A Comprehensive Study of Smart Healthcare in Smart City

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Abstract— The aim of smart city is to manage the energy consumption, growing urbanization, maintain a green environment and improve the living standards of people living in city and economic. Now a days modern technology called information and communication technology (ICT) is playing a vital role in decision, policy design, ultimate and implementation service. In conjunction with the utilization of digital technologies the idea of the smart city is used, it at the same time depicts a reaction to the social, economic and political challenges that post-industrial societies. In this review machine learning algorithm are explained that show how smart city ICT can also improve lower healthcare cost for smart city residents and healthcare effectiveness. This paper gives a detailed survey of some recent techniques used for smart healthcare in smart city.

Indexed Terms-- Smart Cities, IoT, Machine Learning; Sensor Networks, Artificial Intelligence, Healthcare Mobile Health; Smart Environments, Smart Governance.

I. INTRODUCTION

Smart city for technologies can be defined as a collective term that concepts are directed towards to make city technologically more advanced, efficient and more socially inclusive. The term concept consists of economic, technical and social innovations. Operational research, urban computing and regional planning field as well as digital cities are presented by smart planning. Optimize city service are used for the process of analysis and integration. Information and communication technologies (ICT) are used by smart city in order to scale services. These services include transportation and utilities to a growing population. Machine learning techniques are combined with mobile and ambient sensors that shows how smart city infrastructure supports

strategic healthcare. ICT is adopted for smart city development. Now a days population is increasing day by day, it seems by 2050 population of global urban is expected to reach 70% or 66% respectively. The projects of smart cities can definitely deal with guaranteed adopting low carbon emission technologies for developing green environment. Efficient utilization of ICTs is highly necessary in order to meet the requirement of a smart city. ICT also play an important role in data communication and data analysis as well as in effective implementation of complex strategies It provide secure and smooth operation of smart city [1].

The most significant and important part of smart city application is Internet of things (IOT). The IOT helps in generating massive amount of data. As amounts of data is increasing day by day, it is hard to decide exactly the most efficient and accurate actions. There are various advanced techniques such as machine learning (ML), artificial intelligence (AI) and DRL (Deep Reinforcement Learning) which are used for analysis of large amount of data to reach optimal decision. The former techniques yield a longer-term objective into consideration. It can also lead to the near-optimal control decisions, the further accuracy and the precision of these techniques can be improved by increasing the amount of training data to strengthen their learning capabilities. Thus, the automated decision efficiencies.

Understand the ideal concept of a smart city with the help of Cyber-security which is the most important and significant aspect of a smart city. Cyber security plane can be realized as these techniques such as ML, AI and DRL in cyber-security is outstanding and has significantly impacted almost all the sectors of a smart city. The important feature of smart city and big data is energy generation, management, and consumption that impact on ICT-based SGs operations. Artificial Intelligence approaches used in

different ways such as treatment and especially with operations. AI also support medical staff prophylaxis and diagnostics. [2]. The challenges faced by society are population growth, population growth, healthcare, environmental pollution and demographic change can be deal. The approach for handle large amount of data efficiently is machine learning which is the key to successful implementation of the IOT powered wireless sensor network. Healthcare sector used AI-powered IoT and WSNs [3].

Transforming a city into smart city takes more time, it is complex process as it does not mean that   only by introducing novel technologies in territorial systems will transform the current urban problems and challenges into opportunities. The term used territorial systems refers to the combine of actors from diverse segments of society sharing a common space with values, principles and power relations. The developers, data scientists, computer scientists, urban regional planners and policy maker must be embraced as an interdisciplinary by the process of digital transformation. Different parameter such as temperature, humidity, allergens, pollution, traffic conditions, and power grid status in Smart cities rely heavily on sensors to perceive parameters. The values of these parameters provide a context that helps a system to understand the state of a citizen at any given time. Strategically responding to sensed data helps healthcare be smarter [4].

Many researchers have worked on algorithms and methods for smart healthcare in smart city. In this paper different existing methods have been discussed. The methods have been compared with each other to have future aspects in discussed area. The rest of paper is organized as follow, Section 1 contains the introduction of smart city healthcare, Section II contains machine learning and deep learning approach, Section III contains the detailed literature review and Section IV concludes the search work.

