International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9, Issue-7, May 2020

# Human Action Recognition using STIP Techniques

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***Abstract:** The activities of human can be classified into human actions, interactions, object- human interactions and group actions. The recognition of actions in the input video is very much useful in computer vision technology. This system gives application to develop a model that can detect and recognize the actions. The variety of HAR applications are Surveillance environment systems, healthcare systems, Military, patient monitoring systems (PMS), etc., that involve interactions between electronic devices such as human-computer interfaces with persons. Initially collected the videos containing actions or interactions were performed by the humans. The given input videos were converted into number of frames and then these frames were undergone preprocessing stage using by applying median filter. The median filter identifies the noises present in the frame and then which replaces the noise by the median of the neighboring pixels. Through frames desired features were extracted. The recognize of action present in the person of the video using these extracted features. There are three spatial temporal interest point (STIP) techniques such as Harris SPIT, Gabour SPIT and HOG SPIT were used for feature extraction from video frames. SVM algorithm is applied for classifying the extracted feature. The action recognition is based on the colored label identified by classifier. The system performance is measured by calculating the classifier performance which is the Accuracy, Sensitivity and Specificity. The accuracy represents the classifier reliability. The specificity and sensitivity represents how exactly the classifier categorizes it's features to each correct category and how the classifier rejects the features that are not belonging to the particular correct category.*

*Keywords : Action recognition, STIP, Harris filter, Gabour Filter. Histogram Orient Gradient (HOG)*

## I. INTRODUCTION

The recognition of human action from the input video is important for video indexing, retrieval, healthcare, sports visual systems and security survive lance purposes. Recognition of any type of actions in the video is real challenging to analyze of visual architecture of a person. The perfect badge of all actions of person by the custom requires regular techniques.

**Revised Manuscript Received on May 30, 2020.**
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The actions detection with recognition methods are very much useful in computer visual perception.

Process of HAR is to be categorized into two types such as

i) Low level action recognition process and

ii) High level recognition process.

In order to breakdown video, indexing, repossess and reliability purpose the actions recognized from the input video is absolutely necessary. Howbeit, we should incorporate unique mechanisms in order to spot all the actions of human by computer system. The low level recognition processes is simple to implement and they come under recognizing the actions from the extracted feature values. The high level recognition processes are more reliable, computationally expensive and they are employed to find actions in the input video using specific hardware. The objective is to spot the actions of 1 or more person from round the clock observation on the person's actions and deviation within the environmental conditions. The low level action recognition process identifies the actions utilizing the feature points extracted from the video of specific size. These specific processes implementation is easy and they are unreliable in all the time. The high level action recognition process requires some special hardware such as high resolution cameras to detect the actions in the video. These processes are more reliable and they were very much computationally expensive.

**1.1 Classifications of HAR:** Mainly there are three types of person action recognition, they are explained here

**1.1 (a) Single User, Sensor-Based Action Recognition**

With machine learning and new data processing we develop a variety range of human actions by consolidating the rising space detector networks using the technique Sensor-based action recognition. Mobile devices offer sufficient detector information and measuring power to allow accurate action recognition to get an energy consumption estimation of throughout day-to-day life. The sensor-based activity recognition researchers feel that computers are better desirable to act on our behalf to observe the behavior of agents.

**1.1(b) Multi-User, Sensor-Based Action Recognition**

On-body sensors action was recognized for multiple users in early 90s. Throughout workplace scenarios detector technology like acceleration sensors, recognize the cluster activity patterns. With this, they question the basic problem of identifying actions of many users from detector measurements. Each single-user and multi-user actions in a unified answer are know by proposing a novel pattern sound approach.

**1.1 (c) Visual-Based Action recognition**

In the method of naming image, current sequences in particular action labels is the vision based human activity recognition.

The videos taken by a number of cameras help us to track and clearly understand the agents behavior which are very important. HCI, robot learning, interface design, and security surveillance are some of the applications of visual-based action recognition system. Different techniques like Hidden Markov Models (HMM), Kalman filtering, optical flow, etc., have been tried by analysts under completely different modalities like single camera, stereo, and infrared.

## II. RELATED WORKS

The automation in every area comes by rapid growing of technology. The human face and facial expression recognition is heavily needed to specific applications in real life of person. It has many specific applications, which are data privacy, Image or video security surveillance, information security, biometric identification, Human Computer Interface (HCI), Human Behavior Interpretation (HBI), etc.,[1]

As mentioned in first section, the human action recognition using STIP method ignores the spatial temporal (ST) inter relationships between the all types of person visual features. To improve the activity recognition there are many works have been presented to capture STIP information.

