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Advanced Surveillance System with Encrypted Alerts and Privacy Enhancement

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Abstract - The proposed project "Advanced Surveillance System with Encrypted Alerts and Privacy Enhancement" addresses the critical need to increase public safety through a sophisticated security surveillance system. This multi-faceted system integrates core functions including real-time object detection, encrypted image capture, secure email alerts and comprehensive security measures. Different algorithms are used for face detection, which allows the system to continuously evolve and improve its object detection capabilities and adapt to real-world scenarios. The primary goal is to identify specific objects in public spaces and thus contribute to safer communities. The project further prioritizes the protection of captured and transmitted data, implementing strict security measures to protect against attempts to hack email accounts and decrypt images. This project represents a significant leap forward in security and surveillance, offering a versatile and adaptable solution designed to effectively address evolving public safety challenges..

Keywords — Encryption, Decryption, Cryptography, Object Detection, RNS, Machine learning algorithms.

1.INTRODUCTION

Our project addresses the critical challenge of ensuring security in an ever-expanding urban landscape and proposes a surveillance system for urban security. Population growth and the increasing complexity of the urban environment require innovative solutions for efficient monitoring of public spaces and rapid identification of potential threats. Traditional surveillance systems, which are limited by limited accuracy and speed, do not meet the requirements of modern urban security. In response, our project presents a revolutionary solution that integrates advanced image processing and encryption technologies. Using artificial intelligence and encryption algorithms, the system aims to revolutionize the identification and reporting of specific people in public spaces, ultimately contributing to a safer urban environment for all.

Our urban security tracking system uses state-of-the-art machine learning techniques for robust object detection, improving the system's ability to identify and analyze various objects in real-time. In addition, the system uses the Residue Number System (RNS) to encrypt and decrypt images, ensuring secure data transmission and storage. The key used for encryption and decryption plays a key role in achieving high security standards and privacy through state-of-the-art encryption techniques. This two-step approach not only improves object detection capabilities, but also prioritizes privacy, making it a comprehensive and ground-breaking solution to urban security challenges. The system ensures the quality of image encryption and contributes to the overall efficiency of urban surveillance and public safety.

2. LITERATURE SURVEY OVERVIEW

A. Enhanced Image Encryption using Chaotic Maps[1]

A research paper by S. Patel and J. Lee [1] titled “Enhanced Image Encryption using Chaotic Maps” published in August 2020 presents an innovative approach to image encryption. It focuses on advanced encryption techniques and uses chaotic maps to introduce increased security by infusing randomness into the encryption process. This use of chaotic maps aims to strengthen the encryption mechanism and ensure resistance against various cryptanalysis techniques. Research demonstrates the effectiveness of the algorithm by demonstrating its resistance to decryption attempts and maintaining data integrity during encryption and decryption. A significant contribution lies in the use of chaotic maps to introduce randomness, thereby enhancing the security of image encryption and offering a promising avenue for enhancing data protection in image-based applications.

B. Mask R-CNN[2]

An article by K. He, G. Gkioxari, P. Dollár, and R. Girshick [2] entitled "R-CNN Mask", published in October 2017, presents advanced object detection and instance segmentation techniques. It features Faster R-CNN, YOLO, SSD and Mask R-CNN for accurate object detection and segmentation simultaneously. The research discusses optimization techniques such as neural architecture search and efficient backbone models to increase accuracy and efficiency. The benefit lies in the introduction of these methodologies, setting new standards for accurate object detection and instance

segmentation, which significantly affect the field of computer vision.

C. E-health big data privacy predictive clinical decision making scheme based on RNN[3]

The paper by Jiaping Lin, Jianwei Niu, and Hui Li, entitled "RNN-Based E-health Big Data Privacy Predictive Clinical Decision Making Scheme" and published in November 2017, introduces specialized recurrent neural network (RNN) models. designed for real-time healthcare applications. Contributions include the development of sequential and averaged RNN models tailored to optimize clinical decision-making processes. This scheme, with an emphasis on time efficiency, is mainly focused on real-time response and addresses the critical requirements for E-health big data processing in healthcare systems.

D. Intelligent traffic management system based on image processing for Smart City[4]

The paper authored by Vedansh Bhardwaj, Yashwanth Rasamsetti, and Vipina Valsan, titled "Image Processing Based Smart Traffic Control System for Smart City," published on July 2021, introduces an innovative traffic control system. This system leverages image processing techniques to dynamically analyze traffic conditions in real-time, enabling adaptive responses to varying traffic scenarios. A notable contribution of this work is the utilization of Proteus software for designing and verifying the proposed traffic management system. Proteus allows comprehensive simulation and testing, ensuring the system's functionality and reliability within a virtual environment before real-world implementation. This integration highlights the robustness and practical applicability of the proposed smart traffic control system for smart cities.