II.   MACHINE LEARNING AND DEEP LEARNING APPROACHES

Machine learning is a subset of artificial intelligence that empower a system to train (learn) data before being unveil.ML is a sub domain of artificial intelligence that build a set of statistical model and mathematics model for building intelligent machines like robot. Goal of machine learning is to create artificially intelligent system. Machine learning technique begins with aggregating training dataset after that train the classifier on the given training set. Basically, interested in predictive analysis which implies what is going to happen? AI has several applications in different domains i.e. speech recognition, image recognition, natural language processing (NLP) and object manipulation, human action recognition, human activity recognition.

The machine learning methods for Smart health care in Smart city rely on both supervised and unsupervised classification methods. In unsupervised learning approach, unlabeled data is present, unlabeled data is used to train classifiers because unlabeled data is easy to obtain while in supervised learning approach label data is present. Supervised learning can be seen as an excellent way to improve the results that researcher would get using exclusively supervised or non-supervised methods, for the same scenario. In supervised approach test data and training are needed for classification. Classification is performed via supervised learning in first stage and later on clustering is performed via unsupervised learning. Machine learning technique like Naïve Bayes and Support Vector Machine (SVM) have tremendous success in categorization. Other most well-known machine learning technique such as in natural language processing area are k-Nearest Neighborhood, centroid classifier, window classifier and the N-Gram model.

Some relevant machine learning approaches have been outlined below: supervised, unsupervised, semi-supervised and reinforcement learning which are described as follows:

 Supervised learning- This learning provides illustration such as learning with teacher here, teacher knows the answer and guides the trainer. Input featured vector and input classes are acknowledged which helps to provide classified output in the form of either number or classes. SL provides accurate and efficiently exact results in the form of classes or numbers. Testing in this learning can be time consuming if the dataset is of larger size. Different

supervised learning algorithm as follows: K-nearest neighborhood (KNN), Naïve Bayes Classifier, Decision tree, Linear Regression, Support Vector Machine (SVM Algorithms), Random Forest (RF), Artificial Neural Network (ANN) algorithms.

Unsupervised learning - This learning contains only input featured vector acknowledged in beginning and usually number of input classes are unknown. Unsupervised learning is used for analysis and divided into two main types such as. Association and clustering. The main task of clustering is to determine a novel group of categories, so the novel group is interested in itself and the assessment is important. Grouped the data objects s into small groups so that the related instances are clustered, and other instances belong to different groups. Clustering efficiently groups similar and relevant documents in one cluster to visualize documents in collections. Text mining is a data mining technique that is used to classify the huge semi structured data needs proper clustering. K-Means clustering provide the best efficiency . In short, clustering is the process of group the similar data into smaller cluster. In unsupervised learning objects within cluster have high similarities, cluster are formed based on the similarity between the object. Similar objects are grouped in a cluster based on the Euclidean distance. The similarity function can be used for calculating the similarity between the objects in text documents.

The task of clustering is to reduce huge amount of amount of raw data by categorizing in smaller sets of similar items. When all the components of the data instance vectors are in the same physical units then become possible to group similar data instances with the help of simple Euclidean distance. Some algorithms are given such as K-Means Algorithm, Hierarchical Algorithms, Principle Component Analysis (PCA Algorithm).

Semi-Supervised learning – This learning uses unsupervised method to improve supervised algorithms results that uses two stage or multi-stage process. In two stage process, first process namely as classification which is performed via supervised learning algorithms. Second stage process is clustering which is performed via unsupervised learning techniques.

Reinforcement learning (RL) - This learning is based upon the trial-and-error mechanism, that is prediction-based concept that implies it does not dependent upon data. Alternatively, it can also be referred as learning without the data. It is also a form of behavioral learning model. That receives feedback from the analysis of the data. This learning is mainly used in training of robots. Different Reinforcement learning algorithms as follows- Q learning, Hierarchical reinforcement learning algorithm, Temporal-difference learning and policy gradient algorithms Three different machine learning approaches were used in the experiments: Support Vector Machine, k-Nearest Neighbor and Na¨ıve Bayes classifier.

Naïve Bayes Estimation-The Naïve Bayes classifier is the simplest and commonly used classifier as it required less training data. , easily handles the different features separately . This method is important when estimation are produces in real time because it is not computationally complex.

