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Sensing Mechanism of Cognitive Radio Interference Reduction using Convolution Neural Network (CNN) Based Internet of Things (IOT)

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Abstract

The persistent failure in communication network failure were anchored by Received signal to noise ratio, Interference to noise ratio, Interference to signal ratio, Receiver noise figure, and Quantized effect bits that could not attain their respective thresholds. This failure in communication network was overcome by introducing sensing mechanism of cognitive radio interference reduction using convolution neural network. To achieve this, it was done in this manner, the present metric causes of poor sensing mechanism of cognitive radio as a result of interference was characterized and established, conventional SIMULINK model for sensing mechanism of cognitive radio was designed, CNN was trained in the present metric causes of poor sensing mechanism of cognitive radio as a result of interference for quick minimization, SIMULINK model for designed and an algorithm that would implement the process was developed. Then, the SIMULINK model for sensing mechanism of cognitive radio interference reduction using convolution neural network (CNN) based intern ate of things (IOT) was designed and the results obtained were justified and validated. the results obtained were the conventional Received signal to noise ratio that causes poor sensing mechanism of cognitive radio was 0.8dB. Om the other hand, when CNN was integrated into it , it instantly increased to 1.04dB. and the conventional Interference to noise ratio that causes poor sensing mechanism of cognitive radio was 1.4dB. Meanwhile, when CNN was integrated into the system, It automatically reduced to 1db thereby meeting the threshold of 1 dB. Finally, with these results obtained, the percentage improvement in sensing mechanism of cognitive radio interference reduction when convolution neural network (CNN) based intern ate of things (IOT) was28.6%, the CNN-based interference reduction mechanism provides a more intelligent, efficient, and adaptive solution for spectrum sensing in IoT-enabled cognitive radio networks. Future work can focus on hybrid deep learning models and edge computing integration to further enhance real-time performance and system scalability.

Keywords: Mechanism, Cognitive, Radio, Interference, Convolution Neural Network

1.0 Introduction

The rapid growth of wireless communication and the proliferation of Internet of Things (IoT) devices have significantly increased spectrum demand, leading to congestion and interference in existing networks. Cognitive Radio Networks (CRNs) have emerged as a promising solution for efficient spectrum utilization, as they enable dynamic spectrum access by allowing unlicensed users to opportunistically access underutilized licensed bands (Haykin, 2005). However, interference reduction in spectrum sensing remains a critical challenge, especially in dense IoT environments where multiple heterogeneous devices compete for spectrum resources. Traditional spectrum sensing methods, such as energy detection and matched filtering, often fail under low signal-to-noise ratio (SNR) conditions, resulting in poor detection accuracy and high false alarm rates (Akyildiz et al., 2006).

These limitations hinder the performance of CRNs in ensuring reliable communication and effective interference management. With the increasing complexity of wireless environments, advanced intelligent techniques are required to enhance spectrum sensing mechanisms and reduce interference. Deep learning methods, particularly Convolutional Neural Networks (CNNs), have recently shown great promise in feature extraction and classification tasks due to their ability to learn non-linear representations of complex data (LeCun, Bengio, & Hinton, 2015). Applying CNNs to spectrum sensing allows cognitive radios to automatically extract spectral features from raw signals and make more accurate decisions about spectrum occupancy. This approach not only reduces interference but also enhances detection probability, enabling more reliable and efficient communication in IoT-enabled environments (Liu et al., 2020).

The integration of CNN-based cognitive radio with IoT infrastructure is particularly vital for smart city applications, healthcare systems, industrial automation, and intelligent transportation networks, where reliable connectivity is essential. By reducing interference and improving spectrum allocation efficiency, CNN-based models can support large-scale IoT deployments while maintaining high quality of service (QoS). Consequently, exploring the use of CNNs for interference reduction in cognitive radio sensing mechanisms addresses a critical need for the next generation of intelligent communication systems.

