OBJECT MOTION DETECTION USING DIGITAL IMAGE PROCESSING BY FRAME DIFFERENCE METHOD TO DEVELOP ANIMAL REPELLENT SYSTEM IN AGRICULTURAL APPLICATIONS

A Project Progress Report

Submitted in partial fulfillment for the degree of

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

Submitted by

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CERTIFICATE OF COMPLETION

This is to certify that the work entitled, **"OBJECT MOTION DETECTION USING DIGITAL IMAGE PROCESSING BY FRAME DIFFERENCE METHOD TO DEVELOP ANIMAL REPELLENT SYSTEM IN AGRICULTURAL APPLICATIONS"** is the bonafide work of **K VENKATA BHAVANI VEERRAJU (ID NO: N170618), Y VENKATA SIVA REDDY (ID NO:N171055), K SOMA SEKHARA VAMSI (ID NO: N171240), V MOHITH (ID NO: N170053)** carried out under my guidance and supervision for 3rd year project of **Bachelor of Technology** in the department of Mechanical Engineering under RGUKT IIIT Nuzvid. This work is done during the academic session April 2022- September 2022, under our guidance.

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DECLARATION

We **"K VENKATA BHAVANI VEERRAJU (ID NO: N170618), Y VENKATA SIVA REDDY (ID NO:N171055), K SOMA SEKHARA VAMSI (ID NO: N171240), V MOHITH (ID NO: N170053)''** hereby declare that the project report entitled **"OBJECT MOTION DETECTION USING DIGITAL IMAGE PROCESSING BY FRAME DIFFERENCE METHOD TO DEVELOP ANIMAL REPELLENT SYSTEM IN AGRICULTURAL APPLICATIONS"** done by us under the guidance of Dr. J. Srinivasa Rao, Assistant Professor is submitted for the partial fulfillment for the award of the degree of Bachelor of Technology in Computer Science and Engineering during the academic session April 2022- September 2022 at RGUKT-Nuzvid.

We also declare that this project is a result of our own effort and has not been copied or imitated from any source. Citations from any websites are mentioned in the references. The results embodied in this project report have not been submitted to any other university or institute for the award of any degree or diploma.

Date: 21-09-2022

Place: Nuzvid

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We are extremely grateful for the confidence bestowed in us and entrusting our project entitled **"OBJECT MOTION DETECTION USING DIGITAL IMAGE PROCESSING BY FRAME DIFFERENCE METHOD TO DEVELOP ANIMAL REPELLENT SYSTEM IN AGRICULTURAL APPLICATIONS"**

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ABSTRACT

This Report presents a new algorithm for detecting moving objects from a static background scene based on frame difference. Firstly, the first frame is captured through the static camera and after that sequence of frames is captured at regular intervals. Secondly, the absolute difference is calculated between the consecutive frames and the difference image is stored in the system. Thirdly, the difference image is converted into gray image and then translated into binary image. Finally, morphological filtering is done to remove noise.

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CHAPTER 1

INTRODUCTION

An important stream of research within a computer vision, which has gained a lot of importance in the last few years, is the understanding of human activity from a video. The growing interest in human motion analysis is strongly motivated by recent improvements in computer vision the availability of low cost hardware such as video cameras and a variety of new promising applications such as personal identification and visual surveillances. The goal of motion detection is to recognize motion of objects found in the two given images. Moreover, finding objects motion can contribute to objects recognition. Thus, the main objective of the research is to recognize pixels belonging to the same object. However, the present research is based on the following assumptions:

- A well fixed camera – stability is key if you want to isolate motion.
- Stable light, no flickering.
- Contrasting background.
- High camera frame rate and resolution.

Human body motion analysis has been an interesting research for its various applications, such as physical performance, evaluation, medical diagnostics,virtual reality. At present methods used in moving object detection are mainly the frame subtraction method, the background subtraction method and the optical flow method. Optical flow method is to calculate the image optical flow field, and do cluster processing according to the optical flow distribution characteristics of image. This method can get the complete movement information and detect the moving object from the background better. The background subtraction method is to use the difference method of the current image and background image to detect moving objects, with simple algorithm, but very sensitive to the changes in the external environment and has poor anti-interference ability. In the frame subtraction method the presence of moving objects is determined by calculating the difference between two consecutive images. Any motion detection system based on background subtraction needs to handle a number of critical situations such as:

- Image noise, due to a poor quality image source;
- Gradual variations of the lighting conditions in the scene
- Small movements of non-static objects such as tree branches and bushes blowing in the wind.
- Shadow regions are projected by foreground objects and are detected as moving objects.
- The main objective of the present research is to develop an algorithm that can detect moving object at certain distance for object tracking applications.

