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**Artificial Intelligence in Medicine**

**Introduction**

The use of technology in business processes is becoming more prevalent, and health care is no different. Technology is already well integrated with the care we receive. In this paper, we will discuss the use of technology, specifically artificial intelligence, in our healthcare system. We will discuss the benefits and drawbacks of implementing AI (Artificial Intelligence) in healthcare. We will also discuss some of the pressing concerns associated with integrating artificial intelligence into treating patients. Artificial intelligence is the concept of computer systems acting intelligently and making decisions in a way that mimics the human decision-making process. There are seven types of artificial intelligence: reactive machines; limited memory; theory of mind; self-aware; artificial narrow intelligence; artificial general intelligence; and artificial superintelligence.

**Various forms of artificial intelligence**

For many years, artificial intelligence has been used to support clinicians with decision-making. But it has been the simplest form of AI, reactive machines. Reactive systems "require human experts and knowledge engineers to construct a series of rules in a particular knowledge domain." They work well up to a point and are easy to understand. However, when the number of rules is large (usually over several thousand) and the rules begin to conflict with each other, they tend to break down (Davenport, T., & Kalakota, R. (2019). " According to Davenport et al., these reactive systems are being replaced by more advanced artificial intelligence systems such as artificial narrow intelligence systems that utilize algorithms and not and-if statements to make decisions.

Artificial intelligence is used in more advanced systems to detect cancer, assist in or complete surgical procedures, diagnose, predict treatment outcomes, and recommend treatments. Many of the current AI technologies that exist today fall under the category of artificial narrow intelligence. ANI can provide more personalized decision support based on data specific to each patient.

Machine learning and deep learning are subclasses of artificial intelligence and rely on test data sets to program the system. In recent years, the availability of huge datasets and the tremendous computing power offered by graphics processing units (GPUs) have motivated research on deep-learning algorithms, which have shown outstanding performance in various computer vision tasks and have gained a decisive victory over traditional hand-engineered-based methods.

Many deep-learning (DL)-based algorithms have also been developed for various tasks to analyze images and develop automatic computer-aided diagnosis systems. "A DL network typically comprises multiple layers of artificial neural networks and tends to include an input layer, an output layer, and multiple hidden layers." Interestingly, the hidden layers are also used to generate new representations of the image and, with enough training instances, can be used to identify the representations that best distinguish categories of interest (Bera, K., et al. 2019).

**AI in Diabetic Retinopathy (DR)**

Diabetic retinopathy (DR) is one of the main causes of blindness among the working-age population. It is one of the most feared complications of diabetes. The fundamental problem with DR is that it is incurable at advanced stages, so early diagnosis is important. However, this involves remarkable difficulty in the health care system due to a large number of potential patients and the small number of experienced technicians. This has motivated the need to develop automated diagnosis systems to assist in the early diagnosis of DR. Several attempts have been made in this direction, and several approaches based on hand-engineered features have been proposed, which have shown promising efficiency in recognizing DR regions in retinal fundus images. Hand-engineered features are commonly used with traditional machine-learning (ML) methods for DR diagnosis. Different surveys have reviewed these traditional methods. For example, Mookiah et al. and Mansour categorized DR diagnosis according to the adopted methodologies, such as mathematical morphology, retinal lesion tracking, thresholding, and deformable models, clustering-based models, matched filtering models, and hybrid approaches. Faust, et al.

Diabetic retinopathy is a consequence of diabetes that causes vision issues by damaging the retina. Diabetes damages the retinal blood vessels, resulting in potentially fatal consequences such as blindness. DR is avoidable, and early detection is critical to avoid visual loss. We highlight the challenges to be addressed in designing efficient, effective, and robust deep-learning algorithms for various problems in DR diagnosis.

Diabetic retinopathy (DR) results in vision loss if not treated early. A computer-aided diagnosis (CAD) system based on retinal fundus images is an efficient and effective method. Many traditional machine-learning (ML) techniques based on hand-engineered features have been introduced. Hand-engineered features are used in traditional methods for detecting DR biomarkers and lesions. Since its introduction, deep learning has been used to develop multiple approaches for retinal blood vessel segmentation, OD detection and segmentation, the detection and classification of various DR pathologies, and the detection of referable DR.