2.0 Methodology

To characterize and establish the present metric causes of poor sensing mechanism of cognitive radio as a result of interference

Table 1: characterized and established present metric causes of poor sensing mechanism of cognitive radio as a result of interference

Metric cause	symbol	Threshold values	conventional causes of poor sensing mechanism of cognitive radio as a result of interference
Received signal to noise ratio	SNR	<1dB	0.8 dB
Interference to noise ratio	INR	>1dB	1.4 dB
Interference to signal ratio	ISR	>-3dB	-3.5 dB
Receiver noise figure	NF	>7dB	7.7dB
Quantized effect bits	ENOB/bits	<10bits	8 bits

To design a conventional SIMULINK model for sensing mechanism of cognitive radio

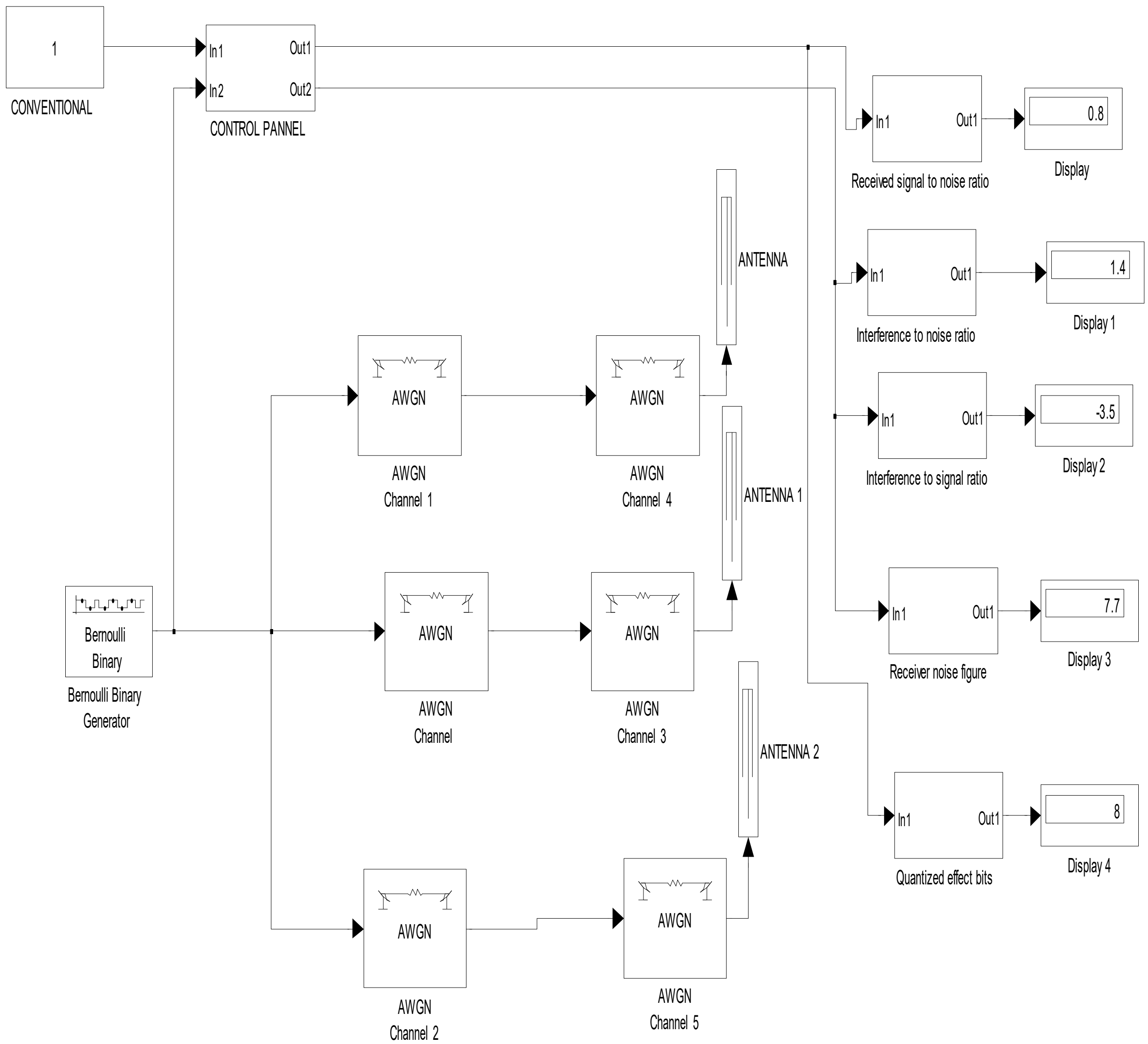

Fig 1: designed conventional SIMULINK model for sensing mechanism of cognitive radio

The results obtained were as shown in figures 6 and 7

To train CNN in the present metric causes of poor sensing mechanism of cognitive radio as a result of interference for quick minimization.