1.1 Purpose and Objective

The main purpose of motion detection is to sense an intruder and send an alert to your control panel, which alerts your monitoring center. We had seen many cases about Animals enter farmer's fields and destroy crops. It has become a common problem for them and the growers have been left troubled and worried. The moment stray animals enter their fields, farmers run after them and chase them out. To overcome from this problem we are detecting the animals by using Motion detection and we record the video data of entry and exit time of that animal. In future, we want to develop a system that detects animals and chase them out from the farmer's fields.

1.2 Description

Object Motion Detection System can be used in surveillance and security systems. The system that this project came up with will be useful for security in a fixed restriction area. Therefore, the background of the targeted area is assumed to be non-moving and considerations of sudden change in lightings are ignored as well. However, the considerations of other factors are taken into consideration. Basically, the initial plan was to use a technique called image segmentation to abstract the foreground image from the source image obtained and later processed to filter out noises or small images disturbance. To perform this, we would use Open Source Computer Vision Libraries from Intel to obtain contours from the foreground image subtracted. We will map these contours' pixels with the original images' to send raw data into the other module of the project performed by our partner on classifying the image frame obtained on whether it's a human motion or not. His module would return a percentage of recognition rates on whether the motion belongs to human or not. Based on a level on acceptable percentage that it is sure it's a human motion, the program would detects and displays the motion with a bounding box on the human which is in a different color to other moving objects that caused motion as well since all moving objects are bounded by the rectangles. The program will record down the scene when the motion event occurs.

1.3 Resources and Requirements

Basically, the project is going to use a method described by David Moore's final thesis on "A real-world system for Human Motion Detection and Tracking" from California Institute of Technology. Mainly, this module requires functions and algorithms written in the Intel's open CV library. In the hardware's perspectives, we had used a webcam for testing purposes with specifications up to 30 frames per second and support up to 600x800 screen sizes. However, the project had only implemented 300x200 of resolution. The reason behind is because of speed performance issues and also limitation by the Intel OpenCV libraries' rectangles drawing functions which did not draws well with larger resolution. This however maybe be only a problem in the version implemented here which is beta3.1.

CHAPTER 2

LITERATURE REVIEW

We had seen many cases about Animals enter farmer's fields and destroy crops. It has become a common problem for them and the growers have been left troubled and worried. The moment stray animals enter their fields, farmers run after them and chase them out. To overcome from this problem we are detecting the animals by using Motion detection.

The importance and popularity of motion analysis has led to several previous surveys: Wang and Zhao proposed a motion detection by using background subtraction technique. In this video sequence is composed of a series of video images which contains the features of geometry information of the target, extract relevant information to analyze the motion of targets then get detection results. The compression ratio was greatly improved. Rakibe and Patil presented motion detection by developing a new algorithm based upon the background subtraction algorithm. In this firstly reliable background model based upon statistical is used. After that subtraction between the current image and background image is done based upon threshold. And then detection of moving object is done. After that, morphological filtering is initiated to remove the noise and solve the background interruption difficulty. Motion detection by overcoming the disadvantages of background subtraction algorithm. In this robust an efficiently computed background subtraction algorithm has been used, which is able to cope with the problem of local illumination changes such as shadows and highlights as well as Motion Detection Based on Frame Difference Method.

2.1 Object detection network:

The mainstream object detection network is divided into two categories: regional recommendation and end-to-end. The region recommendation method is also called two-step method. Firstly, a series of candidate frames containing objects are generated by the algorithm, or the recommended regions, then the candidate frames are classified by convolution neural network. This kind of algorithm has advantages in accuracy and positioning accuracy, such as R-CNN[7], Fast R-CNN[8], Faster R-CNN[9].

The end-to-end method is called one-stage method. Because these methods directly regress the border of the target without generating candidate boxes, and they have advantages in running speed, such as YOLO[10], SSD[11] and so on.

2.2 Motion based object detection method:

In the application of security, both motion detection and object detection can achieve the detection of moving targets, but have drawbacks. The disadvantage of motion detection is that there are more false positives and it is uncertain what target is in the detected area. The deficiency of object detection includes:

- Hard to detect small object
- Missed and false detection often occurs
- High computing cost.

