Deep Learning for Automatic Modulation Recognition

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***Abstract* - A cognitive radio (CR) is a radio device capable of sensing, learning and adjusting to adapt to external wireless environment. There are many types of modulation technologies , and one of the most essential functions in CR is two automatically select these modulation modes according to external environment. Automatic modulation recognition (AMR) is an essential and challenging topic in the devolopment of the cognitive radio (CR) and it is a cornerstone of CR adaptive modulation and demodulation capabalities to sense and learn environments and make corresponding adjustments .Hence we proposed a new system to get more accuracy by different modulation techniques and also we get samples at short time period by increasing speed.**

***keywords* - Cognitive Radio, Automatic Modulation Recognition, Adaptive modulation, Adaptive demodulation, Accuracy**

I. Introduction

Cognitive radio (CR) is a radio gadget equipped for detecting, learning, and changing in accordance with adjust to outside remote conditions. There are numerous kinds of regulation innovations, and quite possibly the most fundamental capacities in CR is to consequently choose these adjustment modes as indicated by outside conditions.

The framework considers both a deep convolutional neural network (CNN) and a long short term memory network. Further, we propose a pre-processing signal representation that combines the in-phase, quadrature and fourth-order statistics of the modulated signals. The presented data representation allows our CNN and LSTM models to achieve 8% improvements on our testing dataset. We compare the recognition accuracy of the proposed recognition methods with existing methods under various SNR values. Wireless communication technologies have experienced an extensive development to satisfy the applications and services in the wireless network. The explosion of advanced wireless applications, such as diverse intelligent terminal access, virtual reality, augmented reality, and Internet of things, has propelled the development of wireless communication into the fifth generation to achieve thousand fold capacity, millisecond latency, and massive connectivity, thereby making system design an extraordinarily challenging task.

II. RELATED WORKS

A Cognitive radio (CR) is a radio gadget fit for detecting, learning, and changing in accordance with adjust to outer remote environments. In this paper, we give an efficient outline on CR systems administration and correspondences by taking a gander at the critical elements of the physical (PHY), medium access control (MAC),and network layers engaged with a CR plan and how these layers are harshly related [1]. This paper presents two calculations for simple and advanced regulations acknowledgment. The main calculation uses the choice hypothetical methodology where a bunch of choice measures for distinguishing various kinds of tweaks is created. In the second calculation the fake neural organization (ANN) is utilized as another methodology for the regulation acknowledgment process[2]. Because of cutting edge execution of profound learning in the actual layer , profound learning has been brought continuously into CR for a scope of undertakings, the greater part of which can be ordered as one or the other grouping, relapse, or dynamic [3]. Millimeter wave (mmWave) monstrous different information various yield (MIMO) has been respected to be an arising answer for the up and coming age of interchanges, in which mixture simple and computerized precoding is a significant strategy for lessening the equipment intricacy and energy utilization related with inconsistent message components[4]. In a various information different yield (MIMO) framework, the accessibility of channel state data (CSI) at the transmitter is fundamental for execution improvement. Late convolutional neural organization (NN) based methods show serious capacity in acknowledging CSI pressure and input. By presenting another NN design, we upgrade the precision of quantized CSI criticism in MIMO communications[5]. In this paper, an EE+SE tradeoff based objective is considered for the essential clients (PUs) and the auxiliary clients (SUs)[6].

Non-symmetrical numerous entrance (NOMA) has been considered as a fundamental various access procedure for improving framework limit and ghastly productivity in future correspondence situations. In any case, the current NOMA frameworks have a principal limit: high computational intricacy and a pointedly changing remote channel make misusing the attributes of the channel and inferring the ideal distribution strategies extremely troublesome tasks[7]. The new idea of monstrous different information numerous yield (MIMO) can altogether improve the limit of the correspondence organization and it has been viewed as a promising innovation for the cutting edge remote interchanges. In any case, the central test of existing monstrous MIMO frameworks is that high computational intricacy and muddled spatial constructions carry incredible challenges to misuse the qualities of the channel and sparsity of these multi-radio wires systems [8]. We introduce and talk about a few novel utilizations of profound learning (DL) for the actual layer. By deciphering a correspondences framework as an auto encoder, we build up an essential better approach to consider interchanges framework plan as a start to finish remaking task that looks to mutually streamline transmitter and collector segments in a solitary process [9].AI (ML) has been generally applied to the upper layers of remote correspondence frameworks for different purposes, for example, sending of intellectual radio and correspondence organization. In any case, its application to the actual layer is hampered by complex channel conditions and restricted learning capacity of traditional ML algorithms [10].

