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ENHANCED ANTITHEFT SYSTEM (EATS) BASED ROBBER NOTIFICATION USING THEFT IMAGE CORRECTION: A FUZZY LOGIC TECHNIQUE (FLT)

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ABSTRACT: *The research paper titled "Enhanced Anti-Theft System (EATS) based Robber Notification using theft image correction: A Fuzzy Logic Technique (FLT)" delineates an innovative approach towards boosting security measures against theft incidents. Traditional security systems often struggle with accurately identifying thieves due to image distortions and environmental factors. In this case, the captured images of the theft are sometimes not correct or raw in nature due to surrounding disturbances or limitations in digital device sensing. Image correction refers to the process of refining theft images so that humans can observe a clear vision of the theft. The paper introduces the Enhanced Anti-Theft System (EATS), which integrates advanced detection of motion of the theft and their activity at the place of theft, such as shops, homes, ATMs, etc. The research paper proposes the need for theft image processing and the development of a system or algorithm to obtain appropriate results compared to traditional image processing systems.*

Therefore, this research paper presents techniques of fuzzy logic to enhance theft detection and notification. In response to the challenges posed by image distortions, the proposed system employs fuzzy logic to refine image analysis and correct theft images, thereby improving the accuracy of thief identification. Through the utilization of IoT devices and fuzzy logic algorithms, EATS aims to provide real-time notification of theft incidents, enabling swift response and prevention measures. The research methodology involves the design and implementation of the EATS prototype, utilizing fuzzy logic techniques for image correction and thief notification. Experimental results demonstrate the efficacy of the proposed system in accurately identifying thieves and promptly notifying relevant authorities. This research contributes to the advancement of anti-theft technologies by introducing a novel approach that combines image correction and fuzzy logic, thereby enhancing security measures and facilitating timely responses to theft incidents. Here notice is send by with corrected theft images which is called ***Robber/Raider Theft Image Notification (RTIN)*** *notification to prevent the theft and theft activities.*

1. INTRODUCTION

Image enhancement means improving image quality to improve human perception. This includes impulse noise reduction and image edge sharpening using various techniques. By improving the quality of the original image, it is more suitable for human or machine analysis. Fuzzy image enhancement, an image enhancement technique, uses fuzzy logic that deals with probability or multi-valued logic, focusing on approximation rather than exact reasoning. Such approach deals with partial truth and matches values between fully true and fully false [1, 3].

Fuzzy image processing, an important application of fuzzy logic, aims to improve contrast using triangular membership functions and fuzzy rules of Mamdan's fuzzy inference system. . The process includes edge detection, image transformation from pixel level to blur level, applying blur rules and blurring to get a better image. Evaluation metrics such as Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) are used to evaluate the improved image quality [4,6].

The application uses MATLAB with the Image Processing Toolkit. This paper explores various aspects of fuzzy image enhancement, including fuzzy sets, Mamdani fuzzy inference systems, membership functions, and fuzzy if-then rules.

In summary, image enhancement techniques aim to improve image quality so that people can better analyze them or machines. Fuzzy image enhancement using fuzzy logic is particularly effective in dealing with blurring and blurring, effectively improving image contrast. After improving the quality of the image different types of parameters, PSNR, MSE, Mean, etc. are calculated to validate the proposed research work [5,6,8].

II. RESEARCH METHODOLOGY

From the Enhanced Antitheft System EATS (fuzzy based) incorporates a comprehensive approach to developing the EATS prototype which is presented in the Figure (1). It involves assembling various hardware components, including
Raspberry Pi-3, a camera, Fuzzy Logic Tool (Matlab), IoT and GSM/GPRS modules, motion sensors, LEDs/buzzers, and a power supply, all within a secure enclosure.

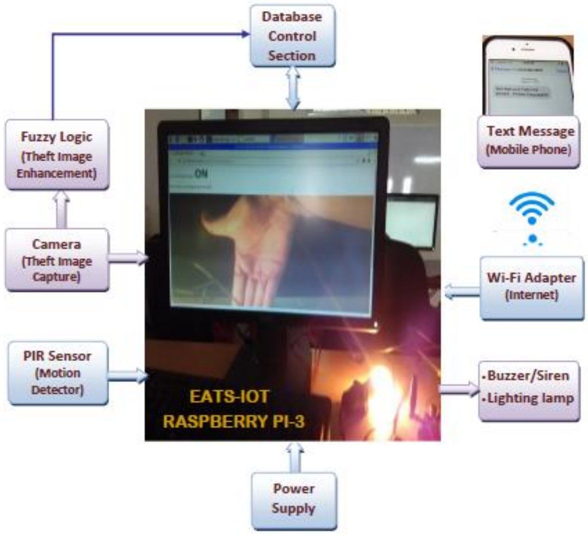

Fig.(1): Enhanced Antitheft (EATS): System and Fuzzy logic theft Image Notification.

Software development involves Python programming to control the Raspberry Pi. Fuzzy Logic Algorithm is developed in Matlab, and integration of theft detection algorithms using fuzzy logic decisions. Notably, the system incorporates provisions for sending notifications via IoT or GSM/GPRS modules upon theft detection. Rigorous testing ensures system accuracy, reliability, and responsiveness, followed by optimization and improvement based on user feedback.

