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"PERFORMANCE ANALYSIS OF SPECTRUM SHARING IN WIRELESS COMMUNICATION SYSTEM"

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ABSTRACT

At the same time as the mobile industry is faced with the explosion of mobile data caused by the increased use of smartphones, tablets, laptops, and other devices the regulatory authorities are challenged to find adequate spectrum resources to react to this trend. As the pressure from rapidly increasing mobile traffic places strains on finding additional frequency resources for mobile, frequency bands become more crowded and finding frequency bands that can be cleared for exclusive mobile use is becoming increasingly challenging. In this paper we present the spectrum sensing performance evaluation using the deep learning techniques, and our result shows that the better results than the previous work.

Key Words: *Wireless communication, Cognitive radio, Long term evolution, Artificial intelligence, Machine learning, deep learning.*

I. INTRODUCTION

A Software Defined Radio (SDR) is a transmitter in which operating parameters, including transmission frequency, modulation type, and maximum radiated or conducted output power can be altered without making any hardware changes. The classical method of demodulating high frequency signals is to shift the signal's frequency down in one or two steps before feeding it to a demodulator. The frequency shifting is necessary because the demodulation is more stable and easier to implement at lower frequencies. The demodulator block is designed to perform a fixed set of services (e.g., modulation and demodulation, encryption and decryption) chosen at design time. Advances in computer design and digital signal processing (DSP) make it possible to replace the classic demodulator with a component that dynamically supports multiple systems, protocols, and interfaces. The signal in this case is sampled by a high-speed analog-to-digital converter (ADC) and all the processing required to extract the useful signal is performed by a computer. This new approach enables an unprecedented flexibility in modulation and encryption capabilities because the digital signal processing module can be reprogrammed. Furthermore, the separation of the hardware platform from the functionality allows the emergence of standards for the hardware platform which, in turn, offers tremendous benefits for the development and deployment of SDR devices [1].

II. COGNITIVE RADIO

The radio frequency is a limited natural resource and getting enabled day by day due to growing demand of the wireless communication applications. To operate on a specific frequency band license are needed. The use of radio spectrum in each country is governed by the corresponding government agencies. In conventional technique each user is assigned a license to operate in a certain frequency band .Most of the time spectrum remains unused and it is also difficult to find it. The allocated spectrum has been not utilized properly; it varies with time, frequency and geographical locations.

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Thus to overcome the spectrum scarcity and unutilized frequency band, a new communication techniques cognitive radio (CR) and dynamic spectrum access (DSA) is introduced. CR network provides efficient utilization of the radio spectrum and highly reliable communication to users whenever and wherever needed [2]. DSA technology allows unlicensed secondary system to share the spectrum with licensed primary system. Joe Mitola and Gerald Maguire introduced the term CR in 1999.

According to Federal Communications Commission (FCC), CR is a radio or system that senses surrounding environment and dynamically adjust its radio parameters to communicate efficiently.

