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Moving Object Tracking Algorithm for Complex Shape and Occlusion Handling

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Abstract*: An object tracking increases loads of enthusiasm for dynamic research in applications such as video surveillance, vehicle navigation, highways, crowded public places, borders, forest and traffic monitoring areas. The system we develop aims to measure and analyze the application of background subtraction method and block matching algorithm to trace object movements through video-based. The making of video surveillance systems "smart" requires fast, reliable and robust algorithms for moving object detection and tracking. This research applies background subtraction method to detect moving object, assisted with block matching algorithm which aims to get good results on objects that have been detected. Performance evaluation is carried out to determine the various parameters. In this paper author design and develop a novel algorithm for moving object tracking in video surveillance also compares and analyse existing algorithms for moving object tracking. Author main aim to design and develop an algorithm for moving object tracking to handle occlusion and complex object shapes.

Keywords: Moving Object Detection; Background Subtraction, Kalman Filter, Video Surveillance.

I. INTRODUCTION

The increasing advancement in technology today, a growing concern for safety and security is arising all over to deal with this concern, the numbers of police work cameras have enhanced within the recent past information collected is however troublesome to store and monitor manually on a continuous basis. There are many approaches to try to this job while not human intervention. The underlying principle of these strategies is detection, segmentation and pursuit objects within the live video.

The various strategies these days getting used for video process are Frame differencing, Optical flow and Background subtraction. To observe the moving objects the Frame differencing methodology uses subtraction of consecutive frames [3]. This approach is easy to implement and simply labile to dynamic environments, however it cannot forever extract the entire edges of the item. Another standard technique is that the optical flow methodology. This methodology has 2 steps. 1st finding the image optical flow and so playing bunch method with the obtained optical flow characteristics. It performs accurately well within the detection method however the drawback is that the enhanced variety of computations. The third methodology is background subtraction. The principle employed in background subtraction algorithmic program is to model a background and compare it with the present frame to observe objects i.e., zones wherever important changes occur. Therefore the background subtraction algorithmic program separates the moving objects i.e., the foreground half from the static a part of the frame i.e., the background.

The video police work has long been in use for observance security sensitive areas for examples banks, shops, traffic observance on main road, public places that are huddled because of the advanced technology the big capability of storage devices are obtainable. The motion detection strategies are classified per the tactic of finding moving object.

Object pursuit is a district that has several sensible applications like video police work, human-computer interaction, and golem navigation [9]. It's a well-studied downside, and in several cases a fancy downside to resolve. The matter of object pursuit in video is summarized because the task of finding the position of Associate in Nursing object in each frame [7]. the flexibility to trace Associate in Nursing object in an exceedingly video rely on multiple factors, like data regarding the target object, form of parameters being caterpillar-tracked and sort of video showing the item [4]. Object pursuit is a crucial a part of a human-computer collaboration in an exceedingly continuous atmosphere, within the sense of permitting the pc to get a stronger model of the important world. for example within the application space of autonomous vehicles wherever it's unattainable for a person's to speak the state of the atmosphere accurately and quickly enough given the necessities of the agent. The broad space of application reflects the importance of reliable, exact, and effective object pursuit. There are many vital steps towards effective object pursuit, together with the selection of model to represent the item, and object pursuit methodology appropriate for the task.

II. REVIEW OF LITERATURE

Extravagant Joy et al. [1] Moving article recognition and pursue territory unit the 2 essential troublesome undertakings inside the great town video investigation framework. It's troublesome gratitude to impediment, nearness of shadows, jumbling, dynamic foundation, and commotion and so on. Identification of moving items, following, object coordinating crosswise over multi-camera, and reidentification region unit the basic strides of multi camera video investigation framework. Different article discovery and pursue in great town video examination are regularly created with regards to fittingness of society like keen police examination, great leaving, traffic perception, vehicle route, great tending and so forth.

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The objective of this paper is to research and survey various methodologies towards different item pursue.