**Artificial Intelligence in Surgical Settings**

Surgical simulation plays a vital role in surgical training, medical education, pre-operative planning, and robotic-assisted surgery. It requires realistic modeling of soft tissue deformation under tool-tissue interactions while providing real-time visual and haptic feedback, which is difficult to achieve. The mass-spring model (MSM) is a popular method to simulate soft tissue deformation. Geometric approaches such as spline surfaces and implicit surfaces lack physical realism. To address physical realism, physics-based approaches were studied for soft tissue deformation. The Chainmail algorithm is a more simplified approach to soft tissue deformation. It considers soft tissues as a discrete model represented by point masses connected by massless springs. MSM is simple in implementation and efficient in computation but cannot accurately reproduce the force-displacement relationship of biological soft tissues.

A neural network is employed in the proposed method for real-time simulation of soft tissue deformation. The computational advantage of neural networks afforded by the collective and simultaneous computing nature of neural cells would be suitable for the real-time computational requirement of surgical simulation. A new neural network methodology for modeling soft tissue deformation for surgical simulation has been developed. The proposed methodology formulates soft tissue and its dynamics as the neural propagation and dynamics of cellular neural networks. It is intended to provide a real-time, realistic, and stable simulation of soft tissues during surgery. The study develops two cellular neural network models for governing the dynamics of soft tissue deformation. One is based on the bioelectric propagation of biological tissues and principles of continuum mechanics; the other is non-rigid mechanics of motion in continuum mechanics. It achieves both computational and physical realism of soft tissue deformation, the researchers say. Interactive soft tissue deformation with haptic feedback is achieved via a haptic device. A proposed methodology exhibits the nonlinear force-displacement relationship and associated nonlinear deformation of soft tissues. Interactive soft tissue deformation with haptic feedback is achieved via a haptic device.

Furthermore, not only homogeneous but also anisotropic and heterogeneous materials can be modeled via a simple modification of electrical conductivity values. The augmented CNN is used for modeling the dynamics of soft tissue deformation. The saturation voltage K of the nonlinear voltage-controlled source in the proposed CNN controls the maximum output of a cell. This property can be used to control the stability of hard tissue simulation dynamics.

**Artificial Intelligence in Pathology and Oncology**

Pathologists and oncologists have specialized training, and many of these clinicians should have similar training, if not the same training, but due to individual variables, their diagnosis or lack of a diagnosis may differ. "Artificial Intelligence" software can help with variabilities due to human error. The development of new AI-based image analysis approaches in pathology and oncology is being led by computer engineers and data scientists, who are developing and applying AI tools for a variety of tasks, such as helping to improve diagnostic accuracy and identifying novel biomarker approaches for precision oncology (Bera, K., et al. 2019). "In modern medicine, biopsy procedures are minimally invasive." In turn, less tissue is collected, thus making the job of a pathologist more difficult. "AI approaches in digital pathology have been increasingly applied towards helping to address issues faced by oncologists, for example, through the development of prognostic assays to evaluate disease severity and outcome as well as assays to predict response to therapy (Bera, K., et al. 2019)."

**Machine Learning for Cerebral Stroke**

**Introduction:**

Cerebral stroke, a condition that causes significant morbidity, disability, and mortality, has emerged as one of the most serious dangers to public health around the world. Although the pathophysiology of stroke is still unknown, it is well accepted that stroke is linked to aberrant metabolic indicators in both hemorrhagic and ischemic stroke. Given that over 90% of the disease's metabolic risk variables are under our control, we should focus more on prevention.

Machine learning is a sophisticated diagnosis and prognosis approach that can categorize medical data into predefined class labels, such as sick or not sick. This method has allowed machine learning to be successfully implemented in clinical diagnosis for increased accuracy and efficiency.

In the last decade, several studies have looked into the use of machine learning models in stroke prediction. The majority of existing stroke prediction studies focus on a comprehensive and balanced dataset, but only a few medical datasets can rigorously match such conditions. A missing value imputation system based on iterative mechanisms has shown acceptable prediction accuracy for incomplete data. The stroke dataset suffers from a class imbalance in clinical practice. They must account for class imbalance if they use learning-based methods to predict strokes. Class imbalance refers to an unequal sample distribution among classes, with minority classes being the rarest and majority classes being the most common. This problem has been resolved at both the data and algorithmic levels.

**Challenge**:

Two major challenges must be overcome to successfully apply machine learning methods for prediction: class imbalance and incompleteness. More emphasis should be paid to the percentage of false negatives and false positives among the model output in the medical industry, particularly for stroke prediction. The technique for stroke prediction in this paper consists mostly of two parts. To begin with, many methods are employed to impute missing values based on the properties of the data.

