

# FAKE CURRENCY DETECTION USING CONVOLUTIONAL NEURAL NETWORK AND IMAGE PROCESSING

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## ABSTRACT

*Counterfeit currency paper notes present a substantial threat to a nation's economy, being produced illicitly outside the bounds of legal authorization. It's crucial to discern between genuine and counterfeit currency to thwart the spread of such unauthorized notes. However, distinguishing fake notes is often a daunting task for the average individual. While financial entities possess sophisticated detection systems, the general public lacks accessible tools for verification. In this study, we propose a solution employing deep learning, specifically Convolutional Neural Networks (CNN's), to effectively differentiate between authentic and counterfeit currency paper notes. Our system operates in real-time, analyzing images of currency notes to ascertain their legitimacy. Through extensive evaluation on a dataset comprising genuine and counterfeit currency samples, our system demonstrates remarkable accuracy in identifying fake notes. This proposed solution holds*

*promise for implementation across various sectors, including banking, financial institutions, and businesses engaged in cash transactions. Timely detection of counterfeit currency mitigates their circulation, thereby safeguarding the economy and individuals from financial harm.*

## INTRODUCTION

Counterfeit currency remains a persistent challenge for governments and financial institutions globally, posing a threat to economic stability. Criminal entities fabricate fake notes, endangering unsuspecting individuals and businesses. Despite various technological advancements proposed to counter this issue, existing solutions have limitations that undermine their efficacy. The proliferation of counterfeit money not only undermines financial integrity but also presents a formidable challenge for ordinary citizens in discerning authenticity. Consequently, the detection of counterfeit currency has become a critical mandate for financial entities and law enforcement agencies. To address these

challenges, we advocate for a novel approach employing Convolutional Neural Networks (CNN's), a sub type of Deep Learning algorithms, to differentiate between authentic and counterfeit currency notes. Central to our proposal is the necessity for a substantial dataset encompassing both genuine and fake currency notes to train the CNN model effectively. Once trained, this model can be seamlessly integrated into a user-friendly interface, empowering users to swiftly authenticate currency notes. The following sections of this paper will proceed as follows: firstly, a thorough examination of previous research and literature will illuminate the existing gaps. Subsequently, we expound upon the dataset employed in our study. The subsequent section delineates our proposed system designed to address the research problem at hand, followed by an intricate exposition of the CNN architecture employed. A detailed analysis of experimental results ensues in the subsequent section. Finally, we synthesize the study's findings, discussing their broader implications, and conclude by listing the sources referenced in this paper.

## LITERATURE SURVEY

In their study, Qingyang Wu, Carlos Feres, Daniel Kuzmenko, and Ding Zhi delve into the realm of RF fingerprinting, employing deep learning techniques for device identification and bolstering wireless

security. an innovative approach to discerning hardware-specific characteristics in wireless transmitters. This technology holds promise for enhancing wireless security across various applications. The authors introduce a novel RF fingerprinting method leveraging deep neural networks. They specifically propose the utilization of a long short-term memory (LSTM) based recurrent neural network to automatically detect and classify hardware-specific traits of transmitters. Through experimental validation with identical RF transmitters, the study reveals remarkably high accuracy in detection, even amidst significant noise levels, underscoring the efficacy of their proposed approach.

“Utilizing Deep Learning for RF Fingerprint Identification via Differential Constellation Trace Analysis by Linning Peng, Junqing Zhang, Ming Liu, and Aiqun Hu” present a pioneering approach in this paper, introducing a fresh deep learning method for authenticating Internet of Things terminals via radio frequency identification. Unlike previous methods, Our method utilizes a differential constellation trace diagram (DCTD).to extract distinctive features from single time series without necessitating synchronization. Subsequently, Our custom-designed Convolutional Neural Network (CNN) is specifically optimized to distinguish between various devices using Discrete Cosine Transform Features

(DCTF). Remarkably, our DCTF CNN surpasses the performance of current CNN-based methods for identifying Radio Frequency Fingerprints (RFF) associated with different devices, boasting superior accuracy, independence from prior information, and reduced complexity.