III. PROPOSED SYSTEM

In the system Automatic modulation recognition (AMR) is an essential and challenging topic in the development of the cognitive radio (CR), and it is a cornerstone of CR adaptive modulation and demodulation capabilities to sense and learn environments and make corresponding adjustments. AMR is essentially a classification problem, and deep learning achieves outstanding performances in various classification tasks. So, this paper a deep learning-based method, combined with two convolutional neural networks (CNNs) trained on different datasets, to achieve higher accuracy AMR. In the proposed system we get more accuracy by different modulation techniques and also we get samples at short time period by increasing speed.

Input signal is given to preprocessing unit. The data is processing for that analog modulation and digital modulation to process of converting data into electrical signal optimized for transmission. The data is given to convolutional neural network (CNN), mainly classification of data are done at CNN network. CNN is used for feature extraction. After feature extraction the data are given to analog modulation classifier and digital modulation classifier. Use a pretrained network as a feature extractor by using the layer activations as features. Pretrained net also given to CNN and analog and digital modulation classifier. After that analog and digital modulation classifier will give final classifier data.

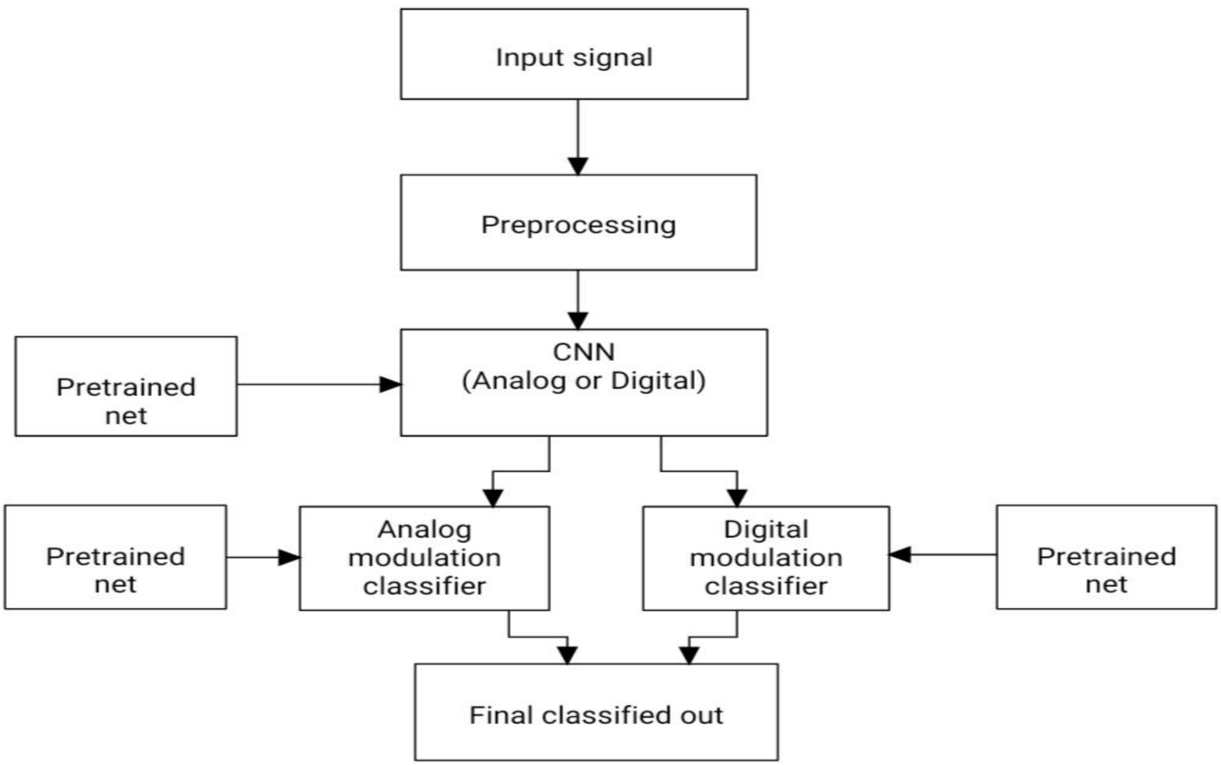

Fig 1: Block Diagram of Proposed System

IV. EXPERIMENTAL RESULTS

In this experiment to design an efficient communication system and the receiver has the ability to detect the type of the modulation of the signal it receives, using Automatic Modulation Recognition (AMR). The dataset contain digital modulation schemes are FSK, OOK and QAM and the analog modulation schemes are AM,PM and PWM, which are widely used in wireless communication systems. The purpose of modulation is to take a message signal and superimpose it upon a carrier signal. The carrier signals are chosen to be on high frequency because of several reasons. They are for easy propogation, they can be transmitted simultaneously without interfering with other signals, to enable the construction of small antennas, and to enable multiplexing.

The simulation performed in this project have been carried out in MATLAB. MATLAB is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows framework controls, plotting of functions and information, execution of algorithms, formation of user interfaces, and interfacing with programs written in different languages.

In this experiment we train the network is belong to **Figure 2** and show the training process of network.