Dr. M. Senthamil Selvi et al. [2] Video police examination has for some time been being used to watch security delicate zones like banks, division shops, interstates, stuck open places and outskirts. The development in registering power, comfort of huge capacity stockpiling gadgets and fast system framework made-up the strategy for less expensive, multi detecting component video police examination frameworks. Verifiably, the video yields region unit handled on-line by human administrators and zone unit commonly spared to tapes for later utilize exclusively once an explanatory occasion. the ascent inside the scope of cameras in ordinary police examination frameworks full each the human administrators and along these lines the capacity gadgets with high volumes of data and made it difficult to affirm right perception of delicate zones for long occasions. In order to channel excess information produced by Associate in nursing exhibit of cameras, and increment the dormant period to explanatory occasions, helping the human administrators with ID of fundamental occasions in video by the work of "keen" video police examination frameworks has turned into a basic interest. The making of video police examination frameworks "shrewd" needs speedy, dependable and solid calculations for moving item location, arrangement, pursue and action investigation.

M. Sahasri et al. [3] pursue and re-recognizable proof in wide-zone camera systems territory unit a troublesome disadvantage because of non-covering visual fields, variable imaging conditions, and look changes. we will in general consider the matter of individual re-distinguishing proof and pursue, and propose a totally one of a kind covering setting mindful shading extraction system that is solid to such changes. Commented on tests territory unit acclimated learn shading float designs during a non-parametric way exploitation the arbitrary backwoods separation (RFD) perform. The shading float designs region unit precisely moved to partner questions crosswise over entirely unexpected perspectives utilizing a brought together diagram coordinating system. A hyper chart outline is utilized to connection associated objects for pursuit and re-distinguishing proof. A different hyper chart positioning strategy is anticipated for individual centered system account. The anticipated standard is substantial on a wide-region camera system comprising of 10 cameras on bicycle ways. Likewise, the anticipated guideline is contrasted and the cutting edge individual re-recognizable proof calculations on the snake dataset.

Mukesh Tiwari et al. [4] Object recognition and pursue is one among the basic territories of examination because of routine correction moving of article and variety in scene size, impediments, look varieties, and self-image movement and brightening changes. In particular, highlight decision is that the significant job in article pursue. It's related with a few ongoing applications like vehicle recognition, video police examination then on. In order to beat the issue of location, pursue related with article development and look.

Aqsa Khan et al. [5] moving article identification might be an essential advance in video shut circuit TV. To dispose of the impact of brightening correction and shadow identified with the moving articles, we tend to anticipate a local power quantitative connection model (LIRM) that is solid to light change. bolstered the investigation of the enlightenment and shadow model, we tend to referenced the conveyance of local force quantitative connection. What's more, along these lines the moving articles region unit metameric while not shadow exploitation standardized local force quantitative connection by means of mathematician blend model (GMM). At that point disintegration is utilized to ask the moving items shapes and delete the dissipate shadow fixes and clamors. From that point forward, we will in general get the improved going articles forms by a fresh out of the plastic new shape improvement system, during which closer view quantitative connection and position territory unit pondered. Finally, a spic and span procedure is utilized to fill frontal area with openings. Exploratory outcomes exhibit that the anticipated methodology will get objects while not strong shadow and shows superb execution underneath various light alteration conditions.

Shweta A. More et al. [6] object identification and pursue is a significant and troublesome assignment required in a few pc vision applications and is a fiery examination space in pc vision. Article discovery includes finding the thing during an edge of a video and pursue includes finding the moving item over a measure of your time. The errand of moving item discovery and pursue might be an irksome because of light changes, dynamic foundation, impediment, messy foundation, nearness of shadows, movement of camera and video clamor. The point of this paper is to propose a structure for moving item location and pursue during a video succession. This structure recognizes and tracks moving item from video arrangements and plots its movement directions which may be utilized for a few applications like people pursue, vehicle pursue, traffic perception, video police examination, in AI and bunches of extra. We have utilized connection based for the most part way to deal with follow the moving article from video arrangements.