K- Nearest Neighbor-The k-Nearest Neighbor approach is a good choice in human action recognition because of its simplicity. This method is also known as classification method which classifies a new sample that based on the labels of the k-instances in the dataset.

Support vector Machine-Support vector Machine is a kind of machine learning techniques based on supervised learning algorithm. SVM is also known as sample-based algorithm because data are separated from different classes where unknown samples are classified using trained model.

Multi-layer perceptron-Deep learning can learn feature representation directly from raw data. This learning method are used to solve complex problem that needed large number of neurons. Multi-layer perceptron extensively used as supervised learning method that why it is known as feed forward neural network. MLP consists of three layer such as input layer, hidden layer, output layer. MLP use one input layer, one output layer and many hidden layers. Perceptron used many hidden layers because number of hidden layers used are depend on problem and type of data used for the model.

Deep Neural Network-The deep learning is a sub part or branch of machine learning which is used for perception and feature extraction. The term deep neural network can be expressed as a neural network with a large number of hidden layers, also contain certain level of complexity. The structure of DNN and neural network are same. The only difference is number of hidden layers. DNN used multiple nonlinear layers.

III.   LITERATURE SURVEY

Zaib Ullah[1] focused on the applications of the preceding techniques in (ITS)intelligent transportation systems (ITSs). To assure the best services of 5G communication, energy efficient utilization of smart grid, cyber-security, smart health care system in a smart city application of techniques were studied. The term health intelligence was led to extensive used of machine learning, artificial intelligence, DRL techniques in healthcare mechanism as data rate increases in high performance IOT devices and cloud computing. Machine learning techniques can play an outstanding role to realize the concept of a smart city. Literature studied showed that former was very helpful in cure prediction, disease diagnosing, social media analytics for medical imaging and particular ailment.

Taher M. Ghazal [2] explained the challenges faced by urban society and focused on dealing these challenges such as population growth, healthcare, demographic change, environmental pollution, and the financial crisis. Fig1: showed the graphical representation of WSNs for smart cities. Thus, in a wider sense the term described the non-technical innovations that made urban life more sustainable. Further, IoT-based sensor networks for healthcare applications was capable one with the potential of minimizing inefficiencies in the existing infrastructure. In order to handle large amount of data wisely machine learning approach used for successful implementation IOT powered wireless sensor network. Paper described how healthcare sector used AI-powered IoT and WSNs. The target of this is to provide a baseline study toward smart cities, smart healthcare, and IOT as well as machine learning and

their co-relation, also explained the different technologies such as machine learning, IOT, AI, Block chain for the enhancement or development of healthcare system that result into development of smart cities. According to this, result enhanced the accuracy of expected result. Therefore, these techniques such as Sensor networks, IoT and machine learning offer better identify diseases. Untapped potential to relieve doctors.
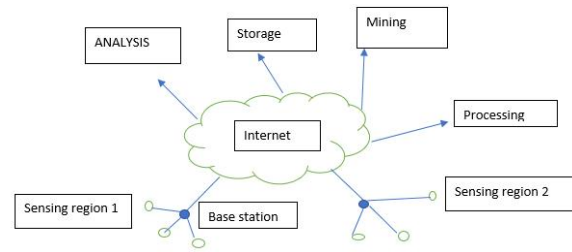

