremendous contribution to the various areas has been made by the Artificial Intelligence techniques from the past many years. Artificial Intelligence will continue to play an increasingly important role in the various fields. This paper is based on the concept of artificial intelligence, areas of artificial intelligence and the artificial intelligence techniques used in the various fields specifically in medical prediction. Artificial Intelligence has several applications like it can be used in gaming, medical application and several others. It can also be used to build smarter products which will add to the benefit of people around. For example the construction of locomotion system for ALS patients requires Artificial Intelligence and it helps ALS patients to attain mobility just by using their thinking capability. Furthermore Artificial Intelligence can replace motion sensor based games as well in future. Our proposed system using the concept of Artificial Intelligence will simplify the efforts required by the doctors or physicians since it will help predict the accurate prediction based on the provided data. Also it will help to save their time and help them faster the treatment process avoiding carrying unwanted tests. This will allow the physicians the flexibility to focus on other important activities and also it will help to diagnose and detect imperceptible effects. This proposed will help the physicians to a larger extent lending a helping support to them

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