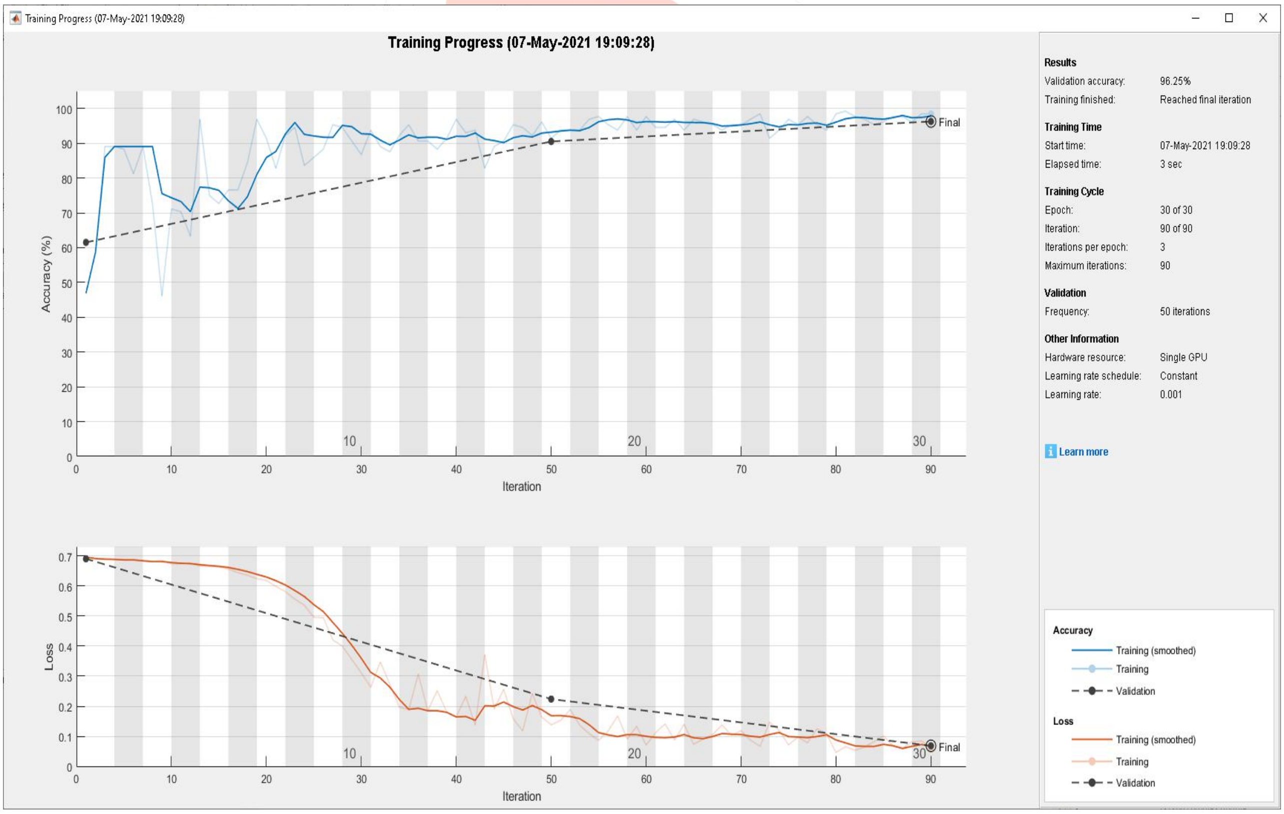

Fig. 2: Training progress of network

From this experiment we can recognise modulation type and which type of modulation is belongs to **Figure 3, Figure 4, Figure 5, Figure 6, Figure 7 and Figure 8** shows the example of modulation recognition of analog and digital modulation.