Kumar S. Beam et al. [7] proposes a totally one of a kind way to deal with make a programmed visual shut circuit TV that is amazingly efficient in police work and pursue moving articles during a video caught by moving camera with none apriority information in regards to the caught scene. Isolating closer view from the foundation is troublesome occupation in recordings caught by moving camera as each frontal area and foundation information change in each sequential casings of the picture arrangement; so a pseudo-movement is discerning in foundation. Inside the anticipated standard, the pseudo-movement in foundation is measurable and stipendiary exploitation segment connection of back to back edges upheld the rule of Fourier move hypothesis. At that point a method is anticipated to demonstrate Associate in nursing acting foundation from late history of shared trait of the present casing and hence the closer view is distinguished by the varieties between the foundation model and accordingly the present casing. K. Kalirajan et al. [8] the development of video police examination is that the most encouraging goals for people living severally in their home. As of late numerous commitments for video police examination are anticipated. Notwithstanding, a solid video police examination guideline stays a troublesome errand because of light changes, expedient varieties in objective look, comparative non target protests in foundation, and impediments. During this paper, a totally exceptional methodology of article discovery for video police examination is presented.

The anticipated standard comprises of fluctuated ventures just as video pressure, object identification, and article confinement.

Ms Jyoti J. Jadhav et al. [9] Moving article location and pursue has been wide used in different order like smart establishment, landing field security framework, video police examination applications, etc. This paper shows the moving article recognition and pursue exploitation reference Background Subtraction. during this procedure, we tend to utilized Static camera for video and introductory casing of video is legitimately consider as Reference Background Frame and this edge is compute from current edge to sight moving article at that point set limit T worth. On the off chance that the pel qualification is greater than the set limit T, at that point it discovers that the pixels from moving item, generally, in light of the fact that the foundation pixels. Anyway this mounted edge suitable only for an ideal condition isn't fitting for entangled surroundings with lighting changes. So during this paper we tend to utilized powerful improvement limit system to get an extra complete going items. This procedure will viably dispose of the effect of daylight changes.

Kinjal A. Joshi et al. [10] presents a study of changed systems related with video shut circuit TV rising the security. The objective of this paper is to survey of differed moving article location and item pursue systems. This paper centers around recognition of moving items in video shut circuit TV at that point pursue the distinguished articles inside the scene. Moving Object identification is introductory low level fundamental undertaking for any video police examination application. Identification of moving article might be a troublesome undertaking. Pursue is required in more elevated level applications that need the circumstance and type of article in each edge. During this review, I outlined Background subtraction with alpha, measurable technique, Manfred Eigen foundation Subtraction and Temporal edge differencing to sight moving item. I conjointly outlined pursue system bolstered reason pursue, bit pursue and outline pursue.

III. METHODOLOGY AND IMPLEMENTATION

The Proposed algorithm is mainly based on background subtraction and block matching algorithm for tracking. For software requirement MATLAB R2013a with operating system windows used for system implementation.

Input video Input is taken from camera. Video is changed into no. of frames are used by MATLAB as an information picture.

A. *Background Subtraction Tracking*

Removal of irrelevant background and detection of the object. It can also be utilized to detect the objects and capture the object's state in every frame. The standard initializing procedure for many more sophisticated tracking algorithms is given below:

Step 1: Compute the background image by averaging the first few frames contain only the static background.

Step 2: For each frame, we subtract background from it and obtain the difference image, then erode the difference

Image to remove small noise, finally select the largest, valid object from this difference image

Step 3: Compute the center of mass and radius of this largest, valid object and plot the contour of the object.

Background subtraction method is very sensitive to noise, random perturbation, motion blur and poor contrast.

B. *Object tracking by Kalman Filter algorithm*

The Kalman Filter calculation has a place with the state space approach class of tracking calculations. It takes care of the tracking issue in light of the state space condition and estimation condition. Kalman Filter partitions to two stages: prediction condition and correction condition. Kalman Filter gauges the speed, position, and increasing speed of the object in each edge of the succession yet it has been assumed that the changes in speed of the object are in restriction.