In the year 2017-18, authors took the challenge in the field of leveraging vision of computer techniques in order to enrich HRI techniques, this concept explores the systems which can expand the capabilities of action [2]. In the year 2018, authors analyzed to detect and recognize activities using wearable sensor or mobile data which are collected with appropriate sensors. They have presented that feature extraction is very important stage in order to helps for reducing time of execution and improvement of accuracy of all person action [3]. The authors Van and Tran, have proposed a techniques which exhibits both optical flow and RGB for HAR. They have analyzed the techniques and application of convolutional neural network, this CNN is very much suitable for the task of person visual activity recognition from various input videos [4].

### A. Existing System

HAR mechanism provides description, interpretation, or comprehension of the scene by bringing out vital options from image. The flawless process can't be outlined as, recasting the present image in an exceedingly needed manner, and the output of the positioning action and speed is obtained at an equivalent time and real-time aspects [5]. Innumerable SIFT variants were projected in order to spot the actions of the person in the video. SIFT-based sampling and local descriptors are often extracted on the motion trajectories [6].

### B. Proposed System

The most well-built image processing system which consists of human eye together with the brain is the Human Visual system. With this resource we try to develop a computer vision system. The video is fed to the system which divides it into each different frames, preprocesses it, to reinforce the image frames by removing the unwanted pixels from the frames. By this technique we can reduce the noise and store those derived pictures for later usage. Options were extracted using the SIFT descriptors of various sort from the preprocessed video frames.

## III. PROPOSED SYSTEM METHODOLOGY

The detailed structure of the human activity recognition (HAR) is as shown in Fig.1.

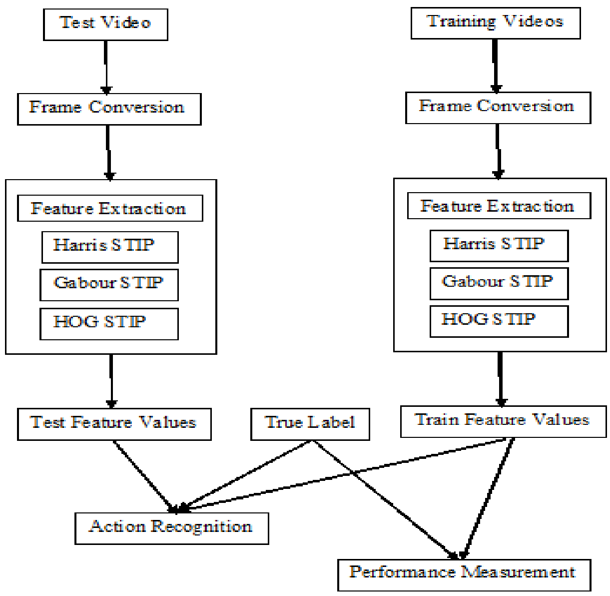


**Fig.1. Structure of human activity recognition flow**

The input video frames were preprocessed to remove the noise from the video. By reducing the noise we can improve the performance of the process. Variety of noise are present in the frames or images, the most common is the salt and pepper noise and can be seen as white and black pixels in the images. Also, the image is preprocessed to remove the unwanted pixels. We can apply and filter techniques to get rid of noise from the frames. The noised pixel is detected by the use of median filters and the noisy pixel is replaced by average of the neighboring pixels. Using the STIP descriptors of various kinds the options were extracted from preprocessed video frames.

The information in each of the considered descriptors is calculated and the features like Harris STIP, Gabor STIP and HOG STIP is extracted from the frames. To detect the corners in the video frames we use Harris STIP and this algorithm is also used to detect the corners in each pixels of the image, by considering the corner localizations differential methods with directions and also even consider the sum of squared differences (SSD). The process of input video loading is as shown in Fig 2. Which clearly show case of the size of the input video and frames counts per second for image analysis.

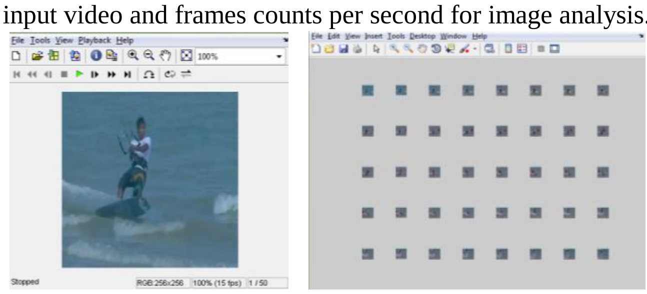

**Fig.2. Illustration of loading the input video to the HAR System and Illustration of converting video in to frames**

The frames and its counts of the given input video to the Human Action Recognition System are illustrated in the Fig 2. These frames are very much useful for analyzing motion of an action in the STEP analysis.