E. Object Detection Using Deep Learning, CNNs and Vision Transformers[5]

The article by AYOUB BENALI AMJOUD AND MUSTAPHA AMROUCH [3] titled “Object Detection Using Deep Learning, CNN and Vision Transformers”, published on April 10, 2023, presents an overview of state-of-the-art object detection algorithms categorized as anchor-based, anchor-free, and transformer-based detectors . It identifies and highlights the strengths of each model, such as the higher accuracy of anchored detectors compared to anchorless detectors, the computational efficiency and lower memory requirements of anchorless detectors, and the balance between accuracy and memory usage in the transformer. based detectors. In addition, the survey compares the major convolutional neural networks for object detection, details the strengths and limitations of each model, and provides significant conclusions regarding these object detection techniques.

F. A New Image Encryption Algorithm for Gray and Color Medical Images[6]

Contribution by SARA T. KAMAL, KHALID M. HOSNY, TAHA M. ELGINDY, MOHAMED M. DARWISH AND MOSTAFA M. FOUDA [4] titled "A New Encryption Algorithm for Gray and Color Medical Images", published on March 2, 2021, presents a new image encryption technique adapted for medical images. The method uses an image segmentation technique based on blocks that are encoded using a zigzag pattern, rotation, and random permutation. The key generated by the chaotic logistic map is used to spread the encoded image, thereby increasing security. The effectiveness of this proposed encryption method is evaluated using security analyzes and time complexity evaluation. The security analysis includes entropy, histogram differential attacks, correlation coefficient, PSNR (Peak Signal-to-Noise Ratio), key space, and sensitivity tests to assess the effectiveness of the encryption method in protecting medical images.

G. Object detection using YOLO: challenges, architectural successors, datasets and applications[7]

The article is authored by Tausif Diwan, G. Anirudh & Jitendra V. Tembhurne. The article presents a comprehensive overview of single-stage object detectors, specifically YOLO, regression formulations, advances in their architecture, and performance statistics. The paper also summarizes a comparative illustration between two-stage and one-stage object detectors, between different versions of YOLO, applications based on two-stage detectors and different versions of YOLO, along with future research directions. The paper describes a state-of-the-art technique, You Only Look Once Object Detection, which is considered a regression problem. The article presents various modifications made to the basic YOLO method and shows their analysis. The paper also provides insight into the challenges YOLO faces, such as the trade-off between speed and accuracy and the limitations of the existing system.

H. High-Performance Computation in Residue Number System Using Floating-Point Arithmetic[8]

The author of the article entitled High-Performance Computing in Residue Number System Using Floating-Point Arithmetic 1 is Konstantin Isupov. The paper proposes a method to support arbitrary sets of modules with cryptographically dimensioned dynamic ranges up to several thousand bits. The paper shows that the proposed implementation reduces runtime by a factor of 39 and memory consumption by a factor of 13 compared to an implementation based on mixed radix conversion. The paper also discusses residue code issues such as determining the relative size of two residue representations and the division process.

I. Selective Area Encryption using Machine Learning Technique[9]

A paper by Soumya Kelur, Ranjan Kumar H S, and Raju K. titled "Selective Area Encryption Using Machine Learning Techniques", published in 2019, presents an innovative approach to encryption. This technique uses machine learning-based object detection, specifically using Harr-cascade classifiers, to identify and then encrypt specific regions of images. The encryption process uses the Residue Number System (RNS), which results in a reduction in data size while ensuring security. This approach demonstrates potential applications in various
areas, including military and medical imaging, by effectively securing core imaging areas. Experimental validation highlights its effectiveness, and future prospects include extending the methodology to video encryption while considering the preservation of contextual information.

J. Image Cryptography using RNS Algorithm[10]

The paper authored by Anushree Shetty,Raksha Kiran,Shravya Shetty,Swathi Naik, titled "Image Cryptography using RNS Algorithm" and published on 2017, The literature review in the provided paper discusses the need for secure image data transmission over unreliable networks. It highlights the importance of securing confidential data exchanged in areas such as politics, the military and research. The survey reviews existing image encryption techniques and highlights challenges and room for improvement in terms of network bandwidth consumption, time complexity, space efficiency, cost, and encoding and decoding complexity. The proposed system uses an image encryption scheme using prime numbers and the Chinese remainder theorem to solve these problems by dividing the image into shared items for parallel encryption and efficient transmission. The conclusion suggests that the proposed multi-level approach, which integrates pseudo-random number generation, prime numbers, and image-based cryptography, is simple, inexpensive, reliable, and resistant to side-channel and algebraic attacks with efficient time and space consumption.