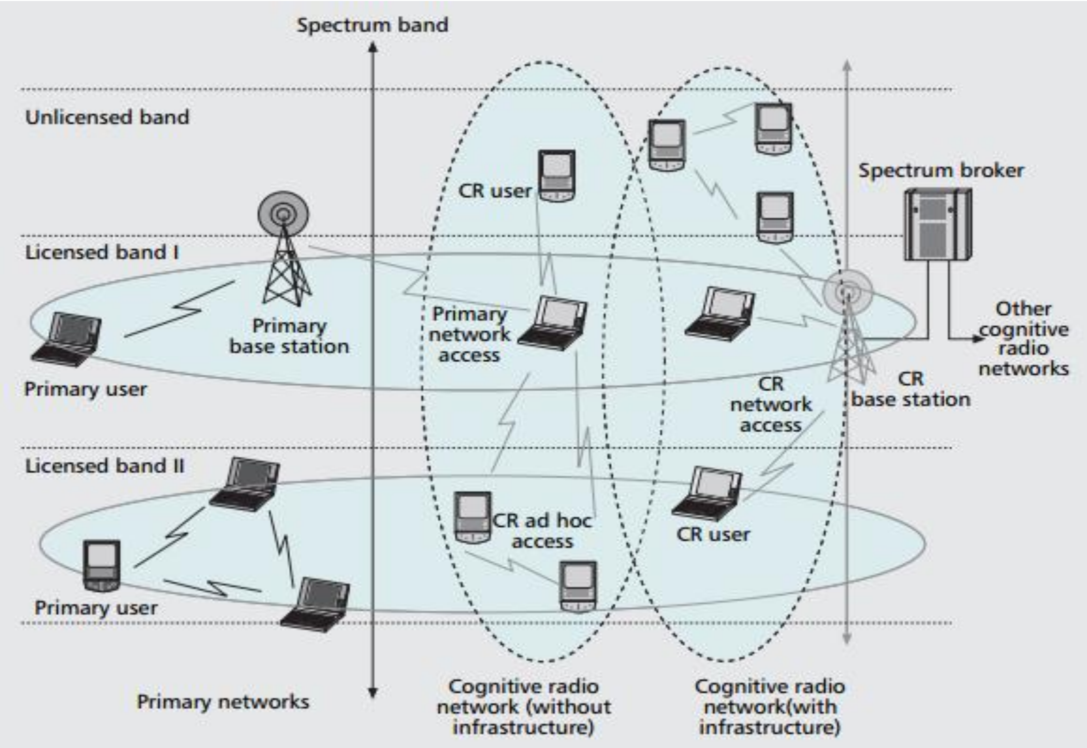

Fig 1: Architecture of cognitive radio network.

III. PROPOSED WORK

Recently, artificial intelligence (AI) techniques have been applied in spectrum sensing analysis. The AI technique is able to learn significant features from original historical data and can make a decision based on on-line data. Machine learning is an application of AI that includes algorithms that parse data, learn from that data, and then apply what they've learned to make informed decisions. Machine learning fuels all sorts of automated tasks that span across multiple industries, from data security firms that hunt down malware to finance professionals who want alerts for favorable trades. The AI algorithms are programmed to constantly be learning in a way that simulates as a virtual personal assistant-something that they do quite well. Deep learning is a subfield of machine learning that structures algorithms in layers to create an "artificial neural network" that can learn and make intelligent decisions on its own. In practical terms, deep learning is just a subset of machine learning. In fact, deep learning is machine learning and functions in a similar way (hence why the terms are sometimes loosely interchanged). However, its capabilities are different. While basic machine learning models do become progressively better at whatever their function is, they still need some guidance. If an AI algorithm returns an inaccurate prediction, then an engineer has to step in and make adjustments. With a deep learning model, an algorithm can determine on its own if a prediction is accurate or not through its own neural network.

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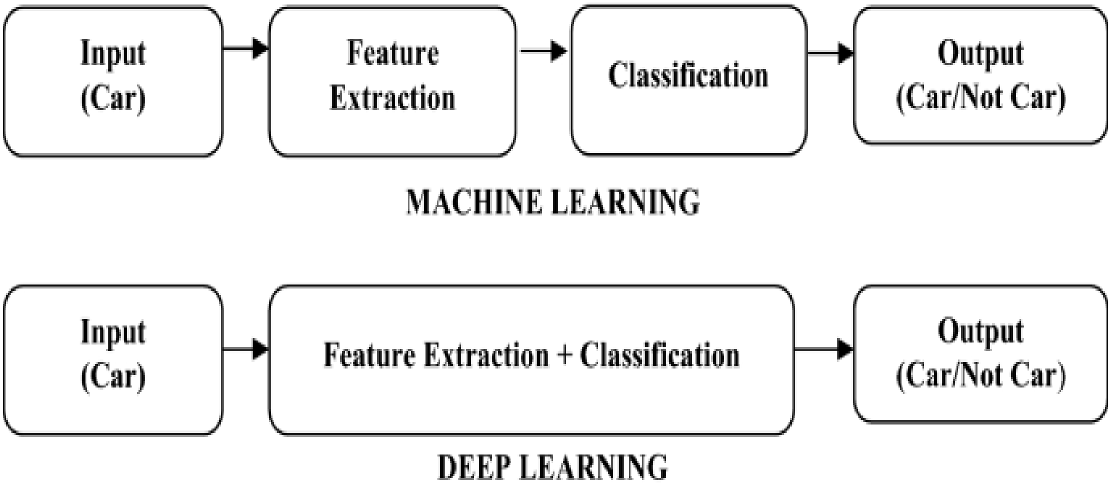

Fig 2: An example of Mahcine learning and deep learning.