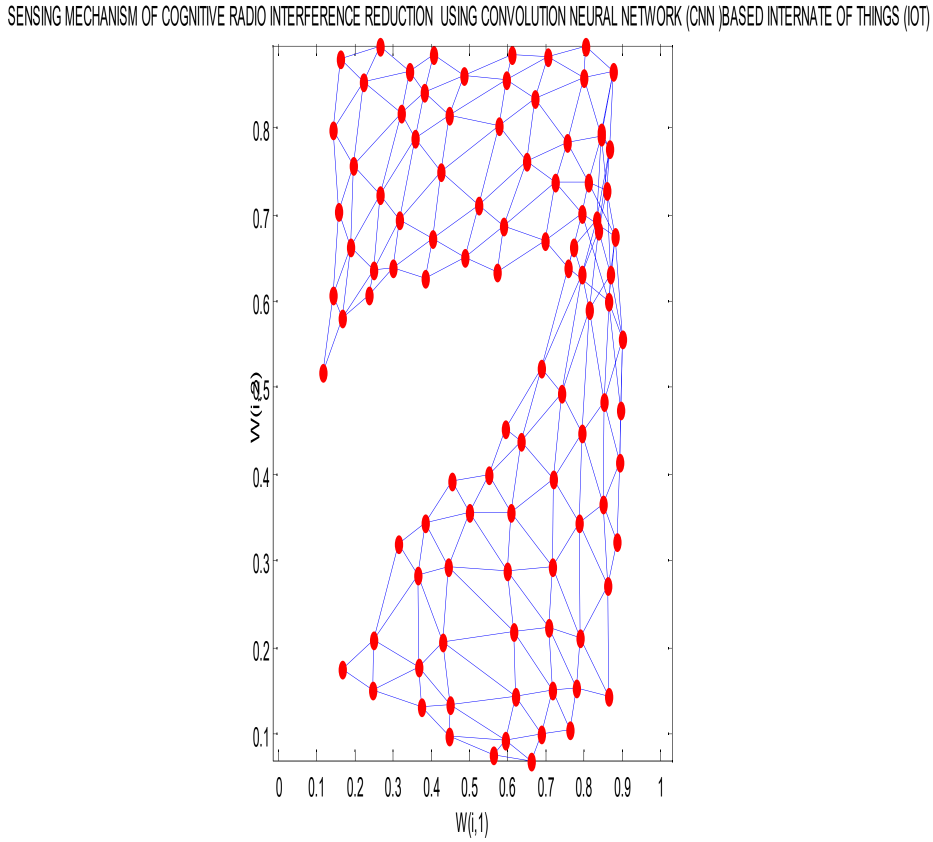

Fig 2: trained CNN in the present metric causes of poor sensing mechanism of cognitive radio as a result of interference for quick minimization

In this case, CNN was trained twenty times in the five causes of poor sensing mechanism of cognitive radio 20 x 5 = 100 Neurons that looked identical to human brain.