K. State-of-the-Art Object Detection: An Overview of YOLO Variants and their Performance[11]

The paper authored by Dhruthi L,Praveen K Megharaj,Pranav P, Niharika Kiran, titled "State-of-the-Art Object Detection: An Overview of YOLO Variants and their Performance" and published in 2023, The paper conducts a literature survey on YOLO (You Only Look Once) object detection covering benefits, limitations and accuracy. It examines the advances from YOLOv1 to YOLOv7 and highlights the benefits in real-time detection. Limitations include trade-offs in accuracy and computational efficiency, reliance on predefined weights, and dataset requirements. Accuracy is evaluated through comparisons on the MS COCO dataset using metrics such as frames per second and mean average accuracy. The survey provides insight into YOLO's strengths, limitations and performance metrics across versions and helps users select a model based on specific requirements.

L. An Adaptive Chaotic Image Encryption Algorithm Based on RNA and Pixel Depth[12]

The paper by Xiaoqiang Zhang and Xuangang Yan entitled "An Adaptive Chaotic Image Encryption Algorithm Based on RNA and Pixel Depth" published in 2021. The paper presents an adaptive image encryption algorithm using RNA and pixel depth for versatility and presents a "2D-ILASM" chaotic system and 3D adaptive Arnold transform. Achieving one frame, one key and disposable pad at the same time, it features a pre-permuted RNA cube and selective diffusion. Experimental results indicate strong safety and wide applicability. The paper lacks a discussion of computational complexity, scalability, and resilience against future attacks, which requires a more comprehensive security analysis. Although attack resistance and real-time key updates are desired, the specifics of the update mechanism and tested scenarios would increase the accuracy and reliability of the algorithm.

3. CONCLUSION

In conclusion, the surveyed papers on image processing and encryption underscore notable advancements in these fields. Innovative techniques such as chaotic maps, Residue Number System (RNS), and machine learning contribute significantly to enhancing data security, especially in critical areas like military and medical imaging. Furthermore, methodologies like YOLO (You Only Look Once) and its variants set new benchmarks for object detection accuracy, demonstrating their profound impact on the landscape of computer vision. Additionally, the integration of Recurrent Neural Network (RNN) models into real-time healthcare applications represents a substantial stride towards optimizing clinical decision-making processes. Collectively, these findings offer promising avenues for bolstering data security, improving object detection accuracy, and optimizing healthcare outcomes in the digital age.

REFERENCES

[1] S. Patel, J. Lee; "Enhanced Image Encryption using Chaotic Maps"; August 2020.

[2] K. He, G. Gkioxari, P. Dollár, R. Girshick; "Mask R-CNN"; October 2017.

[3] Jiaping Lin, Jianwei Niu, Hui Li; "A privacy-preserving predictive clinical decision scheme with E-health big data based on RNN "; November 2017.

[4] Vedansh Bhardwaj, yashwanth Rasamsetti, Vipina Valsan; "Image Processing Based Smart Traffic Control System for Smart City"; July 2021.

[5] Ayoub Benali Amjoud and Mustapha Amrouch; "Object Detection Using Deep Learning, CNNs and Vision Transformers"; 10 April 2023.

[6] Sara T. Kamal, Khalid M. Hosny , Taha M. Elgindy , Mohamed M. Darwish , and Mostafa M. Fouda. " A New Image Encryption Algorithm for Gray and Color Medical Images"; March 2021.

[7] Diwan, T., Anirudh, G., & Tembhurne, J. V, Object detection using YOLO: challenges, architectural successors, datasets and applications.August 2022

[8] Isupov, K, High-Performance Computation in Residue Number System Using Floating-Point Arithmetic.Jan 2021

[9] Soumya Kelur, Ranjan Kumar H S, Raju K; "Selective Area Encryption using Machine Learning Technique";2019

[10] Anushree Shetty,Raksha Kiran,Shravya Shetty,Swathi Naik; "Image Cryptography using RNS Algorithm"; 2017

[11] Dhruthi L,Praveen K Megharaj,Pranav P,Niharika Kiran; "State-of-the-Art Object Detection: An Overview of YOLO Variants and their Performance"; 2023

[12] Yanxia Zhang, Xiaoyan Zhang, and Xiangyang Luo; "Adaptive Chaotic Image Encryption Algorithm Based on RNA and Pixel Depth"; 2021