**Method and Process:**

They filter out irrelevant and redundant features while maintaining the implicit information of the original dataset. This reduces the impact caused by outliers and noise values in the dataset. Random forest regression (RF) is used in this paper since it outperforms the others in terms of accuracy and generalization. They optimize the hyperparameters using grid search and then apply K-fold cross-validation to measure the prediction quality. The core premise of K-means is to partition the sample into k groups, making it one of the most effective clustering algorithms for unsupervised learning tasks. Instance selection (IS) is a frequently used advanced re-sampling technique in machine learning for filtering out noisy and irrelevant data samples from the original datasets. They under sample the majority class of the original data using KNN based on instance selection in this study.

**Results:**

According to this model, the false-negative rate is only 19.1 percent, and the total accuracy is 71.6 percent. When compared to the mean results of other commonly used methods, the false-negative rate decreases by 51.5 percent, and the total error increases by 1.7 percent. As a result of these modifications, the false-negative rate can be reduced significantly without sacrificing overall accuracy. As a result, the hybrid machine learning approach used in this study for stroke prediction is effective and reliable. Further advancements will be made as a result of these efforts, resulting in more accurate and mature stroke prediction.

**Concerns Surrounding the Use of Artificial Intelligence**

The use of artificial intelligence is supported by the government and multiple bills have been passed supporting and providing guidance for the use of artificial intelligence. Only recently, in January 2020, the White House published a draft guidance for the regulation of AI applications. It contains 10 principles that agencies should consider when formulating approaches to AI applications: (1) Public trust in artificial intelligence. (2) public involvement, (3) scientific integrity, (4) information quality, (4) risk assessment and management, (5) benefits and costs, (6) flexibility,

(7) fairness and nondiscrimination, and (8) disclosure and transparency. safety and security (Gerke, S., Minssen, T., et al., 2020) and (10) interagency coordination even with published guidance, AI systems will still fail to meet expectations well after being integrated into live systems.

**Bias and Discrimination**

There are documented cases of AI showing bias and making discriminatory decisions. Unlike humans, computer systems cannot be held accountable for poor decision-making, biased treatment, or discrimination. "Machine learning systems in healthcare may also be subject to algorithmic bias, perhaps predicting the greater likelihood of disease based on gender or race when those are not causal factors." "Davenport, T., & Kalakota, R. (2019).In this case, there could be false positives. Without AI, there is a prevalence of false negatives and conditions being missed by healthcare providers. If healthcare providers could work alongside AI, that could be the solution to alleviating suboptimal care.

**The Black Box**

The "black box problem" refers to the lack of knowledge surrounding the outcome of deep learning algorithms. "DL utilizes unstructured input data, and the bulk of knowledge generation occurs with the hidden layers. It thus becomes difficult to determine which specific characteristic (s) of the input data contributed to the outcome. (2019). Kann, B.H., et al. "If healthcare providers cannot explain how they reached a conclusion or a diagnosis, they cannot properly treat the patient.

" This, in turn, will cause providers to steer clear of DL systems. Additionally, if hospitals cannot provide a detailed standard operating procedure for how they provide a diagnosis because they do not understand which elements led to specific conclusions, the hospital will more than likely not pass regulatory inspections. In turn, this causes hospitals to be more reluctant to integrate more advanced AI systems.

**Predictions for the Future Use of AI in Healthcare**

Technology is used in almost every sector, such as finance, fitness, healthcare, social media, etc. The data collected from every sector of a person’s life could be used to make predictions of their health outcomes. A person’s financial health, fitness level, and social media use when plugged into an algorithm could determine many things about a person’s future health conditions or lack thereof. It could potentially determine if someone will follow at-home treatment.

The world we know is changing, and many people fear that technology will take the place of human beings in the workforce. Technology can help fill open, difficult-to-fill positions in healthcare. For example, there is a shortage of pathologists because pathology isn’t a "fancy" or highly sought-after position. Pathologists spend most of their time looking under a microscope or analyzing data generated from the instruments in the laboratory and have very little interaction with patients. So, is technology a threat to the workforce if it is doing jobs that people are not willing to do?

**Conclusions**

In conclusion, the use of artificial intelligence in the healthcare setting is a controversial topic. Some clinicians believe it will be life-changing for the profession and help get rid of some of the mundane work that distracts them from patient care. Other healthcare professionals believe technology is a distraction and gives them less time with patients. Some patients are not happy with the idea of electronic copies of their health records due to the frequency of security breaches and the fear of their PHI being sold or used to aid in an unauthorized research project.

Many people frown at the thought of AI and the possibility of sharing their data. Yet, these same people do not realize AI is already prevalent in our lives and the healthcare industry is one of the last industries to implement DL systems due to the many governing bodies associated with healthcare systems. The data collected during all patient interactions is used and analyzed to help AI systems make decisions.