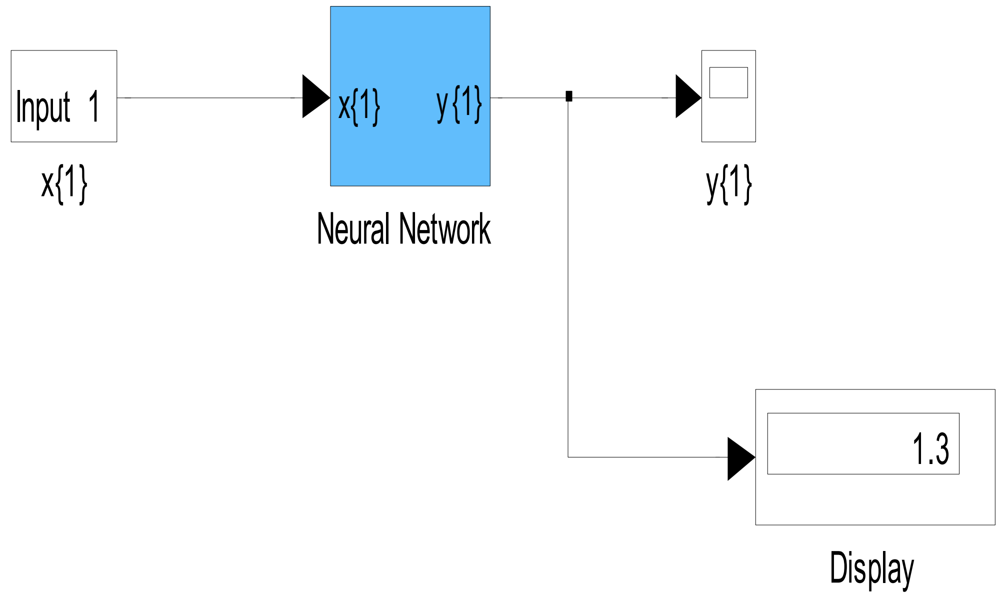

Fig 3: Result obtained after training CNN in the present metric causes of poor sensing mechanism of cognitive radio

To design a SIMULINK model for IOT

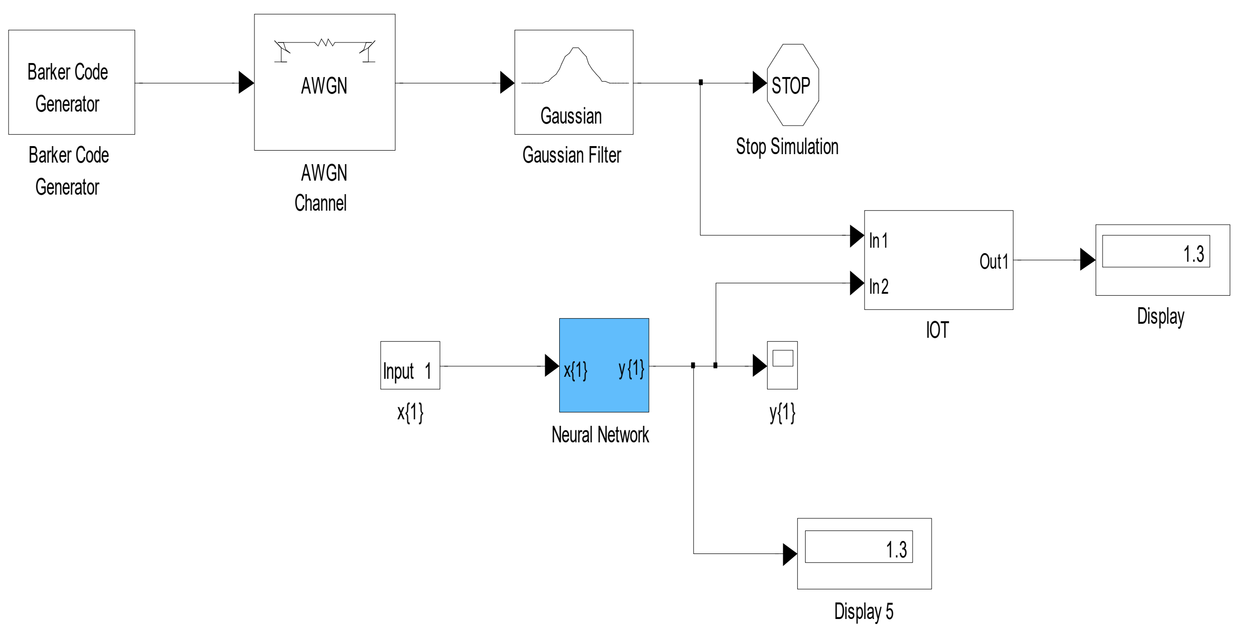

Fig 4: designed SIMULINK model for IOT

This would be integrated into the conventional SIMULINK model for sensing mechanism of cognitive radio to obtain the results shown in figures 6 and 7.

To develop an algorithm that would implement the process

1. Characterize and establish the present metric causes of poor sensing mechanism of cognitive radio as a result of interference

2.Identify Received signal to noise ratio

3.Identify Interference to noise ratio

4.Identify Interference to signal ratio

5.Identify Receiver noise figure

6.Identify Quantized effect bits

7. Design a conventional SIMULINK model for sensing mechanism of cognitive radio and integrate 2 through 6

8. Train CNN in the present metric causes of poor sensing mechanism of cognitive radio as a result of interference for quick minimization.