## EXISTING METHOD

The term "existing system" refers to a currently operational and functional system or set of processes that is already in place and being used within a particular context. It could refer to various types of systems, such as computer systems, software applications, business processes, organizational structures, or any other established framework or mechanism. When discussing an "existing system," it often implies that there is some form of infrastructure or method already in use to fulfill specific needs or tasks. This contrasts with a proposed or potential system, which may be under consideration for implementation in the future. Analyzing and understanding the strengths, weaknesses, and characteristics of an existing system is crucial when considering upgrades, improvements, or replacements.

- SVM

### Support vector machine(SVM):

The Support Vector Machine (SVM) emerges as a prominent method in Supervised Learning, celebrated for its

adeptness in managing both Classification and Regression tasks. While its primary focus lies in Classification within the domain of Machine Learning, SVM aims at constructing an optimal line or decision boundary to partition an n-dimensional space into separate classes, enabling precise classification of forthcoming data points. This optimal boundary, referred to as a hyperplane, serves as the cornerstone of SVM's functionality. Fundamentally, SVM identifies pivotal points known as support vectors, which are pivotal in delineating the hyperplane. These support vectors play a crucial role in defining the decision boundary, thus earning SVM its distinctive title, Support Vector Machine. Below is an illustrative diagram showcasing the classification of two distinct categories using a decision boundary or hyperplane.

## DISADVANTAGES

- Accuracy is less with the svm training.
- False Results detected with model.
- Error Rate is more for the training and checking.

## PROPOSED METHOD

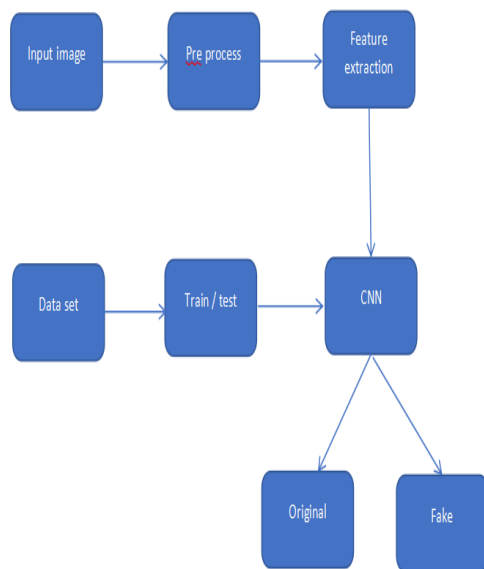
- Pre process
- Feature extraction
- CNN

## ADVANTAGES

- High Accuracy
- More than data loading

## SYSTEM DESIGN

### SYSTEM ARCHITECTURE



### INPUT IMAGE ACQUISITION:

In the domain of image processing and machine vision, image acquisition involves retrieving an image from a specified source, often hardware devices like cameras or sensors. This perspective resonates with the expertise of Raghava Kashyapa, a renowned figure in this field.

### PRE-PROCESS:

Image preprocessing encompasses a series of actions performed to prepare images for model training and inference. These actions

involve tasks such as resizing, orienting, and adjusting colors, among others.

### FEATURE EXTRACTION:-

Feature analysis suggests that we perceive distinct attributes, or features, in all objects and patterns we come across. Recognition-by-components theory posits that we identify objects by breaking them down into their constituent parts. These parts are conceptualized as three-dimensional shapes known as geons. This approach tends to yield superior outcomes compared to directly applying machine learning to the unprocessed data.

### TRAIN AND TEST :-

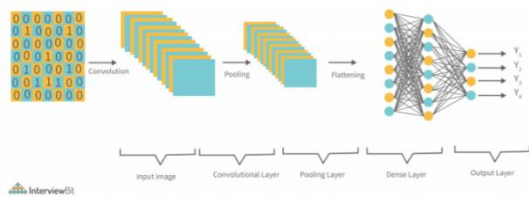
Datasets undergo a split into two subsets. The initial subset, termed the training data, constitutes a segment of the overall dataset utilized to feed the machine learning model, enabling it to discern and internalize patterns. Essentially, it serves as the model's training ground. Conversely, the second subset is referred to as the testing data.