Fig1: Graphical representation of WSNs for smart cities

Farbod Akhavan Niaki[3] explained the effect of wear on dimensional integrity and the geometrical relationship of the tool-tip , as a result flank wear width was derived. The results were compared with different machine learning algorithm such as naïve Bayes and Support Vector Machine (SVM) classification strategies. According to these techniques probabilistic-based methods outperform the deterministic classifier. 3D finite element model was developed. It studied the wear effect on machining induced residual stresses. The result obtained from finite element model used for sharp tool were verified with the experimental results. After that, updated the sharp tool geometry to represent a wear land. The complete platform for monitoring the state of work piece health side together with wear estimation strategy for monitoring state of cutting tool for health in-process monitoring of the machining health in cutting hard-to-machine alloys. Support vector machine method was used for diameter deviation classification. Thus, it shown that the Extended Kalman Filter worked better for classifying 'accepted' and 'major rework with inspection' classes while naïve Bayes works better in classifying 'rework' class.
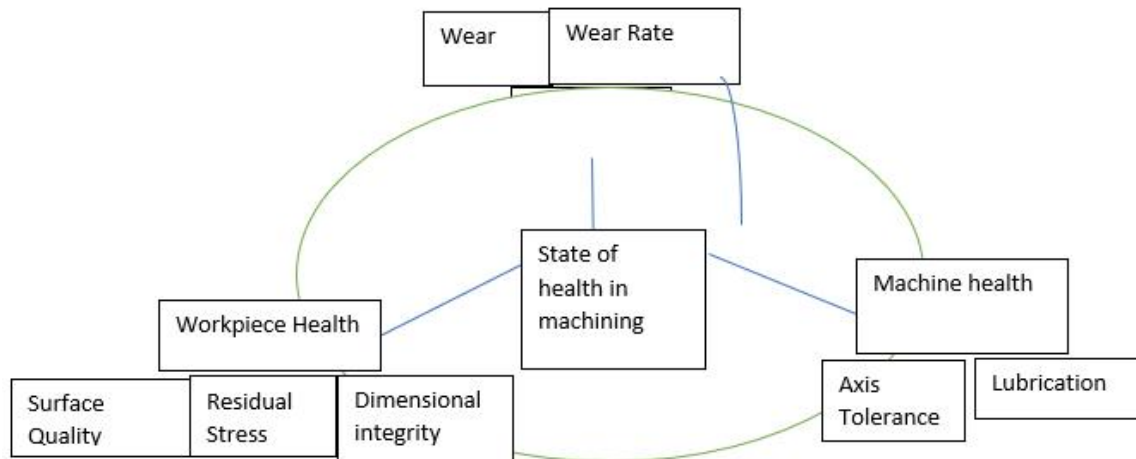
Fig2: Health of machining operation can be studied from 3 interlocked prospects: tooling health, workpiece health and machine health

Diane J. Cook[4] focused on how smart city infrastructure supports strategic healthcare. Smart city infrastructure using both ambient sensors and mobile in order to combined with machine learning. ICT was adopted for development of smart city, author form builds a foundation for smarter healthcare using smart city. According to this studied, first analyze data that was collected from ambient sensors and mobile for intervention and health assessment.

Lisanne de Wijs[5] explained how the smart city concepts were implemented by stakeholders. The author investigates the concepts in three station redevelopment projects in the Netherlands. The results obtained showed that in practice the current implementation of smart city concepts was varied little bit yet not very advanced, but modest. By the lack acceptance innovations and the Knowledge exchange were currently hampered. Transparency should be maintained about how and what data are used. Transparency might create more willingness among users to assist in developing and accepting new data technologies. Thus, the technologies are not yet completely developed. Concerns about the advanced use of data supplied technologies , "loss" of personal privacy are holding back the widespread . Most of the stakeholders seemed to be conscious of the opportunities that the smart city concept offers.

Robert Wilhelm Siegfried Ruhlandt[6] proposed conceptual insights and analyses the relevant body research scheme. The various smart city governance

definition exists, it also discloses, measurement techniques, substantial variances in contextual factors as well as outcomes among the concepts of smart city governance. The author showed an extended superordinate ontological structure allowing for different SCG archetypes. this paper contributes to the SCG discourse by illuminating the thematic topic of SCG from the joint perspective of four inductively developed and distinct categories.

IV.   CONCLUSION

The aim of smart city platform is to provide plug and play smart objects which could be deployed anywhere with an ability to blend into their surroundings.   Different technologies such as machine learning, IOT, AI, Block chain for the enhancement or development of healthcare system that result into development of smart cities. It enhanced the accuracy of expected result. Some author presented the application of machine learning, artificial intelligence, DRL in designing smart governance. The impact of air quality on health can be monitor easily, for this intervention can be design like changing city design, also provide real time information to the people to remain in home during poor air quality time. The future of healthcare is very auspicious. It considers the hasty development in various technology such as machine learning, artificial intelligence, sensors.

In future domain and industry experts will focus on enhance the efficiency of smart city using the

different techniques such as AI, ML, DRL. In order to get more accurate result large set of training data is used.

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