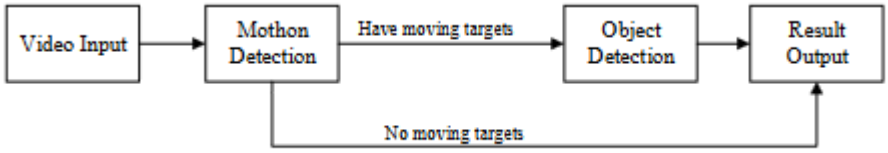

Fig-1: Flow chart of motion based object detection

A new detection method is proposed, which the improved motion detection combined with object detection. The working flow chart is shown in figure 1. The video is decoded and input into the system. If there is a moving object, the corresponding motion area is passed into the convolution neural network of the object detection module for object determination, otherwise the object detection is skipped directly.

2.3 Improved motion detection:

Motion detection depends on the result of foreground detection, and this kind of algorithm may not detect the whole object completely. To solve the problem, the proposed method processes the result of foreground detection to achieve better results. The concrete steps are as follows:

- Find the relationship between all foreground blocks, and if the distance between the two blocks is less than the threshold TH_Distance, mark each other as relational pairs.
- Traversing each foreground block and merging each relational pair,that is, merging all the foreground blocks into a whole block.
- Determining whether there is a cross-over between all merged foreground blocks, if so, merge them.

CHAPTER 3

TOOLS USED

3.1 Softwares

- **Python:** Python offers concise and readable code. While complex algorithms and versatile workflows stand behind machine learning and AI, Python's simplicity allows developers to write reliable systems.

- **Date and time library:** In Python, date and time are not a data type of its own, but a module named datetime can be imported to work with the date as well as time.

- **OpenCV library:** It was generated to support a common infrastructure for computer vision operations and use system behaviour in financial products. It generally targets image processing, faces recognition, video capture, searching, and object disclosure. OpenCV is created to implement various operations including recognizing and detecting faces, analyzing human tasks in videos, identifying objects, recording camera movements, tracking moving objects, and combining images to create a high-resolution image for the accurate scene.

3.2 Hardware components

- A web camera which is in good condition.

CHAPTER 4

PROPOSED METHOD AND FLOW OF THE PROJECT

4.1 Frame Difference Method (proposed Method)

Detection of moving object from a sequence of frames captured from a static camera is widely performed by frame difference method. The objective of the approach is to detect the moving objects from the difference between the existing frame and the reference frame. The frame difference method is the common method of motion detection. This method adopts pixel-based difference to find the moving object.

Difference of Two Consecutive Frame

I_k is supposed to be the value of the kth frame in image sequences. $I_{k+1}$is the value of the (k+1) th frame in image sequences. The absolute differential image is defined as follows: $I_{d(k, k+1)} = |I_{k+1} – I_k|$

Transformation of absolute differential image to Gray Image

There are holes in moving object area, and contour of moving object is not closed. The absolute differential image is transformed to gray image to facilitate further operations.

RGB To Gray : Y ⇦ 0.299*R + 0.587*G + 0.114*B

Filtering and Binarizing Transformed Gray Image

In order to remove the holes, the image is passed through the Gauss low pass filter.

$I_{d1}$is got by filtering the gray image. Now Id1image is binarized using binary threshold and got Id2 binary image.

$I_{d2}(x, y)=$ Where (x, y) is a pixel coordinates in image.

4.2 Flow of the project

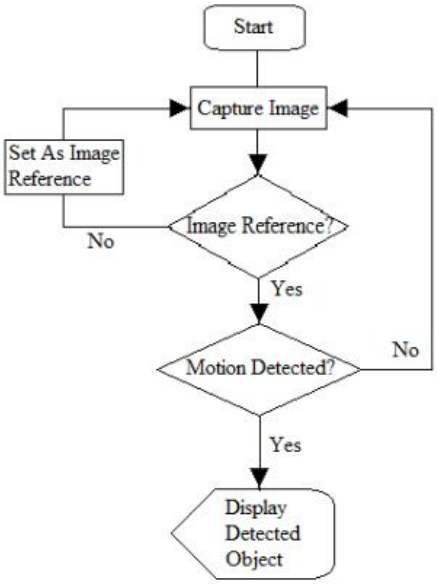

Fig-2: Flowchart for the Workflow of Project

4.3 Working Principle

Videos can be treated as stack of pictures called frames. Here we are comparing different frames(pictures) to the first frame which should be static (No movements initially). We compare two images by comparing the intensity value of each pixels.