IV. BLOCK MATCHING ALGORITHM

A. *Proposed Algorithm:*

A Block Matching Algorithm is a way of locating matching macro blocks in a sequence of digital video frames for the purposes of motion estimation. The underlying supposition behind motion estimation is that the patterns corresponding to objects and background in a frame of video sequence move within the frame to form corresponding objects on the subsequent frame. This can be used to discover temporal redundancy in the video sequence, increasing the effectiveness of inter-frame video compression by defining the contents of a macro block by reference to the contents of a known macro block which is minimally different. A block matching algorithm involves dividing the current frame of a video into macro blocks and comparing each of the macro blocks with a corresponding block and its adjacent neighbors in a nearby frame of the video (sometimes just the previous one). A vector is created that models the movement of a macro block from one location to another. This movement, calculated for all the macro blocks comprising a frame, constitutes the motion estimated in a frame. The search area for a good macro block match is decided by the 'search parameter', p, where p is the number of pixels on all four sides of the corresponding macro-block in the previous frame. The search parameter is a measure of motion. The larger the value of p, larger is the potential motion and the possibility for finding a good match. A full search of all potential blocks however is a computationally expensive task.

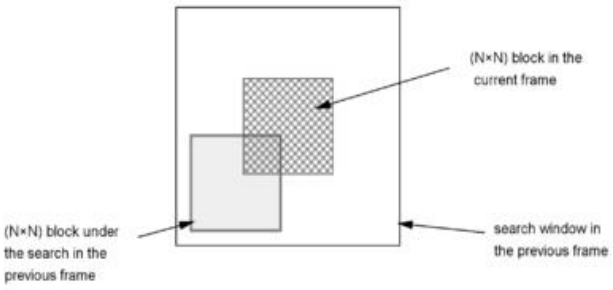


Fig.:1 Candidate block and its neighbor

Motion estimation is the process of determining motion vectors that describe the transformation from one 2D image to another; usually from adjacent frames in a video sequence.

The motion vectors may relate to the whole image (global motion estimation) or specific parts, such as rectangular blocks, arbitrary shaped patches or even per pixel. The motion vectors may be represented by a translational model or many other models that can approximate the motion of a real video camera, such as rotation and translation in all three dimensions and zoom.

For matching difference between two blocks a metric used:

$$Mean\ Absolute\ Difference\ (MAD) = \frac{1}{N^2}\sum_{i-0}^{1-n}\sum_{j-0}^{1-n}|C_{ij} - R_{ij}| \quad ..(1)$$

Where 'N' is the size of macro-block.

C*ij* & R*ij:* Pixels being compared in current macro-block & Reference macro-block respectively.

For comparison between ground truth and predicted values:

The Euclidean distance between point's p and q is the length of the line segment connecting them.

If p=(p1,p2,….pn) and q=(q1,q2,….qn) are two points in Euclidean n-space, then the distance (d) from p to q, or from q to p is given by,

$$d(\boldsymbol{p},\boldsymbol{q}) = d(\boldsymbol{q},\boldsymbol{p}) = \sqrt{(q_1 - p_{1)}{}^2 + (q_2 - p_{2)}{}^2 + \cdots\cdots\cdots + (q_n - p_{n)}{}^2}$$

$$= \sqrt{\sum_{i=1}^{n}(q_i - p_{i)}{}^2} \quad \ldots\ldots\ldots (2)$$

The algorithm can be described as follows:

Algorithm

1. Get two consecutive frames from videos.
2. Divide those frames into 100×100 macro-blocks.
3. Pickup first block from Frame 1 and match that with its same corresponding block of Frame 2
   - If match found between two blocks of two frames then there is no motion
   - If matching difference between two blocks found then motion is detected.
4. To determine direction and magnitude of motion vector, two blocks position difference is used.
5. To match correlation between two blocks FFT is used.
6. Direction and magnitude of motion vectors calculated in step 4. Their resultant shows net change in position.
7. Multiple such motion paths are joined together to find out tracking path of object.