Deep learning has been proved to be an advanced technology for big data analysis with a large number of successful cases in image processing, speech recognition, object detection, and so on. CNN including a set of components (convolutional layers, pooling layers, fully connected layers, and so on) is currently considered as one of the most popular machine intelligence models for big data analysis in various research areas. Conventional machine learning methods tend to succumb to environmental changes whereas deep learning adapts to these changes by constant feedback and improve the model. Deep learning is facilitated by neural networks which mimic the neurons in the human brain and embeds multiple-layer architecture (few visible and few hidden). It is an advanced form of machine learning which collects data, learns from it, and optimises the model. Often some problems are so complex, that it is practically impossible for the human brain to comprehend it, and hence programming it is a farfetched thought. A deep learning model is designed to continually analyze data with a logic structure similar to how a human would draw conclusions. To achieve this, deep learning applications use a layered structure of algorithms called an artificial neural network**.** The design of an artificial neural network is inspired by the biological neural network of the human brain, leading to a process of learning that's far more capable than that of standard machine learning models. It's a tricky prospect to ensure that a deep learning model doesn't draw incorrect conclusions-like other examples of AI, it requires lots of training to get the learning processes correct. But when it works as it's intended to, functional deep learning is often received as a scientific marvel that many consider being the backbone of true artificial intelligence.

A typical architecture of CNN model for classification problems is displayed in below figure. Convolution operations are implemented by traversing input matrices with convolution kernels that can be understood as filters for feature extraction. Different from filters used in conventional image processing method whose parameters need to be set manually, the parameters inside the kernel can be learned automatically by deep learning method. Convolutional layers are built by a set of convolution kernels, whose parameters (channels, kernel size, strides, padding, activation, and so on) should be set and optimized according to the practical problem. The computed output from convolutional layer is then sub-sampled by pooling layers. A group of chained convolutional layers and pooling layers can learn high level features representing the original input. The fully connected network (FNN) block, composed by fully connected neural units, is usually placed at the end as the classifier or used to generate numerical output for regression problems exploiting the learned feature map.

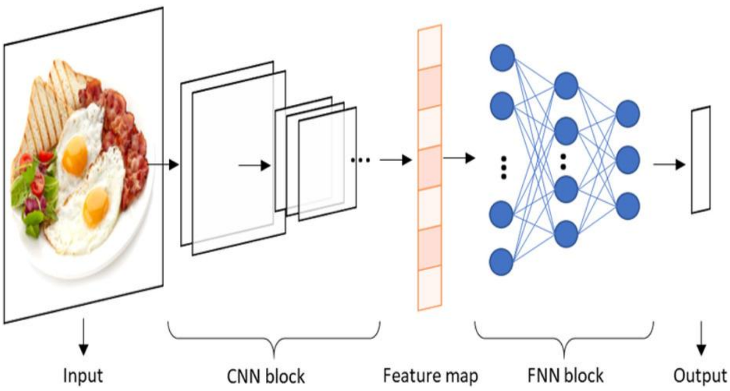

Fig 3: A typical CNN structure for classification.