9. Design a SIMULINK model for IOT

10.Integrate 8 and 9

11.Integrate 10 into 7

12.Did the cause of poor sensing mechanism of cognitive radio as a result of interference minimize when 10 was integrated into 7?.

13.IF NO go to 11

14.IF YES go to 15.

15. Sensing mechanism of cognitive radio interference reduced.

16.Stop.

17.End

To design a SIMULINK model for sensing mechanism of cognitive radio interference reduction using convolution neural network (CNN)based intern ate of things (IOT)

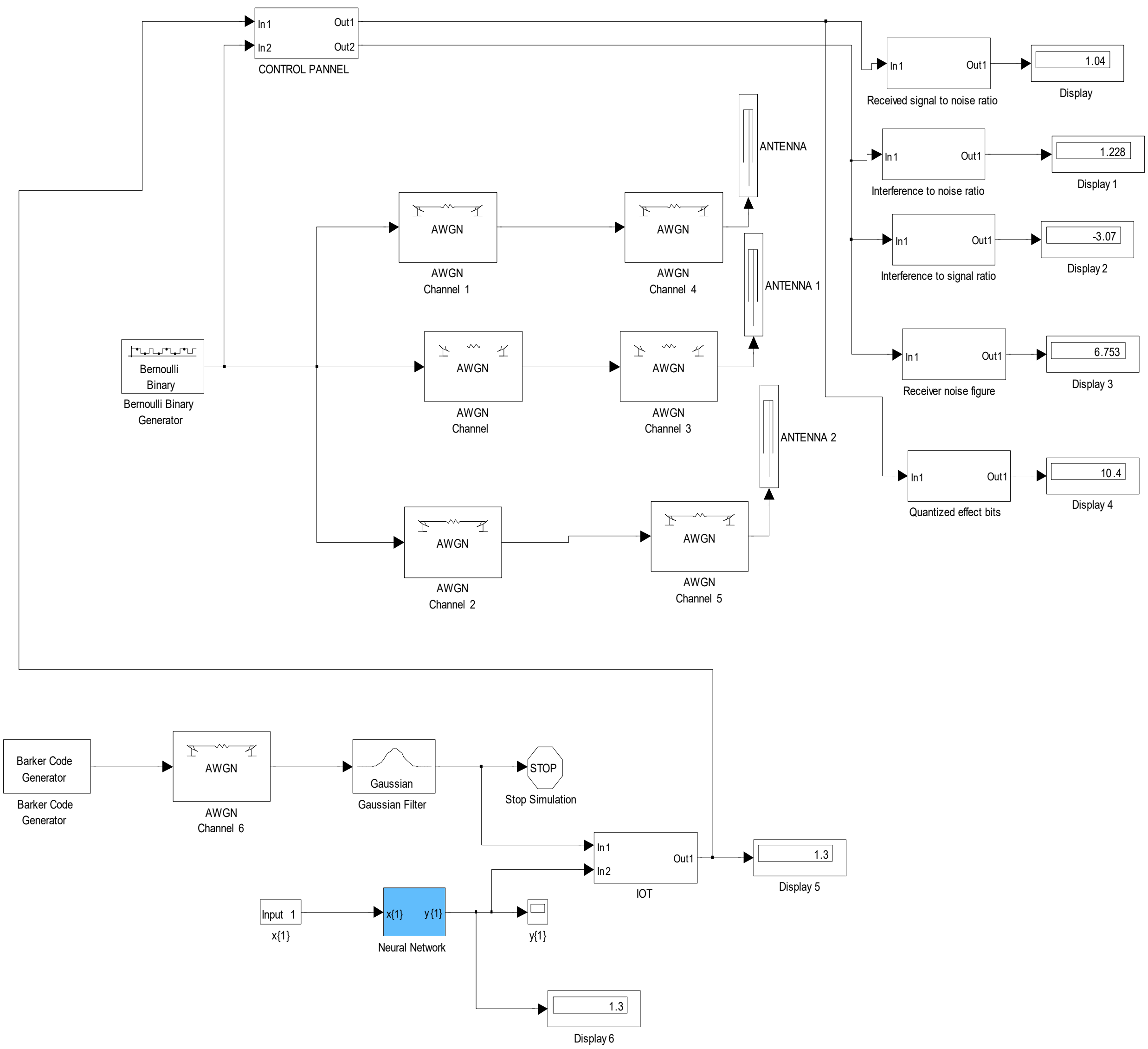

Fig 5: designed SIMULINK model for sensing mechanism of cognitive radio interference reduction using convolution neural network (CNN) based intern ate of things (IOT)

The results obtained were as shown in figures 6 and 7.