Fast Fourier Transform

A Fast Fourier transform (FFT) is an algorithm that samples a signal over a period of time (or space) and divides it into its frequency components. These components are single sinusoidal oscillations at distinct frequencies each with their own amplitude and phase. Over the time period measured in the diagram, the signal contains 3 distinct dominant frequencies.

An FFT algorithm computes the discrete Fourier transform (DFT) of a sequence, or its inverse (IFFT). Fourier analysis converts a signal from its original domain to a representation in the frequency domain and vice versa. An FFT rapidly computes such transformations by factorizing the DFT matrix into a product of sparse (mostly zero) factors. As a result, it manages to reduce the complexity of computing the DFT from O (n^2), which arises if one simply applies the definition of DFT, to O (n log n), where n is the data size.

An FFT computes the DFT and produces exactly the same result as evaluating the DFT definition directly; the most important difference is that an FFT is much faster. In the presence of round-off error, many FFT algorithms are also much more accurate.

An FFT is any method to compute the same results in O(*N* log *N*) operations. All known FFT algorithms require O(*N* log *N*) operations, although there is no known proof that a lower complexity score is impossible.
FFT correlation between two images is given by:

$$P(x, y) = IF^{-1}\,[F^*(u, v)\,G(u, v) / \,|\,F^*(u, v)\,G(u, v)]\,|\,\ldots. \quad (3)$$

Where, F: FFT of image 'f'
G: FFT of image 'g'
IF^{-1}: Inverse of Fourier Transform

V. EXPERIMENTAL SET UP

Graphical Analysis

1. MOT WALK

A. Qualitative Analysis

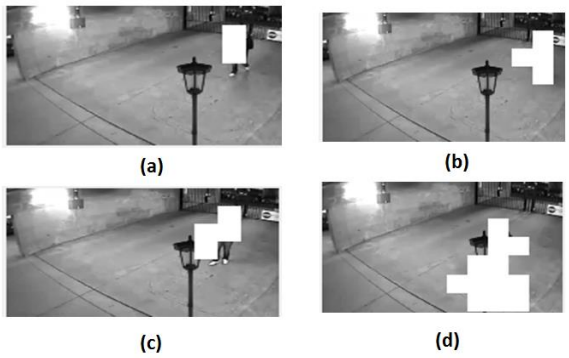


Fig:2 (a),(b),(c),(d) Row wise Block Matching

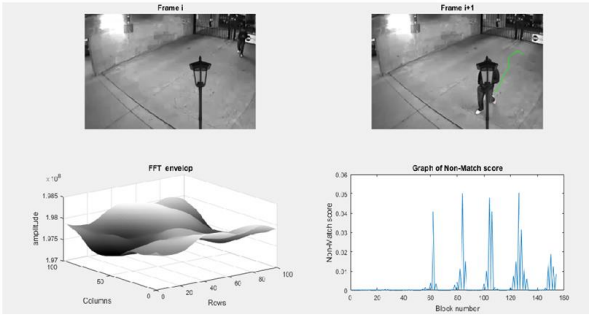
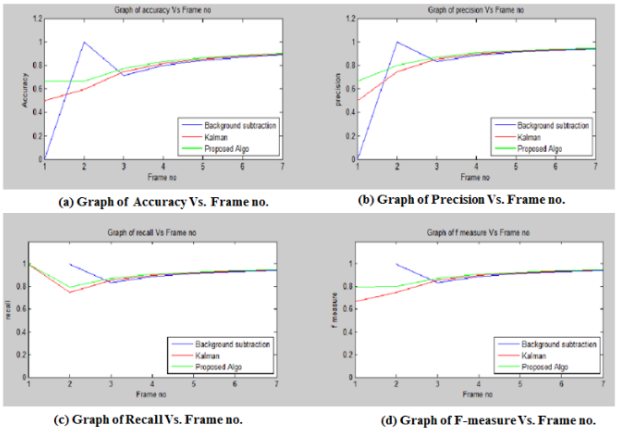


Fig: 3 (a) frame i (b) frame i+1 (c) FFT envelope (d) Graph of Block no Vs Non Match score

B) Quantitative Analysis



(a) Graph of Accuracy Vs. Frame no. (b) Graph of Precision Vs. Frame no.