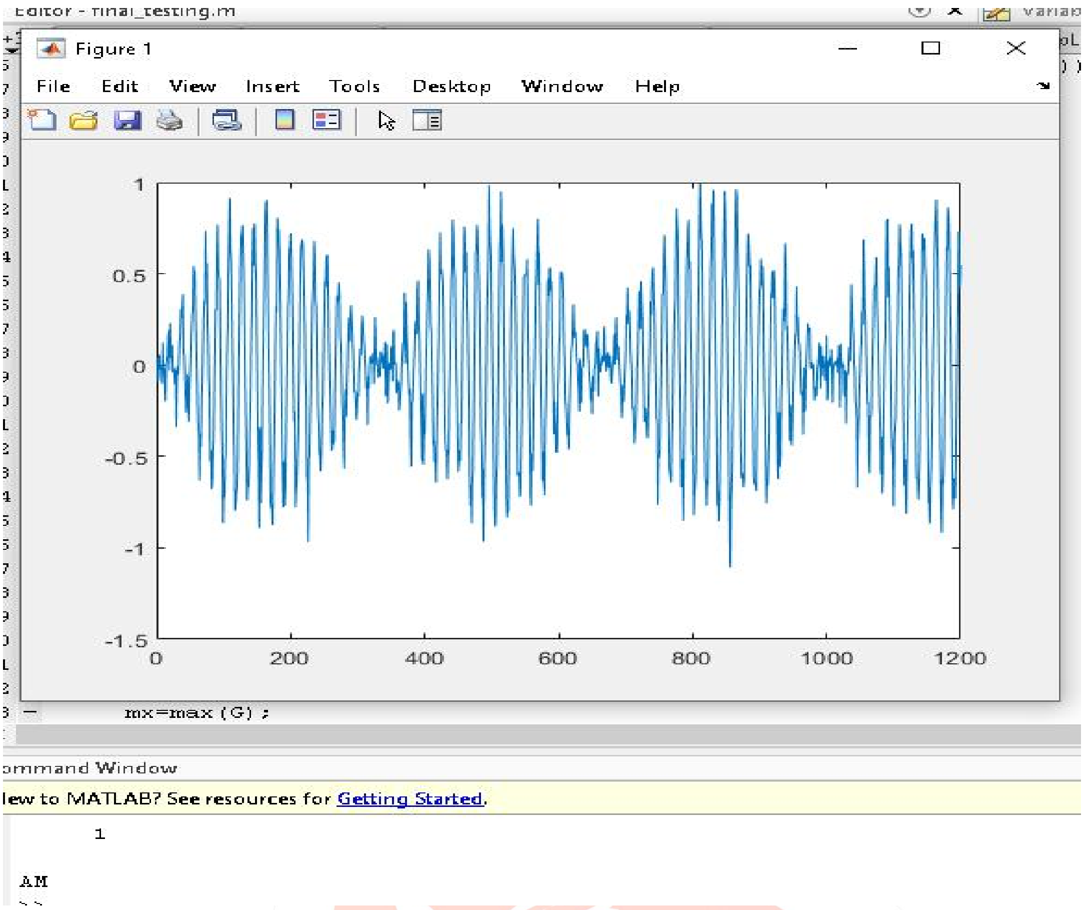

Fig 3: Modulation recognition of analog AM modulation

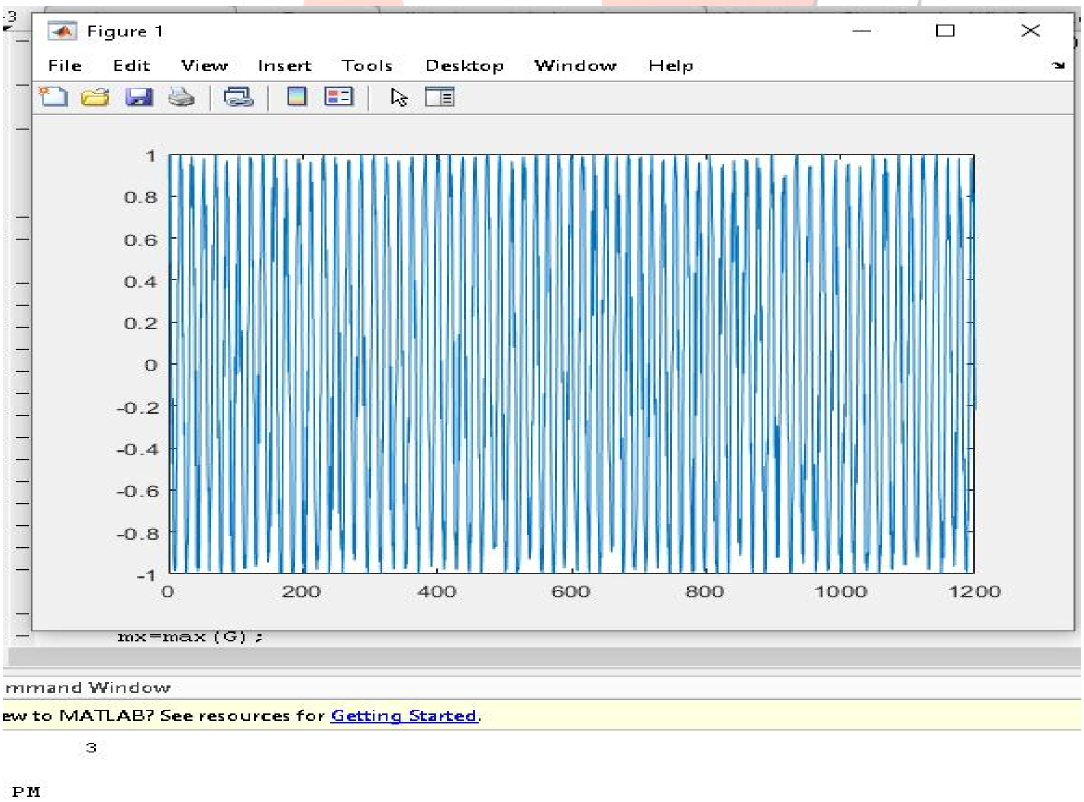

Fig 4: Modulation recognition of analog PM modulation

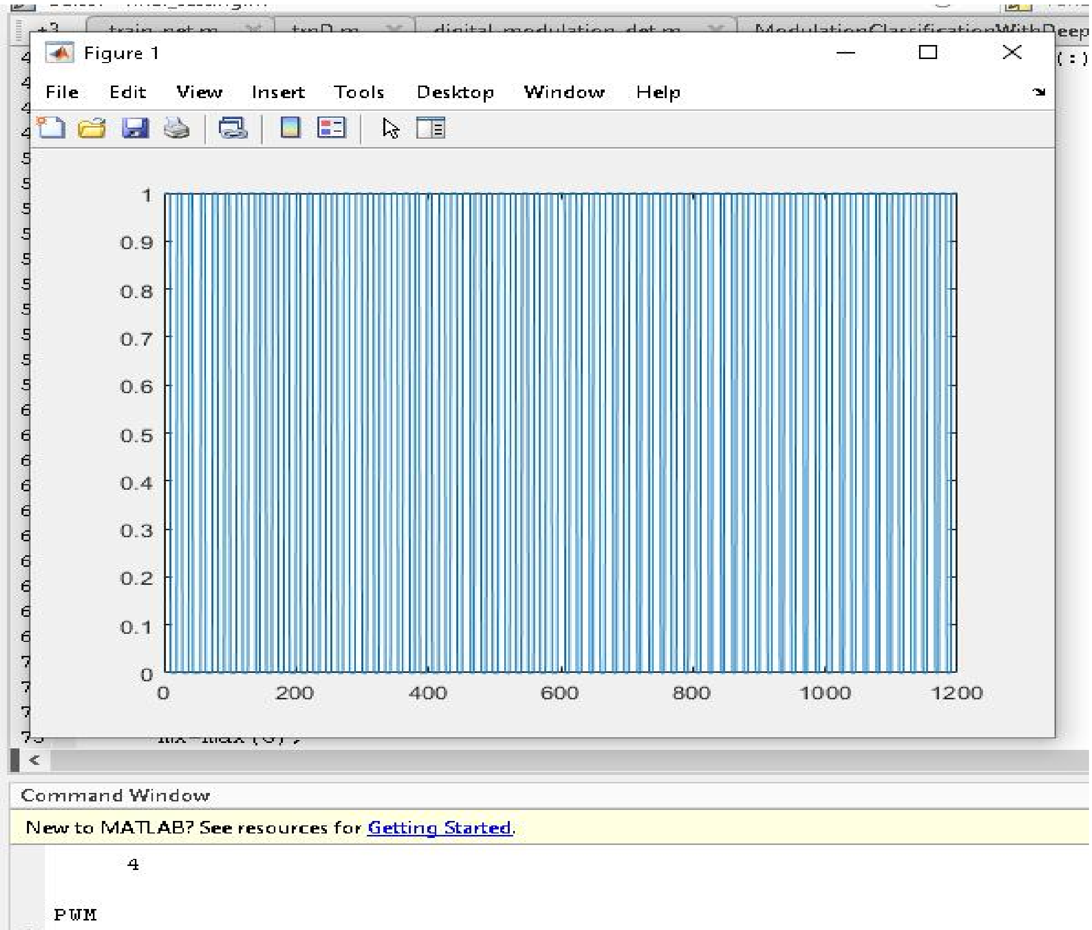

Fig 5: Modulation recognition of analog PWM modulation

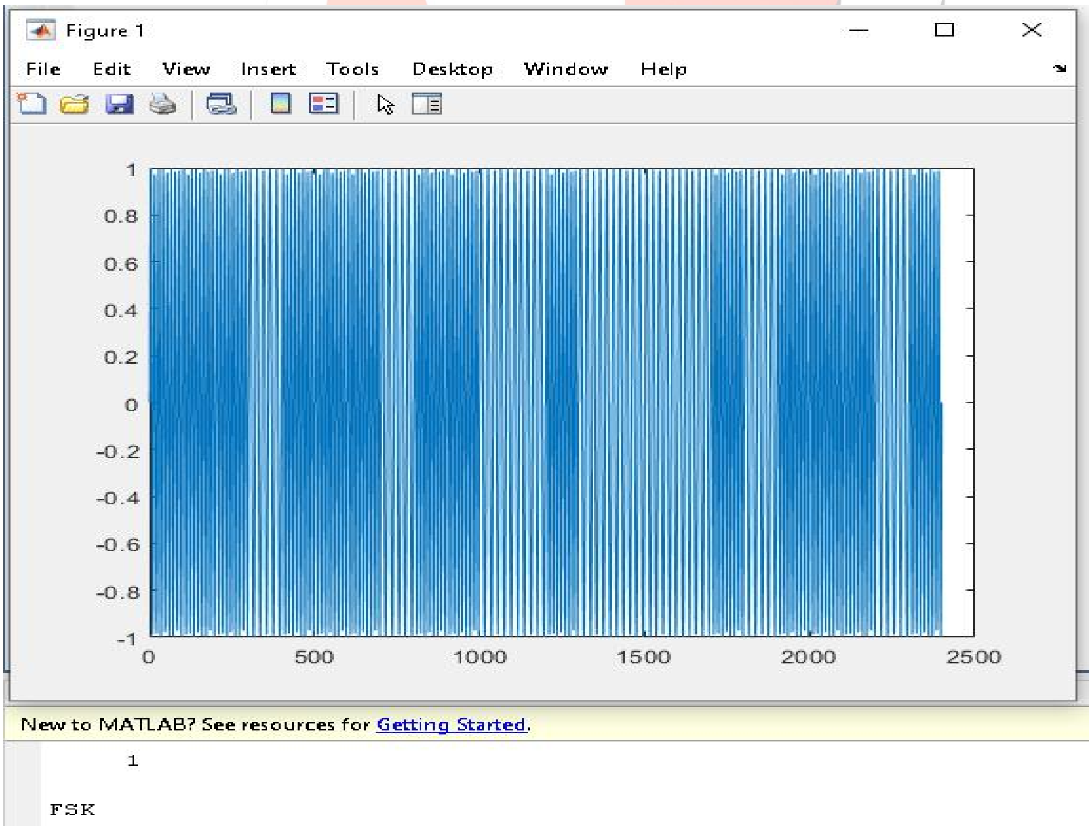