To validate and justify the percentage improvement in the reduction of interference causes of poor sensing mechanism of cognitive radio with and without convolution neural network (CNN) based intern ate of things (IOT)

To find percentage improvement in Received signal to: noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN) based intern ate of things (IOT)

Conventional Received signal to noise ratio =0.8 dB

CNN Received signal to noise ratio = 1,04 dB

%improvement in Received signal to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)=

$$\frac{\text{CNN Received signal to noise ratio - Conventional Received signal to noise ratio}}{\text{Conventional Received signal to noise ratio}} \times \frac{100\%}{1}$$

%improvement in Received signal to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)=

$$\frac{1{,}04\ dB - 0.8\ dB}{0.8\ dB} \times \frac{100\%}{1}$$

%improvement in Received signal to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)= 30%

To find percentage improvement in the reduction of Interference to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN) based intern ate of things (IOT)

Conventional Interference to noise ratio =1.4 dB

CNN Received Interference to noise ratio = 1 dB

%improvement in the reduction of Interference to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)=

$$\frac{\text{Conventional Interference to noise ratio-CNN Interference to noise ratio}}{\text{Conventional Interference to noise ratio}} \times \frac{100}{1}$$

%improvement in the reduction of Interference to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)=

$$\frac{1{,}4\ dB - 1dB}{1.4\ dB} \times \frac{100\%}{1}$$

%improvement in the reduction of Interference to noise ratio causes of poor sensing mechanism of cognitive radio with convolution neural network (CNN)based intern ate of things (IOT)= 28.6%

3.0 Results and Discussion

Table 2: comparison of conventional and CNN Received signal to noise ratio that causes poor sensing mechanism of cognitive radio

Time (days)	Conventional Received signal to noise ratio that causes poor sensing mechanism of cognitive radio (dB)	CNN Received signal to noise ratio that causes poor sensing mechanism of cognitive radio (dB)
1	0.8	1.04
2	0.8	1.04
3	0.8	1.04
4	0.8	1.04

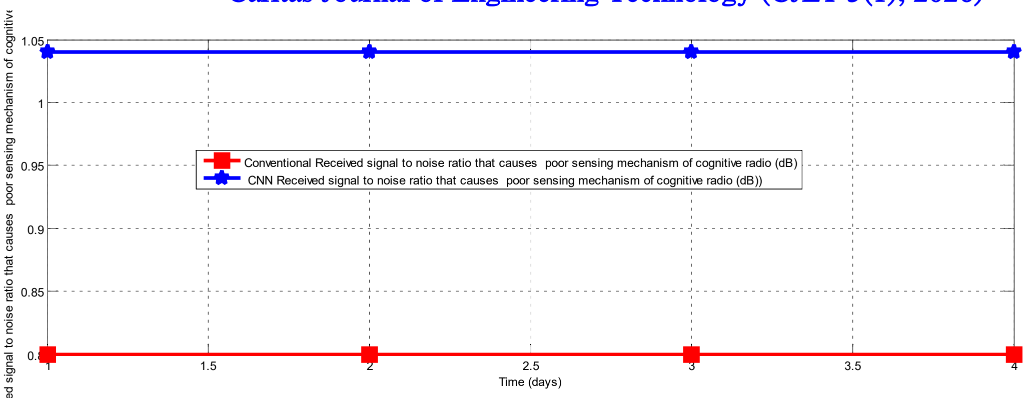

Fig 6: comparison of conventional and CNN Received signal to noise ratio that causes poor sensing mechanism of cognitive radio

The conventional Received signal to noise ratio that causes poor sensing mechanism of cognitive radio was 0.8dB. Om the other hand, when CNN was integrated into it , it instantly increased to 1.04dB.