(c) Graph of Recall Vs. Frame no. (d) Graph of F-measure Vs. Frame no.

Fig: 4 Graph of Accuracy, Precision, Recall and F-Measure Vs. Frame No.

2. INSECT

A) Qualitative Analysis

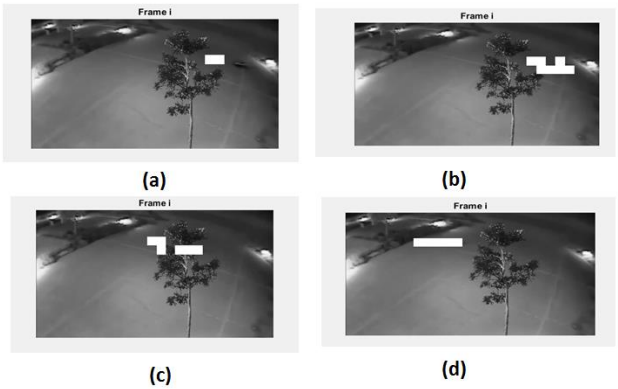


Fig: 5 (a),(b),(c),(d) Row wise Block Matching

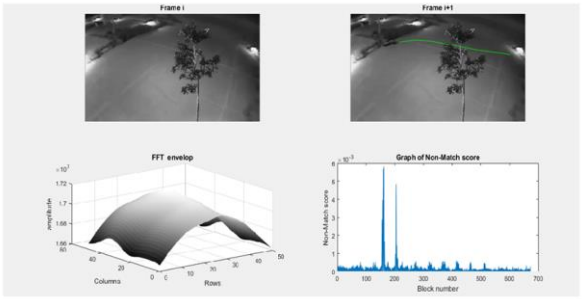
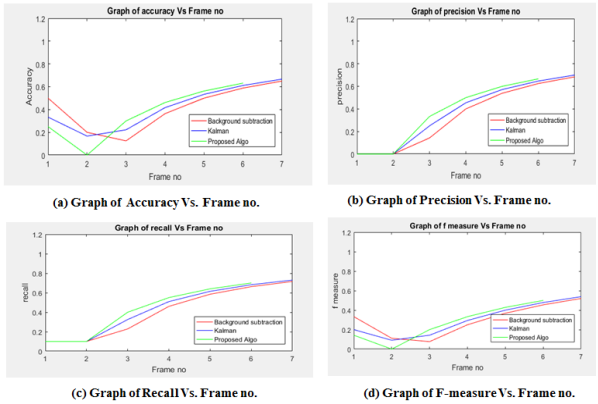


Fig: 6 (a) frame i (b) frame i+1 (c) FFT envelope (d) Graph of Block no Vs. Non-Match score

B) Quantitative Analysis



(a) Graph of Accuracy Vs. Frame no. (b) Graph of Precision Vs. Frame no.

(c) Graph of Recall Vs. Frame no. (d) Graph of F-measure Vs. Frame no.

Fig: 7 Graph of Accuracy, Precision, Recall and F-Measure Vs. Frame No.