**Fig.3. Human Activity Recognition GUI Window representation**

After the loading input video in the HAR GUI window need to check for preprocessing of the video which is shown in Fig.3.

## IV. FEATURE EXTRACTION TECHNIQUES

### A. Harris STIP

The algorithm is used to spot the corner present in each pixel of a picture using the corner score differentiation into account w.r.t direction. A grip is the sudden modification in the brightness of a picture. Corner is the junction of 2 edges. The resemblance is computed by locating the sum of squared differences (SSD) between the 2 patches. If the pixels within the image is of uniform intensity then the nearby edges will look similar if not the edges will look relatively different. To abstract some varieties of options and deduce the contents of a picture in computer vision systems Corner identification is a worthy appeal. Corner identification is applied many times in motion or movement's detection, image mosaicking, image registration, tracking of videos, panorama sewing, and 3D modeling and various types of objects recognition.

**Detection process of Harris Corner**

Intensity variation mechanism is used to detect all points through a local neighborhood we make use of Harris mechanism, and a very small region of the feature could be showing the maximum change in intensity levels when comparing with the shift of windows in any direction. This concept is explained using the autocorrelation functions are illustrated below:

Let us consider P as a scalar function which is represented by function $P \rightarrow R$ and small increment among any position in the domain as represented by h, $a \in \Omega$. Corners are defined as the points x that gives large values of the below illustrating functional for very small shifts h,

$$E(h) = \Sigma\, w(a)\, (P(a+h) - P(a) \text{ ----------------(i)}$$

That is the large variation in any other direction. The function w(a) gives permission for selecting the region of support, which is clearly called as a Gaussian function.

Taylor expansions will be used to get linearization of the expression P(a+q) as

$$P(a+q) \simeq P(a)+\nabla(a)Tq$$

Hence the right hand of (i) gives

$$E(q) \simeq \Sigma\, w(a)\ (\nabla P(a)\, q)^2\, da =$$

$$\Sigma w(a)\, (qT\, \nabla P(a)\, \nabla P(a)\, Tq) \quad \text{-----------(ii)}$$

The last equation (ii) depends on the image gradient through the matrix of autocorrelation, or tensor structure, which is represented as

$$Z = \Sigma\, w(a)\, (\nabla P(a) \nabla P(a)T) \text{ ---------- (iii)}$$

The largest eigen value of Z corresponds to maximum intensity variation direction, and also the second one corresponds to orthogonal direction of the intensity variation.

### B. Gabour STIP

Gabor function caters to an energy density of local spectral values located around initially represented position and also certain direction of frequency. A two dimensional convolution with a Gabor function in circular domain is separately able to one-dimensional ones series. To detect the corners we go with Gabor wavelet, these wavelets serves as 2nd Order PD operator. A linear filter for detecting edges, which is named after Dennis Gabor, is the Gabor filter. Orientation description and Frequency and of Gabor filter is identical to human component analysis method. They are awfully suitable for texture description and differentiation. A plane wave of sinusoidal signal is controlled using Gaussian Kernel function is also a 2D Gabor filter in a spatial domain. Gabor filter have been used extensively in pattern analysis, optical character recognition, finger print recognition, facial expression recognition etc.

**Features of Gabor filter:** The basic feature extraction of Gabor filter in the two dimensional function is as illustrated in expression 1.

The Gabor features referred to multiple resolution Gabor feature, are generated from outputs of Gabor filters by using multiple filters on many frequencies fa and orientations. Frequency representations are illustrated in the equation 1

$$f a = h{-}a f max \quad a=\{0,\ldots,A-1\} \text{ ------1}$$

Where, fa is the $a^{th}$ frequency, $fmax= 0$ is the maximum frequency generated and h>1 is the scaling factor of frequency. Let us consider $\theta n$ as filter orientations are drawn as,

$$\theta n = 2\pi n/N\ ,= 0,\ldots,N-1 \quad \text{------2}$$

Where, is the $n^{th}$ orientation and N is maximum orientations.

### C. HOG STIP

Histogram of Oriented Gradients (HOG) is the best object detection in computer vision technology and image processing which uses the applications of feature descriptors. Fundamentally, the split of single image into very small connected regions which are called cells, and for each cell we compute a HOG directions or edge orientations for the all pixels within the cell.

