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Motion-Based Detection and Tracking of Moving Objects in Real Time Scenario

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Abstract – Detecting and tracking moving objects in real time scenario is a vast, active and complex area of computer vision. Detection and tracking is used in many fields like surveillance, intelligent tracking system and many other application. Due to increase in utilization of detection and tracking researchers are continuously making efforts to develop new algorithm to improve the efficiency of available system. Many times combination of multiple algorithms is used to overcome each others inefficiency and results in better algorithm. The main aim of this project is to detect and track moving object using a moving camera mounted on servos which are controlled by the signals of arduino UNO board. The detection will be done using Eigen background subtraction algorithm based on Gaussian mixture models. Morphological operations will be perfomed on the resulting frames in order to eliminate noise. These operations will be followed by blob analysis, which are group of connected pixels and correspond to moving objects. The moving objects are detected and tracks are recorded which are solely based on motion of objects. The motion of each track is estimated by kalman filter which is used to predict the track's location in each frame. The tracking will be done in two parts, first part will be detecting the moving objects in each frame and second part will be associating the detections corresponding to the same objects overtime.
Keywords– surveillance, detection, Arduino, matlab, Kalman filter, Blob analysis.

I. INTRODUCTION

Computer vision is mainly understanding and simulating the working manner of human eyes by using computer. Computer vision is a research field which percepts and represents the 3D information of real world. The information is extracted to 2D information and is also able to reconstruct the 3D information by analyzing the extracted 2D information accordingly. The surface reconstruction and representation of 3D objects are required by many numerous applications. Object detection is a process, which is to analyze the input image and to determine the number, location, size, position and the orientation. Object detection is the base for object tracking, whose results directly affect the process and accuracy of object tracking. Object detection is usually performed by object detectors or background subtraction Algorithms. Detection of moving objects provides a classification of the pixels in the video sequence into either foreground or background. This classification of pixels to detect moving objects uses an approach background subtraction. In background subtraction, each pixel in the video frame gets deviate from the background taken as moving objects for applications such as surveillance so, there are many challenges in developing a good background subtraction algorithm. A good background model should have a sense of reacting quickly to changes in background and adapting itself to accommodate changes occurring in the background such as moving of a stationary object from one place to another. For a real-time system, good background detection rate and the processing time for background subtraction is essential.

II. RELATED WORK

A. *Object detection methods*

1) *Frame differencing:* Frame differencing has easy calculations and is easy to implement. The moving object path is traced by calculating difference between two consecutive frames. For a variety of dynamic environments, it has a strong adaptability, but it is generally difficult to obtain complete outline of moving object, responsible to appear the empty phenomenon, as a result the detection of moving object is not accurate.
2) *Point detectors*: Point detectors are used to find interesting points in images which have an expressive texture in their respective localities. A desirable quality of an interest point is its invariance to changes in illumination and camera viewpoint. In literature, commonly used interest point detectors include Moravec's detector, Harris detector, KLT detector, SIFT detector.
3) *Optical Flow:* Optical flow method [1] is to calculate the image optical flow field, and do clustering processing according to the optical flow distribution characteristics of image. This method can get the complete movement information and detect the

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moving object from the background better, however, a large quantity of calculation, sensitivity to noise, poor antinoise performance, make it not suitable for real-time demanding occasions.

4) *Segmentation:* The aim of image segmentation algorithms is to partition the image into perceptually similar regions. Every segmentation algorithm addresses two problems, the criteria for a good partition and the method for achieving efficient partitioning.

B. Object Tracking methods

1) *Point tracking:* Tracking can be formulated as the correspondence of detecting objects represented by points across frames. Point tracking can be divided into two broad categories, i.e. Deterministic approach and Statistical approach. Objects detected in consecutive frames are represented by points, and the association of the points is based on the previous object state which can include object position and motion.

2) *Kernel tracking:* Performed by computing the motion of the object, represented by a primitive object region, from one frame to the next. Object motion is in the form of parametric motion or the dense flow field computed in subsequent frames. Kernel tracking methods are divided into two subcategories based on the appearance representation used i.e. Template and Density-based Appearance Model and Multi-view appearance model.

3) *Silhouette Tracking:* It Provides an accurate shape description of the target objects. The goal of silhouette tracker is to find the object region in each frame by means of an object model generated using the previous frames. Silhouette trackers can be divided into two categories i.e. Shape matching and Contour tracking.

III. PROPOSED SYSTEM.

The proposed system needs a connection of computer with arduino circuit and arduino circuit is connected to the servo using breadboard. The computer consists of required software's Matlab, Arduino IDE with all packages and drivers.