Fig 6: Modulation recognition of digital FSK modulation

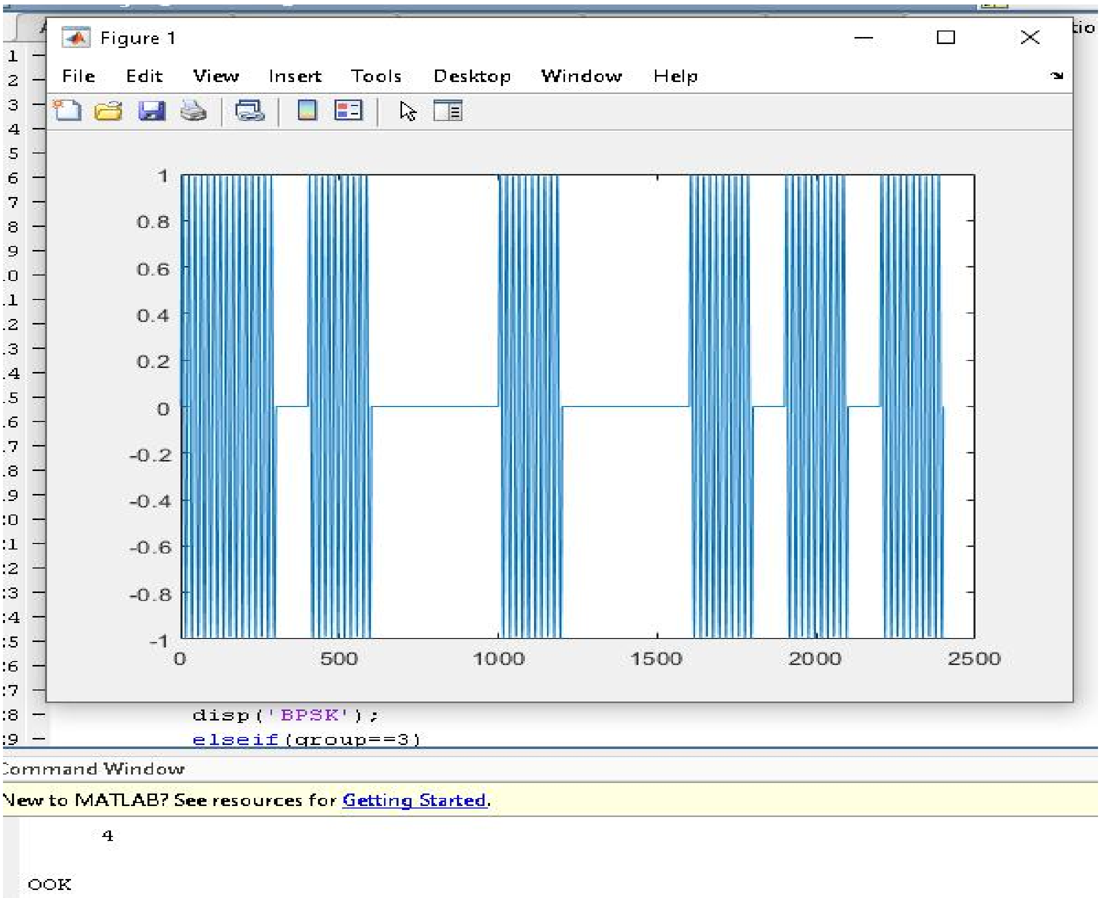

Fig 7: Modulation recognition of digital OOK modulation

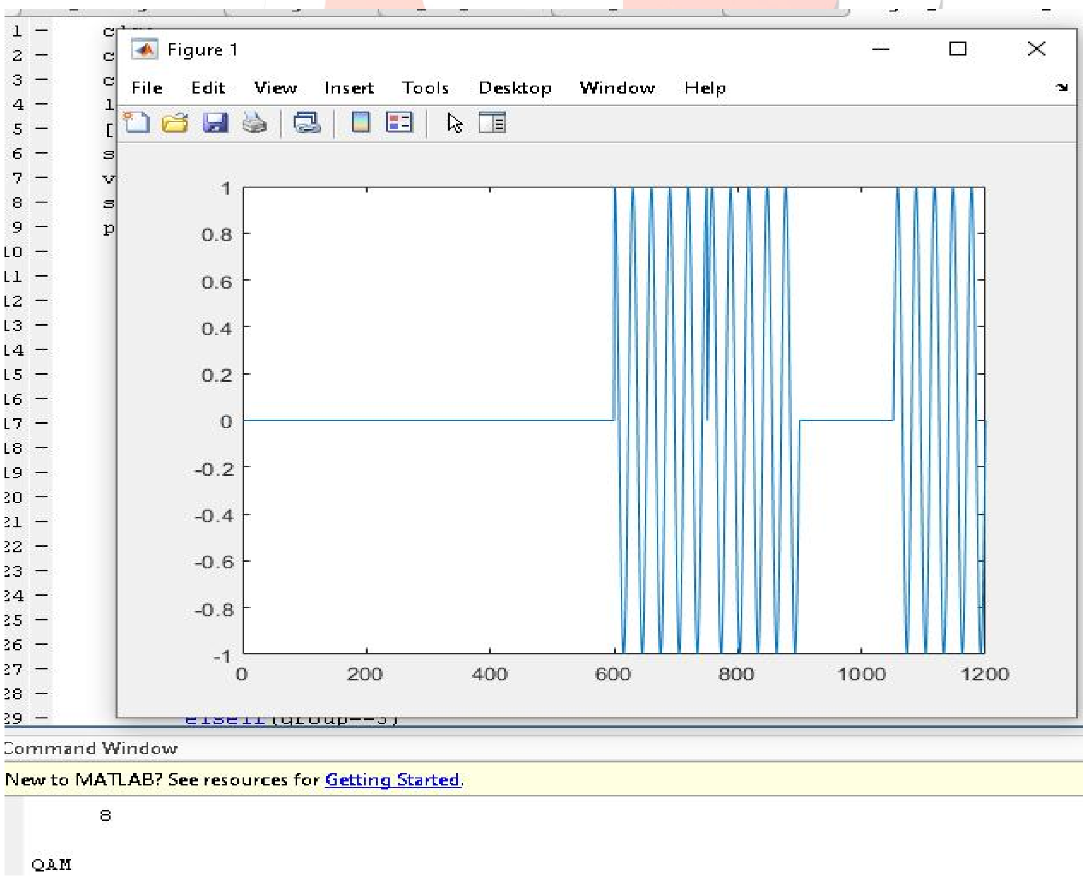

Fig 8: Modulation recognition of digital QAM modulation

V. CONCLUSION

Cognitive Radio (CR) is widely regarded as one of the most promising technologies for future wireless communications. To make radios and wireless networks truly cognitive, however, is by no means a simple task, and it requires collaborative effort from various research communities, including communications theory, networking engineering, signal processing, game theory, software– hardware joint design, and reconfigurable antenna and radiofrequency design. Deep neural networks have been pushing recent performance boundaries for a variety of machine learning tasks in fields such as computer vision, natural language processing, and speaker recognition. Recently researchers in the wireless communications field have started to apply deep neural networks to cognitive radio tasks with some success an automatic modulation recognition framework for the detection of radio signals in a communication system.

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