VERIFICATION OF THE AUTHENTICITY OF BULLION COINS WITH FREQUENCY ANALYSIS (USING AI)

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Bullion coins made of gold or silver are treasured by collectors and investors. Their high value makes them targets for counterfeiters who create fakes to deceive markets. This research explores a new approach to make authentication easier and accessible.

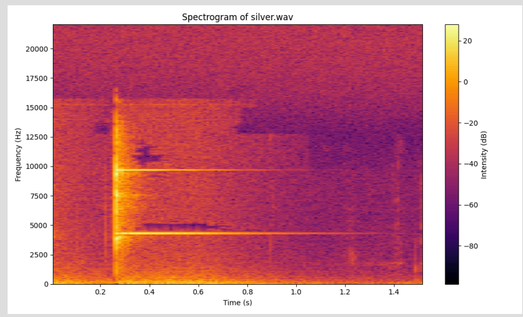
01 COUNTERFEITING CHALLENGE

Counterfeits threaten the value and trust in bullion coins. Traditional authentication like chemical tests or density checks often requires costly equipment or risks damaging the coin. These methods are impractical for most collectors or traders needing quick reliable checks.

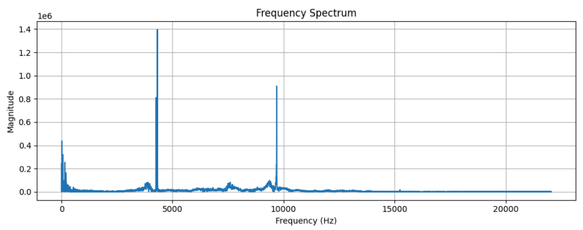
02 ACOUSTIC SOLUTION

This project offers a mobile app that verifies coins by their sound. Striking a genuine coin creates unique vibrations based on its material and shape. Fakes made of different metals sound distinct, allowing a non-destructive AI-based method to detect them.

03 USING SPECTROGRAMS



04 AI ANALYSIS



Fourteen silver coins were recorded, each struck 10 times, using a smartphone. The recordings were transformed into spectrograms. An autoencoder neural network was trained to recognize spectrogram patterns of genuine coins. A test coin's spectrogram was reconstructed—low reconstruction error indicates a genuine coin, while high error suggests a counterfeit. Techniques such as time-shifting were applied to augment the small dataset for improved training.

05 PERFORMANCE

The autoencoder performed well, with low error for genuine coins (MSE of 0.00056) and higher error for fakes (0.00132). Training converged, and spectrogram comparisons showed clear differences between real and fake coins.

06 CONCLUSION

This method is promising but limited by a small dataset and error metric. Future work will include more coins, improved error measures, and integration of other authentication techniques to enhance reliability.