RF FINGERPRINT IDENTIFICATION USING MACHINE LEARNING

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Introduction

- In the Global system for mobile communications (GSM) system, all mobile devices have International Mobile Subscriber Identity (IMSI) which is unique for all devices. It is used to distinguish each device but it can be imitated and this can cause huge security problems. The project presents a solution to prevent this.
- It is mainly about the utilization of RF impairments of mobile devices caused by their hardware components such as ADC, DAC, mixer, etc.
- The CNN algorithm is constructed to learn the signals of the mobile devices and decide which device is radiating GSM signal.

Solution Methodology

- USRP B210 is manufactured by Ettus Research is used for signal capturing.

Ettus Research™ A National Instruments Brand

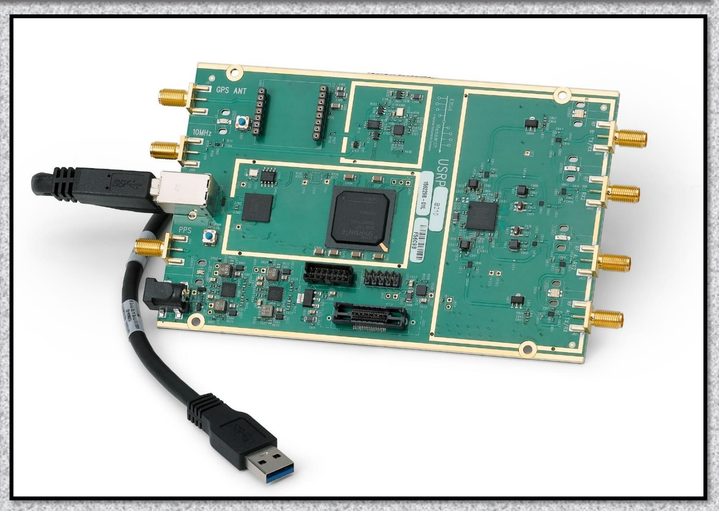

Figure 1. USRP B210

- GSM 2G was used for signal capturing since there are two many devices using 3G or LTE and these devices can create interference.
- Absolute radio-frequency channel number (ARFCN) is a code that specifies a pair of the uplink signal and the downlink signal in GSM cellular networks.
- The calculations in the table is used for DCS-1800 (Digital Cellular System)

Uplink (UL) Formula (MHz)	FUL(n) = 1710.2 + 0.2*(n-512)
Downlink (DL) Formula (MHz)	FDL(n) = FUL(n)+95

Table 1. ARFCN to frequency conversion

The signal is viewed and saved after the power squelching using GNU Radio companion.

