Combination of Thermal and SRGB Imaging Techniques for Advanced Surveillance System

Presented By

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Objectives

- Surveillance is described as close observation; this term is used mostly when it comes to security observations and recording.
- Nowadays in our daily life we see the need of security rising up with the constant increase in the world of technology and features.
- On the other hand, the industries and firms continuously face threats and are pushed to a situation of seeking help for their safety.
- This work is focused on providing clarity to such issues to the respective personal.
- This concept deals with the enhancement of the surveillance system by infusing two different frames of Thermal and sRGB obtained input and give the output of noise reduced, enhanced and more visible image.

Introduction

- In recent scenarios, the surveillance is one of the most predominant usages in all environments for keeping watching and gives alerts to the users.
- In most of the places such as industries, malls, hospitals, etc are monitored with the help of security camera.
- Keeping eye on all the spaces at all times is not possible.
- It is significantly has thermal and sRGB imaging property in the required system.
- Nowadays the security cameras are more advanced, smaller with advanced features which are also reasonable.
- If the captured images from the camera are combined with sRGB, regions of interest (ROI) and thermal information of the surrounding environment can be ignored.

Block diagram of the proposed work

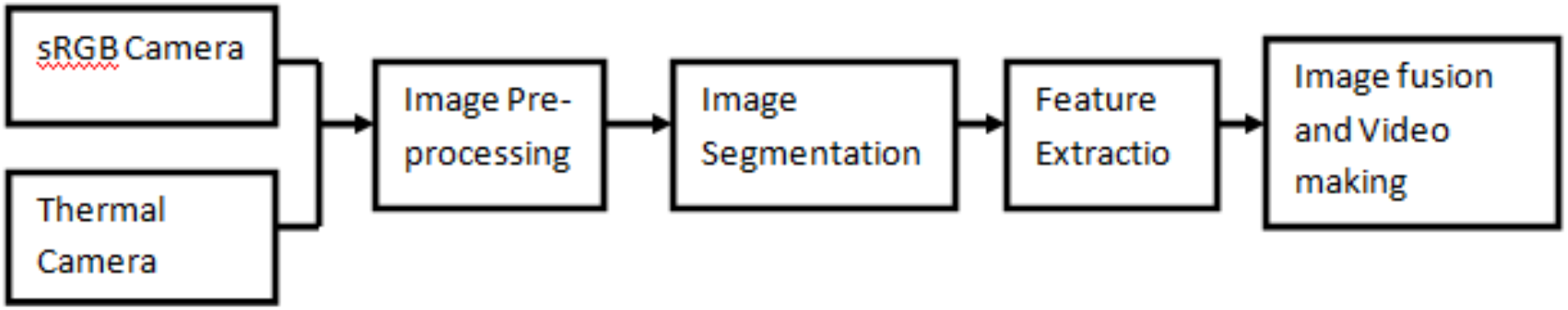


Image Pre-processing

- Thermal image is obtained in the form of thermo grams that shows the object with normal temperature in grayscale and as the temperature of the object increases, it changes to pseudo colors.
- These are an indication that there are variations in wavelength represented by distinct colors.
- sRGB image or Normal color image is obtained by conventional camera which is also passed through preprocessing and it is reduced to interpretable data for further process.
  - Gaussian filter
  - Morphological filter

Image Segmentation

- The Pre-Processed image is obtained and processed using filters of edge detection and thresholding technique, and also the object detection technique is applied by using GWBR filter.
- GWBR filter – Gradient Weighted Background Reconstruction (GWBR) Filter is used for background reconstruction of video image frames used to isolate the environment and the targeted area as,

$$\hat{B}(x, y, k) = \sum_{m=-p}^{p} \sum_{n=-p}^{p} f(x+m, y+n, k) h_{x,y,k}(m, n)$$

Where,

k – Number of frame,

p – Order of GWBR filter in binary with mean 0 or 1.

Feature Extraction and Object Detection

- Thermal signature extraction is based on k-NN (k-nearest neighbour) algorithm for extracting the feature points. The belief of track *m* is defined as the posterior probability and formulated as the probability of a detected element being an object *A* given the newly observed data D_n in frame *n*.

- The term $P(D_n)$ described the evidence of the observed data. The evidence is a scale factor that ensures that the posterior probability sums to one and can be rewritten by the law of total probability,

$$P(D_n) = P(A) \cdot P(D_n|A) + P(A^c) \cdot P(D_n|A^c)$$

Contd…

- The term $P(A)$ is the prior probability and describes the belief of an object being an animal before the data D_n have been observed, also defined as the belief at $n - 1$.

$$P(A) = Bel_{A,m}(n - 1)$$

- The probability $P(D_n|A)$ is described as the likelihood and defined as the discriminant function $g_A(D_n)$ of *kNN* given by the ratio of k_A and k.