Each pixel of cell provides gradient weights to its respective angular bin. We can take blocks as spatial regions, which are the neighboring cells group. The base for classification and normalization of histograms is assembling of cells as blocks. The block diagram represents the normalized group of histograms. This process yields better invariance to changes in brightness or shadowing.

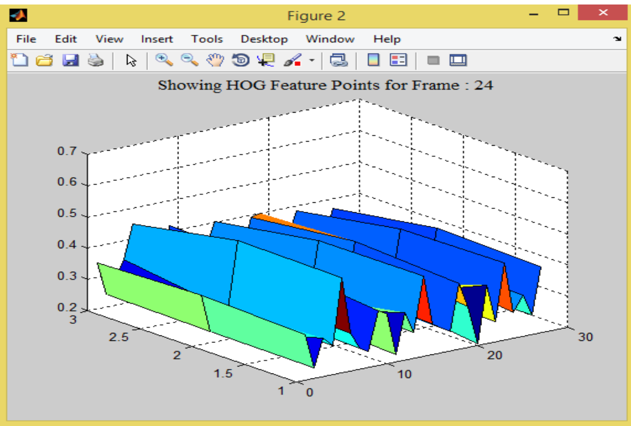


**Fig. 4. Illustration of 3 D HOG feature extraction in HAR System.**

**Calculation of Histogram Orient Gradient:**

The initial step of generating the descriptor in HOG is to measure the one dimensional derivatives point such as Ga and Gb in a and b direction by the convolution of gradient masks Ma and Mb with original image I:

Ga= Ma* I Ma = [−1 0 1] ------------- 3

Gb = Mb* I Mb = $[-1\ 0\ 1]^T$ ------------4

With the help of derivatives basis functions Ga and Gb, which calculates the degree of HOG gradient[ |G(a,b)| ] and angle in direction ϕ(a, b) for each one of pixel.

The degree of HOG gradient shows its strength at a pixel is as shown in the equation 5:

$$|G(a,b)| = \sqrt{Ga(a,b)2 + Gb(a,b)2} \text{------------------5}$$

The feature of 3D HOG extraction is as shown in Fig 4. All three feature extraction techniques in HAR system of STIP algorithm are shown in Fig 5.

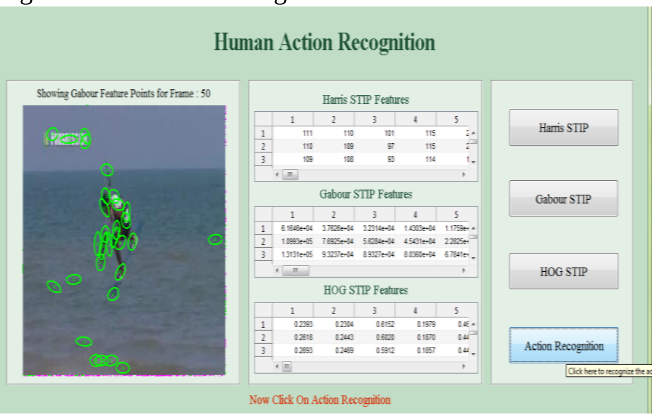


**Fig.5. Illustration of feature extraction techniques in HAR System.**

## V. ACTION RECOGNITION SYSTEM

Using Multi SVM classifier, the actions in the video are recognized. Support vector machines are utilized for the classification purpose [8]. Vector machines and regression analysis are the supervised learning models along with learning algorithms associated, which are capable of analyzing the data and hence, recognize the patterns. Support Vector Machine (SVM) is a non – probabilistic binary linear classifier. Expression for hyper plane is represented as (a.h)+t =0 Where, t – Set of training vectors, a – Vectors perpendicular to the separating hyper plane and h – Offset parameter which permits to raise the margin. The Output showing as "Surfing" and "Cycling" is one of the action identified from the input video processing is illustrated in Fig.6.


**Fig.6: Output showing as "Surfing" and "Cycling" is one of the action identified from the input video processing.**

**A. HAR:** This module detect and recognizes the following actions and interactions based on the given videos in their specific actions of various persons of color or gray scaled videos and this system exactly recognizes human actions like, Boxing, Surfing, Walking, Running, Clapping, Hand waving, Jogging, Cycling.

## VI. PERFORMANCE MEASURES

To calculate the implementation of HAR mechanism, accuracy, sensitivity and specificity of the classifier are estimated. Accuracy of the classifier is the rate at which the classifier is able to identify the image based on the given label. Sensitivity of the classifier is calculated based on how exactly the classifier is able to classify the data to the defined categories. Sensitivity is also recognized as rate of true positive or rate of recall. Specificity of the classifier is calculated based on how exactly the classifier is able to reject the data from each category. Specificity is also known as True Negative Rate.