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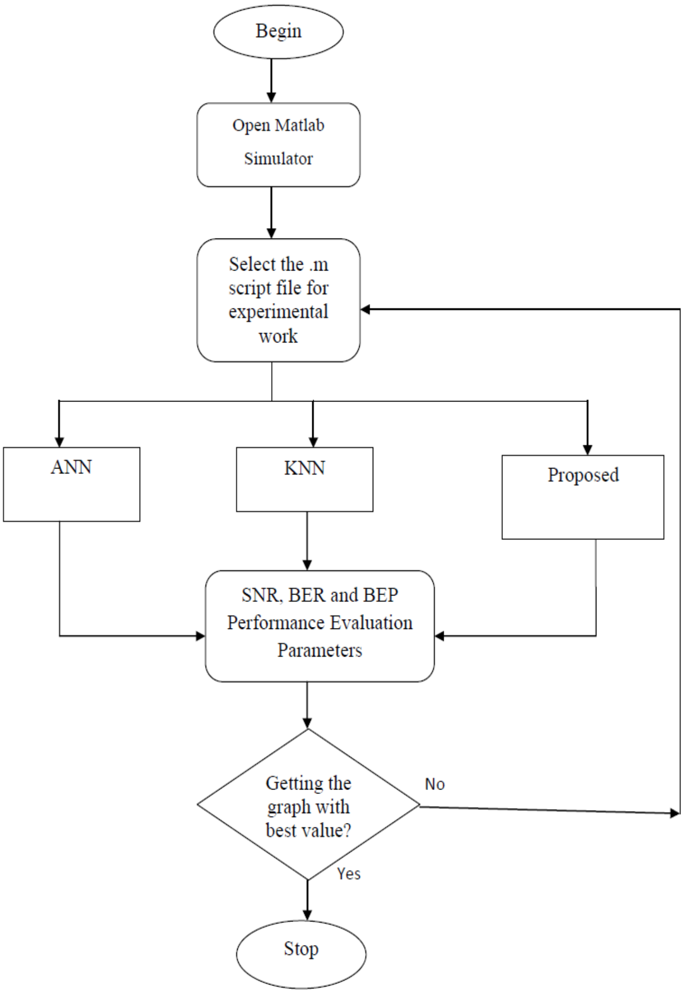

Fig 4: The above figure shows flow graph for the experimental process.