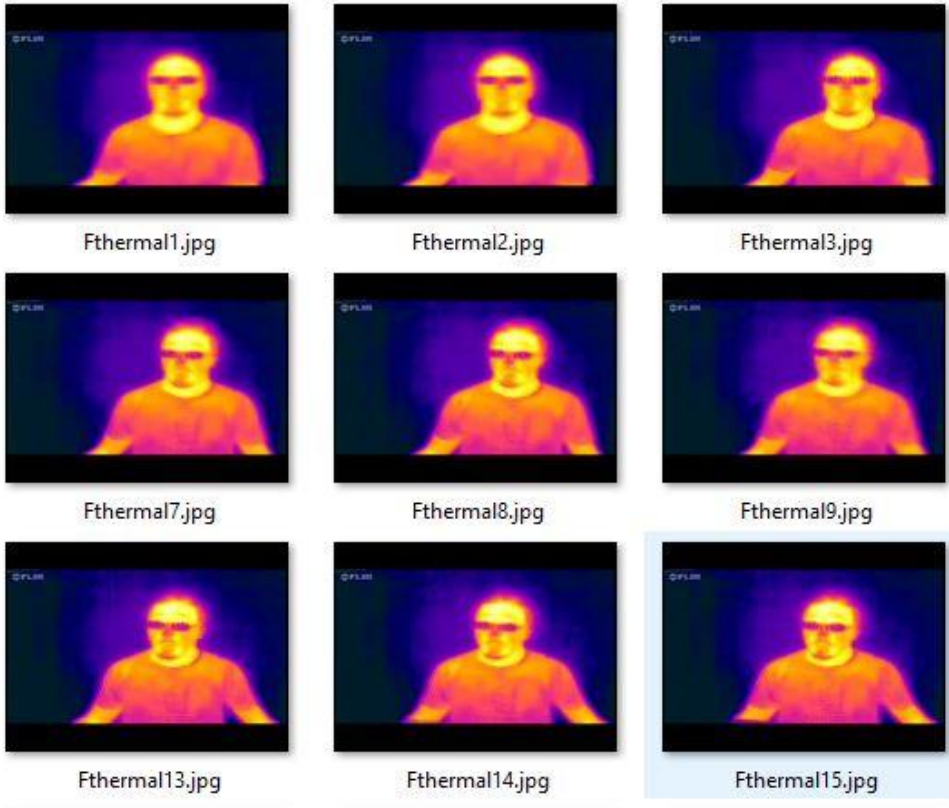
- where k_A is the number of *kNN* samples that are animals, e.g., if $k_A = 6$ (majority vote), the probability is approximately equal to 0.55.

Results and Discussion

•The Video data input from sRGB and Thermal Imaging camera module is obtained and spliced into 30 frames per second as shown in figure.

•This condition for 5 subjects (day, night, auto gain, heavy rain, and snowing) which leads to a total of 150 features, with the different orientation of 00, 450, 900 and 1800 so totally 600 features is considered in this experiment.

Ordinary camera frames



Thermal camera frames

Pre-processing

•Pre-Processing technique is used to filter the unwanted frequency component from the original image which gives a better quality of the image.

•It is widely used in the effects of the graphical data, to reduce the image noise and dimensionality of the input information.

Segmentation and Object detection

- Segmentation algorithm is applied in different scenarios in this we see the results of different levels of threshold.
- Object detection technique can be employed in real life scenarios in this we have applied facial recognition system which will be effective in identifying personals in a crowdie scenarios as shown in figure.
- It is implemented with k-NN algorithm for training the feature points from the input data.
- During the testing phase, it validates with the source and target information.
- The confusion matrix is the required term for classification procedure; from this parameter the performance metrics are computed.

Performance metrics

- The evaluation of the experiments are made using Quantitative performance metrics The detection rate and (DR) and false alarm rate (FAR) included in the metrics is expressed as :

$$DR = \frac{TP}{TP+FN}$$

$$FAR = \frac{FP}{TP+FP}$$

		Proposed	RGB	Thermal	RGBT
Day	DR	0.90	0.93	0.95	0.97
	FAR	0.38	0..09	0.31	0.29
Night	DR	0.88	0.78	0.48	0.89
	FAR	0.38	0.69	0.32	0.66
Auto Gain	DR	0.97	0.86	0.73	0.91
	FAR	0.33	0.09	0.76	0.40
Heavy Rain	DR	0.95	0.46	0.69	0.48
	FAR	0.28	0.26	0.11	0.27
Snowing	DR	0.99	0.79	0.21	0.92
	FAR	0.59	0.52	0.25	0.55

Conclusion

- This work presented a new design of surveillance system, shown that the enhanced output gives the extracted feature from both Thermal imaging as well as the sRGB image.
- The design is efficient comparatively to other normal surveillance security systems, taking the coverage, blind spots and visibility factors in count.
- This is also a future blooming design with lot of scope for further development and design for the betterment of the mentioned efficiency factors.
- Finally considering various scenarios and the downsides of today's technology we present this design that overcame the obstacles of current technology and paving a way for futuristic advance surveillance security system, providing a safer environment.

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