## CONVOLUTION NEURAL NETWORK

### INTRODUCTION

Convolutional neural networks (CNNs) represent a fascinating blend of biology, mathematics, and computer science, with a profound impact on computer vision. The pivotal moment arrived in 2012 when Alex Krizhevsky leveraged CNNs to clinch

victory in the ImageNet competition, slashing the classification error from 26% to 15%. This breakthrough marked the ascent of neural networks in the realm of computer vision, akin to the Olympics of this field. Since then, deep learning has become the cornerstone of various tech giants' services. Facebook employs neural nets for automatic tagging, Google for photo search, Amazon for product recommendations, Pinterest for personalized home feeds, and Instagram for enhancing search infrastructure.



Addressing the concept of the problem space, image classification serves as the means for a computer to discern the content of an input image, assigning it to a specific class or determining the likelihood of various classes. This ability mirrors the innate skill humans possess from infancy, effortlessly recognizing and categorizing objects in our surroundings. While we effortlessly perceive and label images, computers rely solely on arrays of pixel values—essentially, numerical representations of image data—to perform this task. When a computer processes an image, it interprets it as a grid of pixel values, typically represented as a 32 x 32 x 3 array (with the third dimension indicating RGB

values). For example, a color image of size 480 x 480 would be represented as a 480 x 480 x 3 array. Each pixel's value, ranging from 0 to 255, denotes its intensity. Despite these numbers being meaningless to us, computers utilize them as the sole input for image classification, ultimately producing probabilities corresponding to different classes.

The objective for computers is akin to our own cognitive processes: to identify distinctive features that distinguish one object class from another. Just as we recognize a dog by its characteristic features like paws or four legs, computers employ convolutional neural networks (CNNs) to discern Rewrite gradually advancing from basic features like edges and curves, and progressing to more abstract concepts through convolutional layers. This strategy mirrors the hierarchical organization of the visual cortex, where distinct cells react to particular visual inputs, akin to a step-by-step evolution from rudimentary to sophisticated perceptions. such as edges of particular orientations. CNNs emulate this specialized functionality, with each layer detecting and extracting features essential for accurate classification. In a CNN, the initial convolutional layer plays a crucial role. This layer convolves filters across the input image, detecting patterns and producing activation maps, which represent the

presence of specific features. These filters act as feature identifiers, each specializing in detecting particular characteristics like straight edges or curves. Through this process, the CNN progressively extracts hierarchical representations of the input image, facilitating accurate classification. Thus, the problem space of image classification involves transforming raw pixel data into meaningful representations, akin to the cognitive processes underlying human perception. Through convolutional neural networks, computers achieve this feat by discerning intricate patterns and features, mirroring our innate ability to recognize and categorize visual information.

## SOFTWARE REQUIREMENTS

- Python idle
- Anaconda navigator
- Opencv

## HARDWARE REQUIREMENTS

- Working System : Windows So to speak
- Processor : i5 or more
- Crush : 4gb or more
- Hard Plate : 50 GB

## DEPLOYMENT DIAGRAM

The deployment diagram depicts the setup of the application's runtime components. It proves particularly valuable when the system

is fully constructed and prepared for deployment.



## FLASK

Flask stands out as a nimble and adaptable web framework designed for Python, ideal for crafting web applications. It is designed to be simple, easy to learn, and flexible, allowing developers to create web applications quickly and efficiently. Flask provides essential tools and libraries to handle tasks such as routing, HTTP requests, sessions, and template rendering.

### Key features of Flask include

**Routing:** Flask uses decorators to map URLs to functions, making it easy to define routes and create endpoints for handling different HTTP methods like GET, POST, PUT, DELETE, etc.

**HTTP Request Handling:** It offers request and response handling, allowing developers to work with incoming HTTP requests and craft appropriate responses.

**Template Engine:** Flask comes with Jinja2, a powerful and user-friendly template engine that enables the separation of HTML from Python code, facilitating the creation of dynamic web pages.

**Extensions:** Flask has a modular design, allowing developers to integrate various extensions for functionalities such as database integration (SQLAlchemy), form validation, user authentication, etc.