These are the tasks involved in this project:

- Capturing the first frame of the video
- Comparing each frame with the first frame
- Detecting the motion (if any)
- Storing the time of motion of the object

4.4 CODE

```
# Python program to implement
# Webcam Motion Detector
import cv2

from datetime import datetime

r_frame = None

motion_list = [ None, None ]

time = []

video = cv2.VideoCapture(0)

frame_width = int(video.get(3))

frame_height = int(video.get(4))

c=1

while True:
    check, frame = video.read()

    motion = 0

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    gray = cv2.GaussianBlur(gray, (21, 21), 0)

    if r_frame is None:
        r_frame = gray
        continue

    diff_frame = cv2.absdiff(r_frame, gray)

    thresh_frame = cv2.threshold(diff_frame, 30, 255, cv2.THRESH_BINARY)[1]

    thresh_frame = cv2.dilate(thresh_frame, None, iterations = 2)

    cnts,_ = cv2.findContours(thresh_frame.copy(), cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)

    for contour in cnts:
        if cv2.contourArea(contour) < 10000:
            continue
        motion = 1

        (x, y, w, h) = cv2.boundingRect(contour)

        cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 3)
```

```
    motion_list.append(motion)

    if motion_list[-1] == 1 and motion_list[-2] == 0:
        time.append(datetime.now())

        video_object =
cv2.VideoWriter('Data/Video%d.avi'%(c),cv2.VideoWriter_fourcc('M','J','P','G'), 30,
(frame_width,frame_height))

    if motion:
        video_object.write(frame)

    if motion_list[-1] == 0 and motion_list[-2] == 1:
        time.append(datetime.now())

        video_object.release()

        c = c+1


    cv2.imshow("Gray Frame", gray)

    cv2.imshow("Difference Frame", diff_frame)

    cv2.imshow("Threshold Frame", thresh_frame)

    cv2.imshow("Color Frame", frame)

    key = cv2.waitKey(1)

    if key == ord('q'):
        if motion == 1:
            time.append(datetime.now())
            video_object.release()
        break
video.release()

f=open("Data.txt","w")
f.write("\tStart Time\t\tEnd Time\n")
for i in range(0, len(time), 2):
    f.write(str(time[i])[:19]+"\t\t"+str(time[i + 1])[:19]+"\n")
f.close()
cv2.destroyAllWindows()
```

CHAPTER 5

RESULT

Simulations

After running the code there 4 new window will appear on screen. Let's analyse it one by one:

Gray Frame: In gray frame the image is a bit blur and in grayscale we did so because, In grey pictures there is only one intensity value whereas in RGB (Red, Green and Blue) image there are three intensity values. So it would be easy to calculate the intensity difference in grayscale.

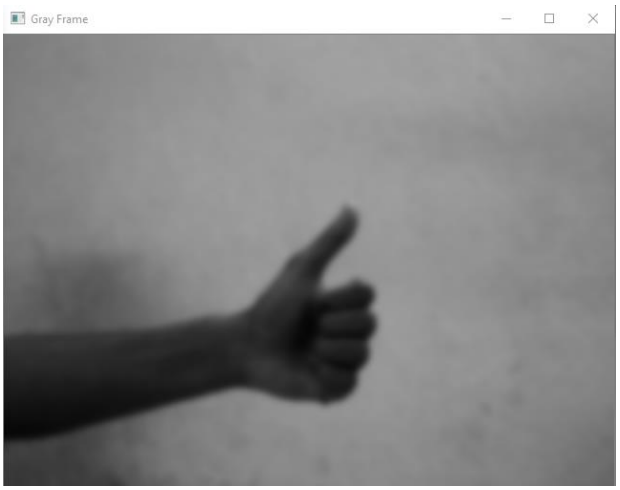

Fig-3: gray frame

Difference Frame: Difference frame shows the difference of intensities of first frame to the current frame.