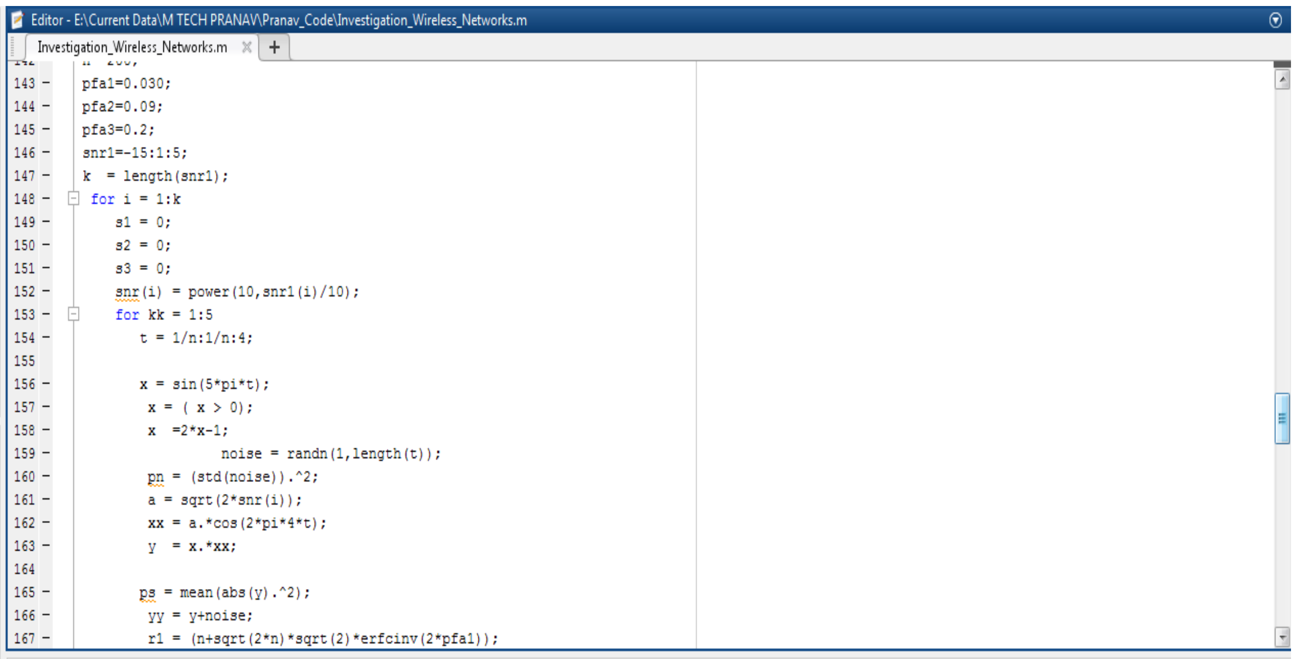

Fig 5: The above figure shows experimental work.

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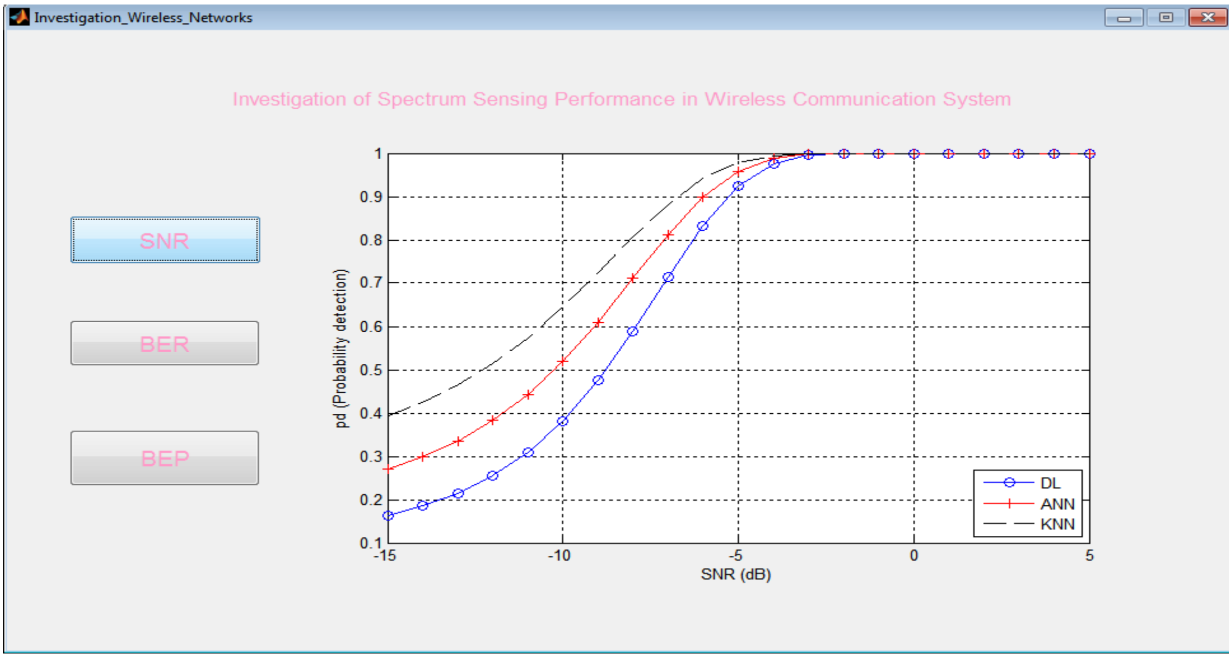

Fig 6: The above figure shows the performance parameter evaluation with experimental work.

IV. Conclusion

Currently, on the verge of the 5th generation (5G) of the mobile communication systems, forward looking spectrum policies and spectrum sharing are gaining attention as the enablers of the evolution. Regulatory concepts for spectrum sharing are being developed in all parts of the world. Some of these concepts are frequency specific, whereas others aim to provide a general framework that could be applied to different frequency bands. One of the pioneering concepts for frequency specific spectrum sharing which aims at higher utilization of the ultra-high frequency (UHF) band.

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