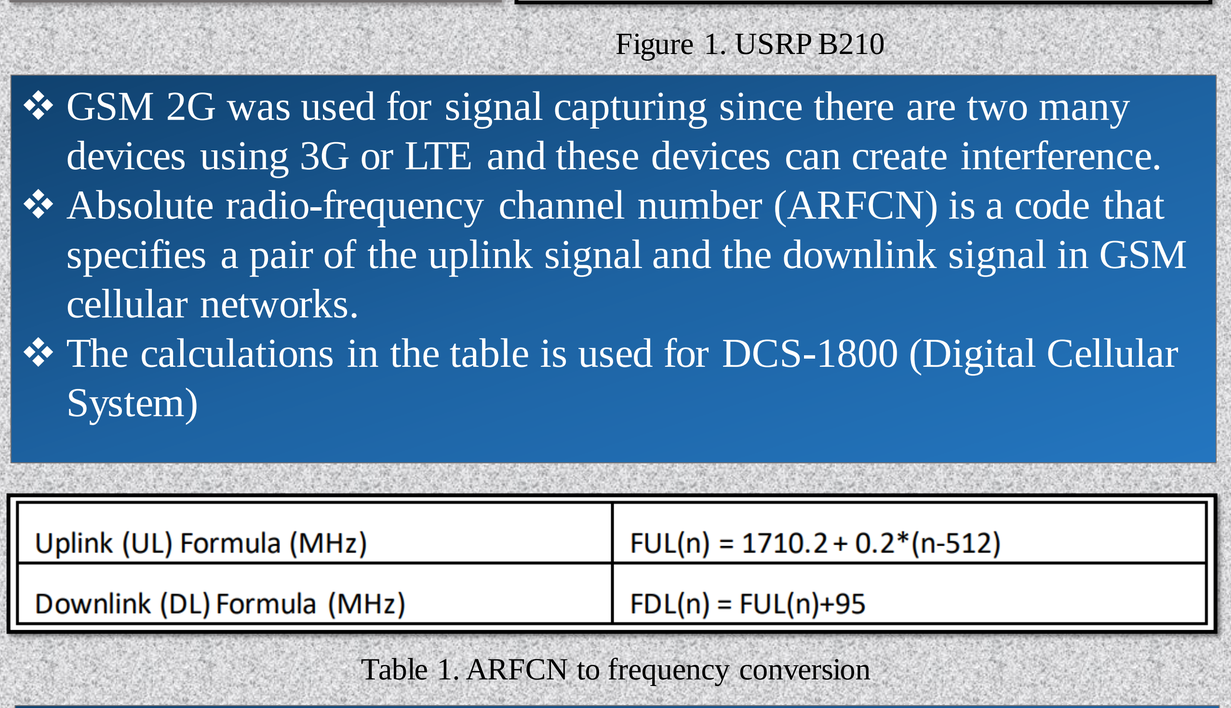

Figure 2. Signal Capturing Block Diagram

❖ This is an example of a captured uplink GSM signal. Since GSM 2G signals are using GMSK their time domain shape is like square waves and frequency domain shape is like sinc function

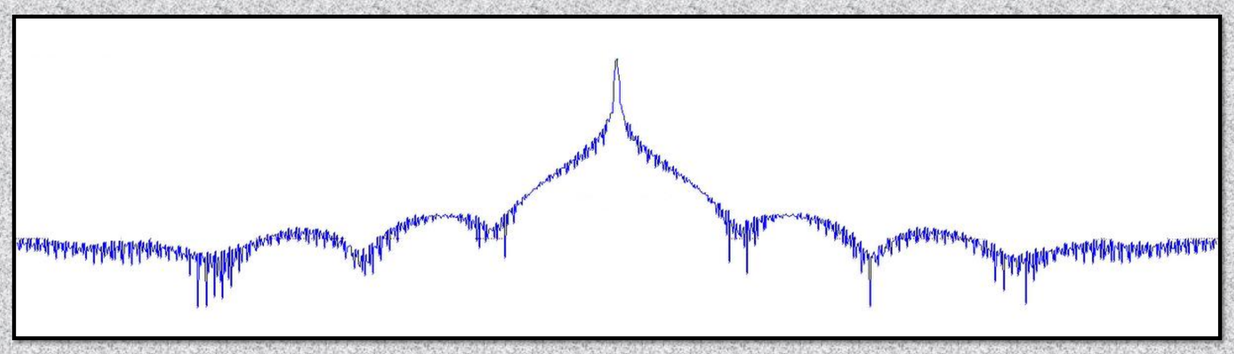

Figure 3. Captured UL GSM signal

MATLAB

- MATLAB is used to obtain the images which will fed the CNN algorithm. The images are 2D histogram of the constellation of the signals. The CNN algorithm is also constructed in MATLAB