There is a focus on security measures, regulatory compliance, and consideration of privacy and ethical issues during the development and implementation phases. Appropriate documentation is maintained for future reference and problem-solving, underscoring the researchers' commitment to the transparency and accountability of their methods. Fuzzy inference system (FIS) utilizes the human reasoning abbot the image and its correction which are strengthened by the fuzzy rules. The required fuzzy algorithm is developed to get the experimental results.

- **Fuzzy Algorithm (Image Processes) :**

1. Reads an input color image. Converts the image to double precision for fuzzy processing and Extracts color channels (R, G, B).
2. Defines fuzzy enhancement rules (fuzzyRule1, fuzzyRule2).
3. Applies fuzzy rules to each color channel.
4. Calculates Mean Squared Error (MSE) and Peak Signal-to-Noise Ratio (PSNR) for the enhanced image.

5. Displays the original and enhanced images along with their statistics.

Table (1): Theft Image : Hand/Palm motion captured by camera (ti.png)

Evaluation Matrix	Original	Fuzzy
Mean (Statistical mean)	0.35146	0.36023
MLI (Mean of Luminance Index)	89.20	0.4100
MSE (Mean Squared Error)		0.016585
PSNR (dB) (Peak Signal-to-Noise Ratio)		17.8028

The algorithm uses the optimized fuzzy rules changing color channels in the input image:

Fuzzy Rule 1:

Defined as fuzzyRule1 = @(x) max(0, min(1, 1.5 * x - 0.3)), enhances color channels by increasing pixel values linearly with a slope of 1.5 and shifting them by -0.3. Ensures pixel values remain within the range [0, 1].

Fuzzy Rule 2:

Defined as fuzzyRule2 = @(x) max(0, min(1, 1.2 * x + 0.1)), Enhances color channels by increasing pixel values linearly with a slope of 1.2 and shifting them by 0.1. Also ensures pixel values remain within the range [0, 1].

These fuzzy rules are independently applied to each color channel (Red, Green, Blue) of the input image. After application, the enhanced color channels are combined to form the final enhanced image. The coefficients (slope and shift) in these rules can be adjusted based on specific enhancement requirements, potentially through experimentation or optimization. The execution of code calculates Mean Squared Error (MSE) and Peak Signal-to-Noise Ratio (PSNR) for the enhanced image. The output displays the original and enhanced images along with their statistics.

III. RESULTS AND DISCUSSION

Procedural steps are used to execute the program so we get the results which are expressed in the Figure (2).

i) Auto start of EATS-IOT start the camera and set to capturing of images

ii) Set the captured images on Fuzzy Inference System (FIS) using Matlab programming that is Input to the FIS

iii) Check for pixel threshold if enough to call motion detected

iv) Run the fuzzy image processing code to enhanced the theft images

v) Compare the original image and Fuzzy Processed Image.

vi) Send FPI for further investigation in theft activity. After execution of the program

Fig. (2): Result : Ordinal and Fuzzy processed Images.

The output test results are tabulated in the Table (1) which gives the eminence above parameters PSNR provides a measure of quality in terms of signal-to-noise ratio, while MSE directly measures the average squared difference between corresponding pixels. Both are useful for quantifying the fidelity of theft image enhanced by Fuzzy Logic Technique (FLT) algorithms.

The higher PSNR values and lower MSE values indicate better quality. Mean parameter value represents the average pixel intensity of the image. In the enhanced fuzzy theft image, the mean value has increased slightly from the original image, indicating some enhancement in the overall brightness or intensity.

Result Analysis: Based on the analysis of the results presented in Table (1), it can be concluded that: The new evaluation data show small improvements compared to the original metrics. The statistical averages, MLI and MSE values are slightly higher for fuzzy estimation, indicating a possible better performance. The mean of the Luminance Index (MLI) increases significantly with fuzzy estimation, indicating a more accurate representation of brightness in the image.\ nMean Square Error (MSE) is significantly lower for blur estimation, indicating better image quality preservation. Peak signal-to-noise ratio (PSNR) shows a significant improvement in blur estimation, indicating better image resolution and noise. Overall, fuzzy estimation seems to improve hidden image detection with camera recorded hand/palm motion, as evidenced by improvements in various estimation metrics. However, further analysis and testing may be necessary to confirm these results and assess their practical implications.

IV. CONCLUSION:

It is concluded that the EATS-IOT project successfully achieves its objectives, demonstrating practical effectiveness in theft prevention. Observations and test results validate its alignment with goals and suitability for consumer use. The application of fuzzy logic enhances image quality, as evidenced by Image Quality Assessment metrics Rref. Table (1)). The system's working prototype signifies a significant advancement in antitheft technology.

V. FUTURE SCOPE:

The future scope for the EATS-IOT system includes integrating advanced security features like biometric authentication, improving the user interface, and exploring integration with smart home systems. Scalability, compatibility with future technologies, data analytics for predictive maintenance, collaboration with industry partners, and regulatory compliance are also key areas of focus for further development.

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