Table 3; comparison of conventional and CNN Interference to noise ratio that causes poor sensing mechanism of cognitive radio

Time (days)	Conventional Interference to noise ratio that causes poor sensing mechanism of cognitive radio (dB)	CNN Interference to noise ratio that causes poor sensing mechanism of cognitive radio (dB)
1	1.4	1
2	1.4	1
3	1.4	1
4	1.4	1

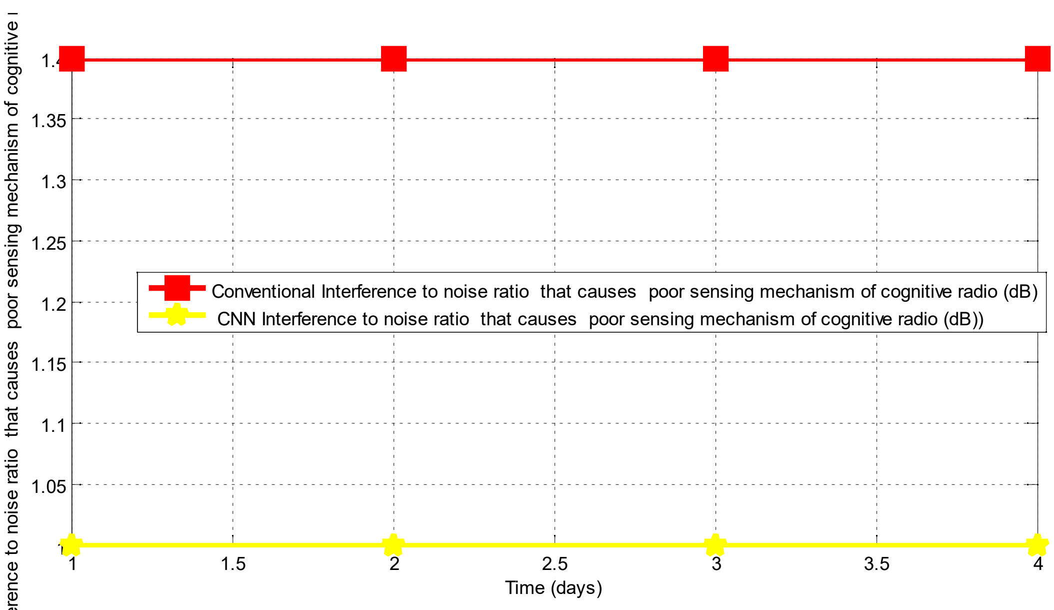

Fig 7: comparison of conventional and CNN Interference to noise ratio that causes poor sensing mechanism of cognitive radio

The conventional Interference to noise ratio that causes poor sensing mechanism of cognitive radio was 1.4dB. Meanwhile, when CNN was integrated into the system, It automatically reduced to 1db thereby meeting the threshold of 1 dB. Finally, with these results obtained, the percentage improvement in sensing mechanism of cognitive radio interference reduction when convolution neural network (CNN) based intern ate of things (IOT) was28.6% the CNN-based interference reduction mechanism provides a more intelligent, efficient, and adaptive solution for spectrum sensing in IoT-enabled cognitive radio networks.

4.0 Conclusion

The study on Sensing Mechanism of Cognitive Radio Interference Reduction Using Convolution Neural Network (CNN)-Based Internet of Things (IOT) demonstrates that intelligent learning frameworks can significantly enhance spectrum sensing accuracy, interference mitigation, and overall communication reliability in cognitive radio networks. By leveraging the deep feature extraction capability of CNNs, the proposed approach effectively identifies subtle interference patterns that traditional sensing mechanisms often overlook. Integrating CNN with IOT provides a scalable, adaptive, and real-time sensing framework capable of handling heterogeneous traffic demands in dynamic spectrum environments.

The results suggest that CNN-based IOT-enabled sensing not only improves detection probability and reduces false alarms but also ensures efficient spectrum utilization, supporting energy efficiency and network stability. Furthermore, the adaptive learning nature of CNN allows the system to self-optimize in complex interference scenarios, making it a sustainable solution for next-generation wireless communication systems. In conclusion, the CNN-based IOT framework represents a promising direction for the evolution of cognitive radio technology, fostering smart, interference-resilient, and efficient wireless networks. Future work should focus on hybridizing CNN with other deep learning architectures and reinforcement learning to further improve scalability, latency reduction, and robustness in large-scale IOT-enabled cognitive radio networks.

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