The following equations describes the exact calculations of the measuring parameters like Sensitivity, Specificity and Accuracy of the given input action video.

$$Sensitivity = \frac{True\ Positive}{True\ Positive + False\ Negative} \text{ ------------ 6}$$

$$Specificity = \frac{True\ Negative}{False\ Positive + True\ Negative} \text{ ---------------7}$$

$$Accuracy = \frac{(True\ Positive(TP)) + (False\ Negative(FN))}{(False\ Positive(FP)) + (True\ Negative(TN)) + (True\ Positive(TP)) + (False\ Negative(FN))}$$

----------------------8

The performance measurements in HAR system and its calculated results are illustrated in Fig 7. The Accuracy, Sensitivity and Specificity of the given existing and proposed system is as shown in Fig 8. The HAR Performance Measurements bar graph representations are shown in Fig 9.


**Fig.7: Illustration of performance measurements in HAR system.**

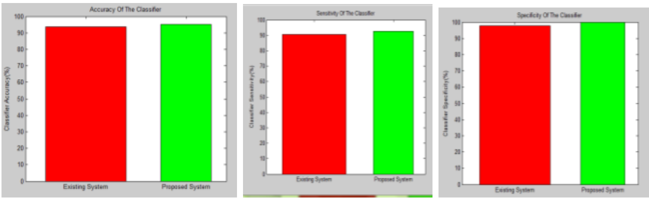

**Fig. 8: Bar graph outputs for representation of Accuracy Sensitivity and Specificity of the given activity.**

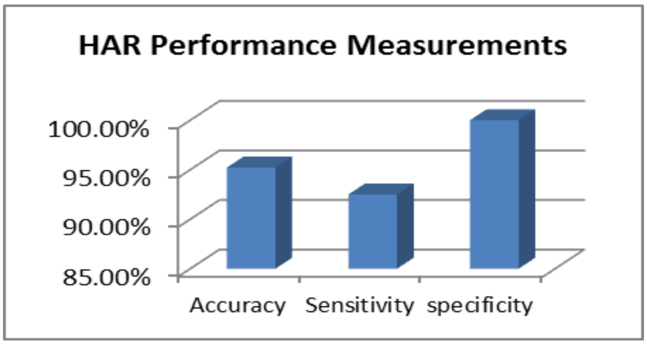


**Fig.9. HAR Performance Measurements**

The table 1 shows results of various HAR activities in terms of Accuracy, Sensitivity and Specificity

**Table 1: Illustrating the results of various HAR activities in terms of Accuracy, Sensitivity and Specificity.**

| Approach | Activities | Accuracy | Sensitivity | Specificity |
|---|---|---|---|---|
| HAR Labeled human activities using STIP Techniques | Walking | 96.56 % | 97.1 % | 100% |
| | Running | 97.125 % | 94.2 % | 100% |
| | Surfing | 95.312 % | 92.5 % | 100% |
| | Boxing | 92.32 % | 96.5 % | 100% |
| | Jogging | 91.12 % | 93.12 % | 100% |
| | Cycling | 97.512 % | 92.73 % | 100% |
| | Hand Waving | 96.372 % | 91.55 % | 100% |
| | Clapping | 98.392 % | 89.56 % | 100% |

## VII. CONCLUSION

The action performed by the person in the video is identified by the planned mechanism on the basis of options extracted exploitation color STIPs. Action recognition is created using the kernel function of the SVM classifier. The exactness of the designed system gives high accuracy than existing techniques as the different change in classifications are minimized to a larger extent. STIP detectors and descriptors were redeveloped so that multiple photometric channels are incorporated additionally with image intensities, leading to color STIPs.

The action performed by the person in the video is recognized accurately by the proposed method based on the extracted options. The results are obtained with the exact correctness even though there have been challenges such as illumination variations, contrast variations, abrupt motions and scaling of the person in the video. To boost the performance of the system, it is used by automation of supervised learning classifiers. The supervised learning framework classifiers require manual label and therefore, the system must be trained for the classification purpose. The system performance is improved and also, some of the feature extraction algorithms are deduced. These algorithms describe the classifier. The additional options that are to be extracted must overcome the problems of real time implementation of the system.

## FUTURE WORK

The human action recognition techniques can also be applied using data fusion techniques. Which are speech action data can add to the human facial expressions or any action recognition to achieve better performance output to the real time given videos.

## ACKNOWLEDGMENT

Authors would like to thank all who are directly or indirectly involved, advised and coordinated in collecting data and software information for the support of this paper.

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