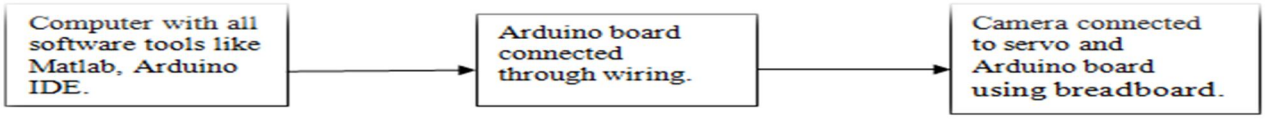


Fig.1 Overview of Hardware Connection.

The computer used should have configurations to support the software application Matlab and Arduino IDE. The camera is connected to the computer using USB and is also mounted over the servos in order to provide motion to camera that is to pan and tilt as per the motion of object. Arduino IDE is used as a integration medium between Matlab and Arduino UNO board. Arduino board is connected to the computer using an USB and power supply to Arduino is provided by a 12 volt adapter. The input in form of video is provided by camera and the videos are processed by programs in Matlab. The outputs of functions in Matlab program are converted to signals understandable by the UNO board using Arduino IDE. The signals are carried to the servos by UNO board and it gives motion to camera. The signals varies as the detected object moves and correspondingly the camera tracks the object. This live tracking takes place for only single specific, predetermined object, whereas in the case of the recorded videos the detection and tracking of multiple moving objects is done.

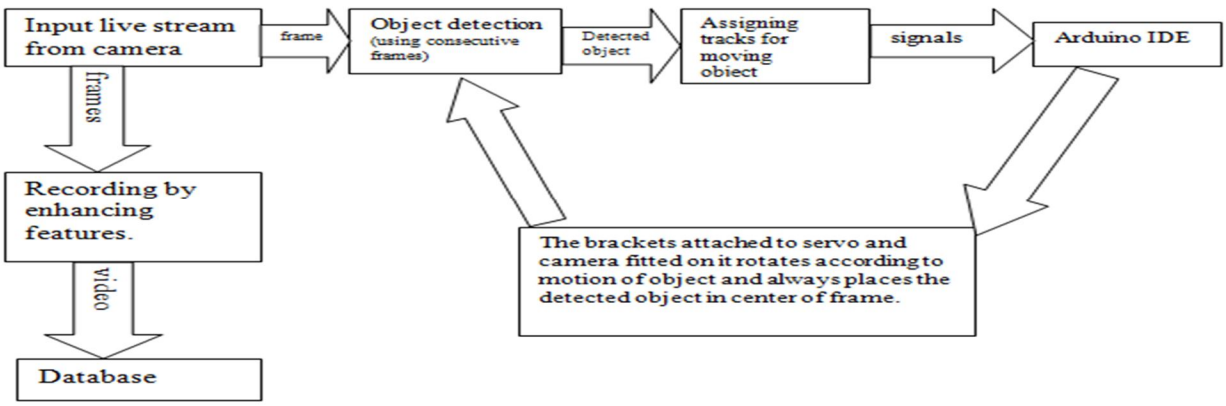


Fig.2 Processing overview

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Proposed system works for two types of data input case. First case is for the live feed of video in which a specific and predetermined object is detected and tracked. The objects are detected using color of objects or Haar cascade features. Secondly the processing of videos stored in memory or databases. In first case a single object is detected and tracked using the combination of two servos for pan and tilt. In Second case the stored videos are used for detecting and tracking the moving objects.

IV. TOOLS

A. Arduino UNO

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. Arduino projects can be stand-alone or they can communicate with software running on a computer.



Fig.3 Arduino UNO Board.

B. Servo

A Servo is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft. As the coded signal changes, the angular position of the shaft changes.

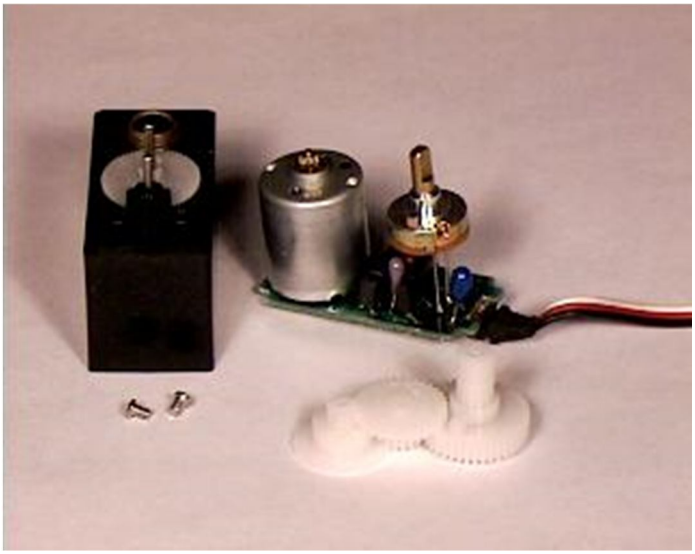


Fig.4 Servo

V. CONCLUSION

This method is more efficient, feasible and easy to implement. The surveillance is easy as dual mode is used to detect and track objects(one on recorded videos and one on live field). The primary advantage is that the memory space used is much less than that