3. THEFT

A) Qualitative Analysis

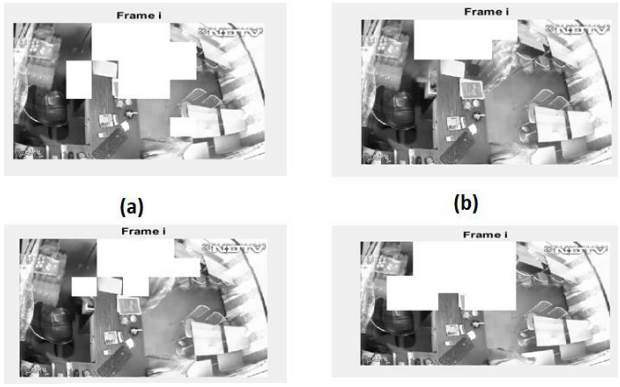


Fig 8: (a),(b),(c),(d) Row wise Block Matching

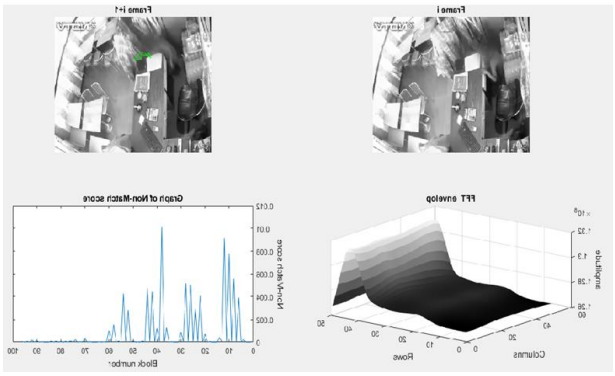
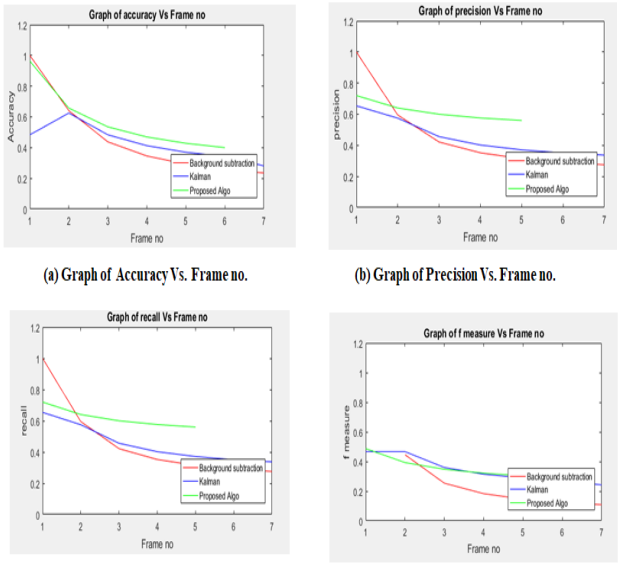


Fig: 9 (a) frame i (b) frame i+1 (c) FFT envelope (d) Graph of Block no Vs Non-Match score

B) Quantitative Analysis



(a) Graph of Accuracy Vs. Frame no. (b) Graph of Precision Vs. Frame no.

Fig: 10 Graph of Accuracy, Precision, Recall and F-Measure Vs. Frame No.

VI. COMPARISON OF PERFORMANCE PARAMETERS

Table: 1. Comparison methods

	Parameters	Accuracy	Precision	Recall	F Measure
1. MOT WALK	Background Subtraction	0.72	0.90	0.81	0.85
	Kalman Filter	0.71	0.91	0.80	0.83
	Proposed Algorithm	0.80	0.97	0.89	0.90
2. INSECT	Background Subtraction	0.67	0.73	0.69	0.65
	Kalman Filter	0.79	0.78	0.67	0.71
	Proposed Algorithm	0.90	0.80	0.75	0.82
3.THEFT (Real Time video)	Background Subtraction	0.78	0.63	0.65	0.34
	Kalman Filter	0.79	0.69	0.68	0.38
	Proposed Algorithm	0.81	0.76	0.74	0.49

VII. CONCLUSION

From the consideration of all the points we conclude that the Block Matching Algorithm method is simpler and gives good performance. The aspect of block matching is use of intelligent search strategies to reduce the computation complexity. Block Matching Algorithm met is more accurate and reliable method. Results are also improved. Kalman filter which is having probabilistic approach of point tracking is suitable for moving object tracking. Various performance measures are compared and analyzed between three methods. Accuracy, Precision, Recall and F-measure of Block Matching Algorithm are improved than the Kalman Filter Method and Background subtraction tracking method.

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