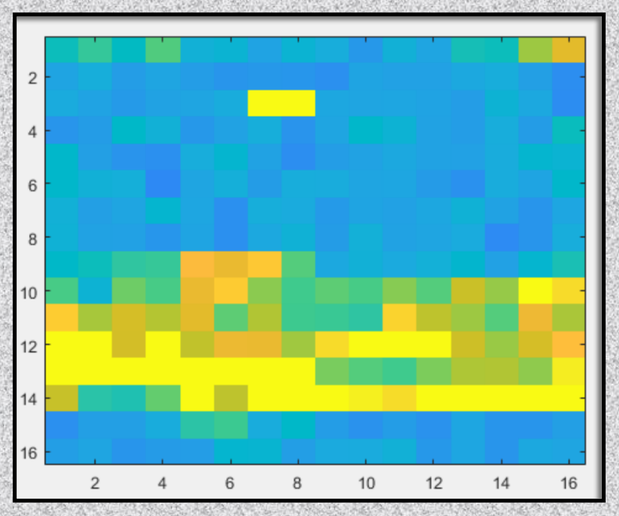

Figure 4. Example of constructed image

- Algorithm uses 1 convolutional layer, 1 hidden layer and 1 output layer.

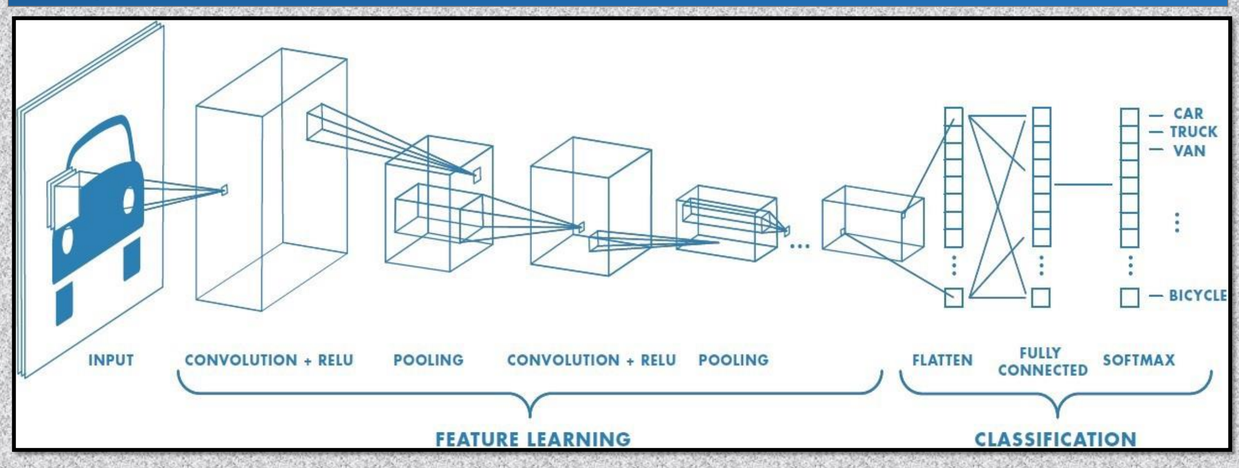

Figure 5. Block diagram of CNN algorithm

- According to predictions of the algorithm, the accuracy of the algorithm is 0.625.
- Confusion matrix gives an idea for us to understand the behavior of the algorithm. The algorithm is not inclined to predict one class more.

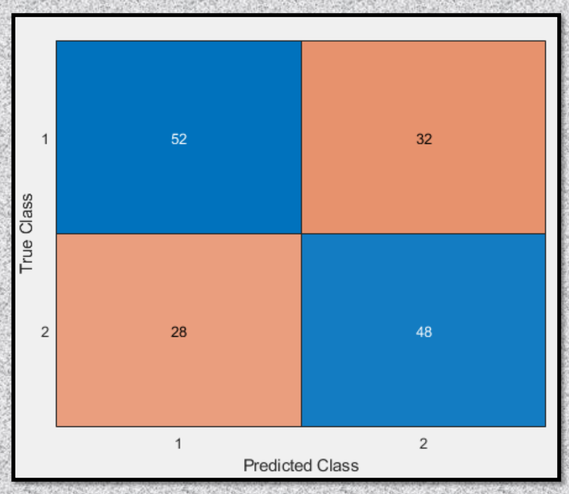

Figure 6.Confusion Matrix

Results and Discussion

- Accuracy can be progressed by increasing train dataset.
- Base stations can ensure the security using this algorithm.
- RF fingerprint identification can be used for all systems uses RF devices with the aim of ensuring security.

Acknowledgements

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