**Scalability:** While Flask is minimalistic by design, it's scalable and can be extended as needed by integrating various libraries and extensions, making it suitable for building both simple and complex web applications.

**Werkzeug and Jinja2:** Flask is built on top of the Werkzeug WSGI toolkit and uses the Jinja2 template engine, providing a robust foundation for web development in Python.

Overall, Flask's simplicity, flexibility, and extensive documentation make it a popular choice among developers for building web applications, RESTful APIs, and prototypes in Python.

## TEST CASES:

**Test case1:**(packages testing)

**Input:** downloading packages in interactive mode

**Output:** importing packages in script mode

**Test case2:** (Jupyter testing)

**Input :** user execution in jupyter notebook

**Output:** jupyter notebook

**Test case3:**(data process)

**Input :** load data

**Output:** load data and display data in output code

**Test case 4:**(pre-process)

**Input:** do pre-process

**Output:** did pre-process using resize and conversion

**Test case 6:**(output)

**Input :** find output

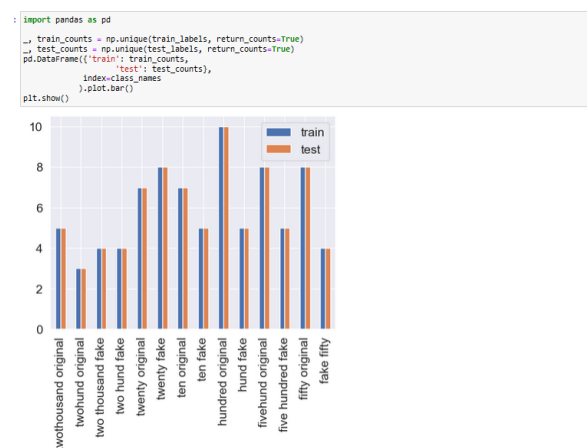
**Output:** do the training part with algorithm and check currency image real or fake

## OUTPUT SCREENS:

```

(train_images, train_labels), (test_images, test_labels) = load_data()
Loading C:/Users/Hp/Desktop/fakecurrency dataset/train
100% 4/4 [00:00:00, 59.741t/s]
100% 8/8 [00:00:00, 65.611t/s]
100% 5/5 [00:00:00, 14.891t/s]
100% 8/8 [00:00:00, 25.372t/s]
100% 5/5 [00:00:00, 16.571t/s]
100% 10/10 [00:00:00, 69.811t/s]
100% 5/5 [00:00:00, 192.431t/s]
100% 7/7 [00:00:00, 56.491t/s]
100% 8/8 [00:00:00, 76.971t/s]
100% 7/7 [00:00:00, 12.161t/s]
100% 4/4 [00:00:00, 69.811t/s]
100% 4/4 [00:00:00, 43.841t/s]
100% 3/3 [00:00:00, 98.951t/s]
100% 5/5 [00:00:00, 128.951t/s]
Loading C:/Users/Hp/Desktop/fakecurrency dataset/test
100% 4/4 [00:00:00, 66.711t/s]
100% 8/8 [00:00:00, 67.271t/s]
100% 5/5 [00:00:00, 14.711t/s]
100% 8/8 [00:00:00, 24.791t/s]
100% 5/5 [00:00:00, 16.621t/s]
100% 10/10 [00:00:00, 69.971t/s]
100% 5/5 [00:00:00, 185.251t/s]
100% 7/7 [00:00:00, 56.951t/s]
100% 8/8 [00:00:00, 75.521t/s]
100% 7/7 [00:00:00, 12.141t/s]
100% 4/4 [00:00:00, 67.841t/s]
100% 4/4 [00:00:00, 43.511t/s]
100% 3/3 [00:00:00, 85.761t/s]
100% 5/5 [00:00:00, 125.881t/s]

```





or both sides, front and back. To further refine accuracy, capturing images from various angles could be explored. The circulation of counterfeit currency poses a severe threat to a country's economy, underscoring the critical need for counterfeit detection. Some of the techniques discussed earlier are not only cost-effective but also efficient, enabling swift identification. Hence, selecting an appropriate approach based on specific applications is imperative. This effort should extend beyond banks to encompass other cash transaction venues like shops.

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