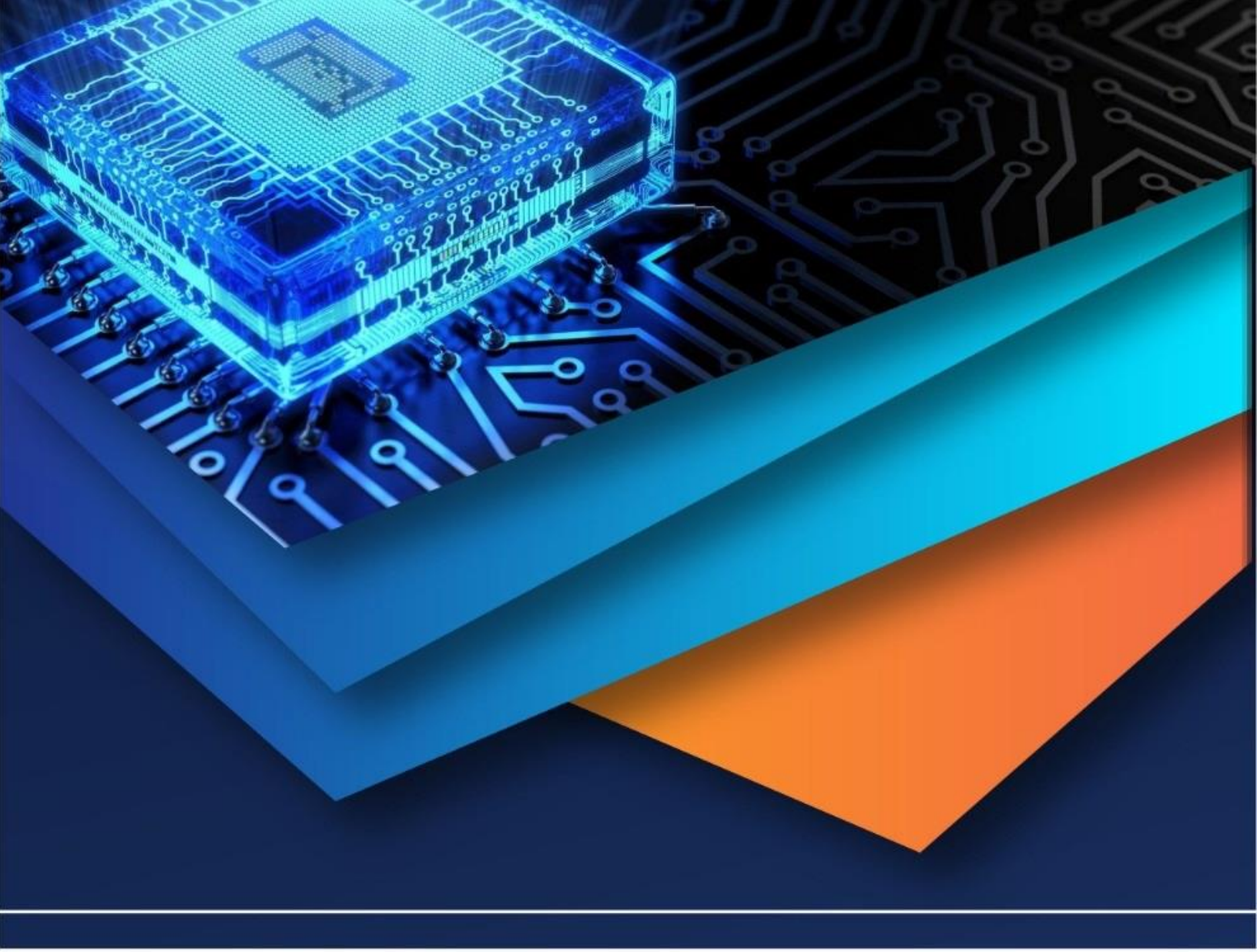
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used by the conventional surveillance, saving memory device costs. It is easier to identify the pixels and frames where a movement is detected as the effort of navigating through the entire video to view the motion is eliminated.

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