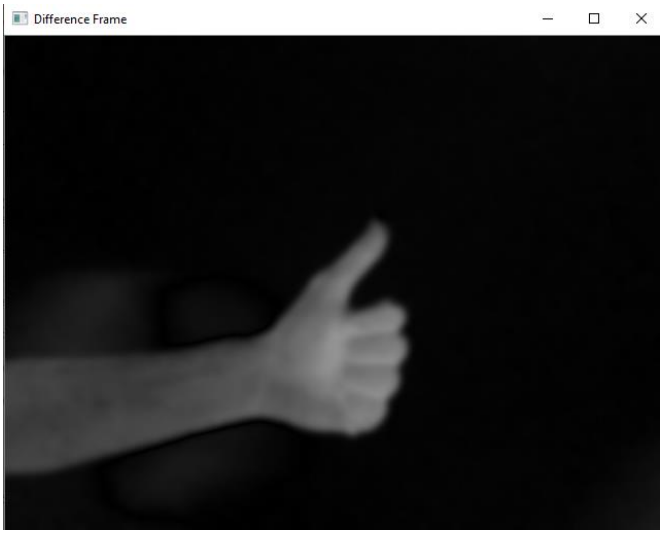

Fig-4: difference frame

Threshold Frame: If the intensity difference for a particular pixel is more than 30(in our case) then that pixel will be white and if the difference is less than 30 that pixel will be black

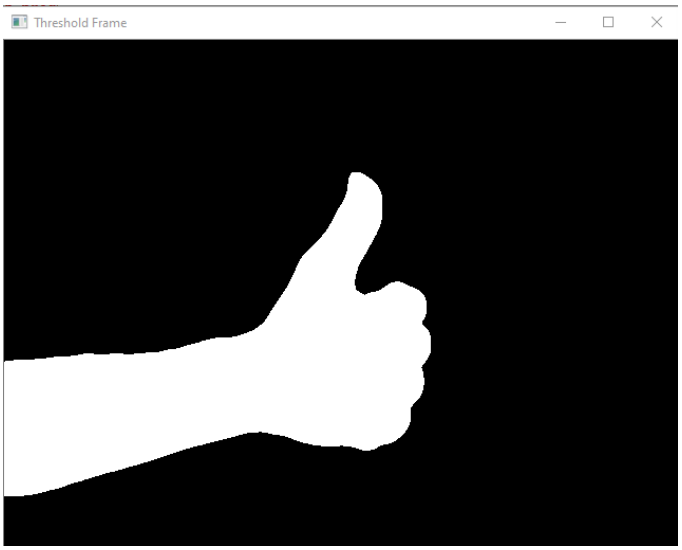

Fig-5: threshold frame

Color Frame: In this frame you can see the color images in color frame along with green contour around the moving objects

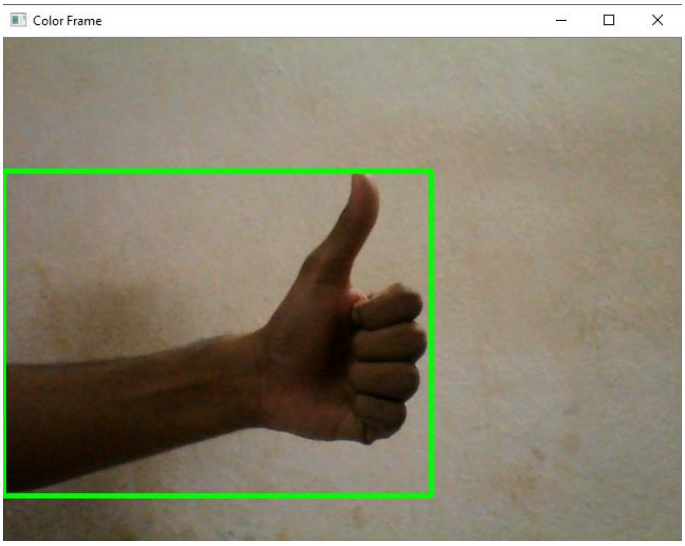

Fig-6: color frame

Time Record of movements

Data.txt - Notepad

File Edit Format View Help

Start Time	End Time
2022-09-16 22:33:25	2022-09-16 22:33:31
2022-09-16 22:33:32	2022-09-16 22:33:32
2022-09-16 22:33:32	2022-09-16 22:33:32
2022-09-16 22:33:32	2022-09-16 22:33:32
2022-09-16 22:33:34	2022-09-16 22:33:34
2022-09-16 22:33:34	2022-09-16 22:33:34
2022-09-16 22:33:34	2022-09-16 22:33:34
2022-09-16 22:33:35	2022-09-16 22:33:35
2022-09-16 22:33:35	2022-09-16 22:33:35
2022-09-16 22:33:35	2022-09-16 22:33:38
2022-09-16 22:33:40	2022-09-16 22:33:42
2022-09-16 22:33:43	2022-09-16 22:33:49

Fig-7: Time record of movement

Video Recording of movements

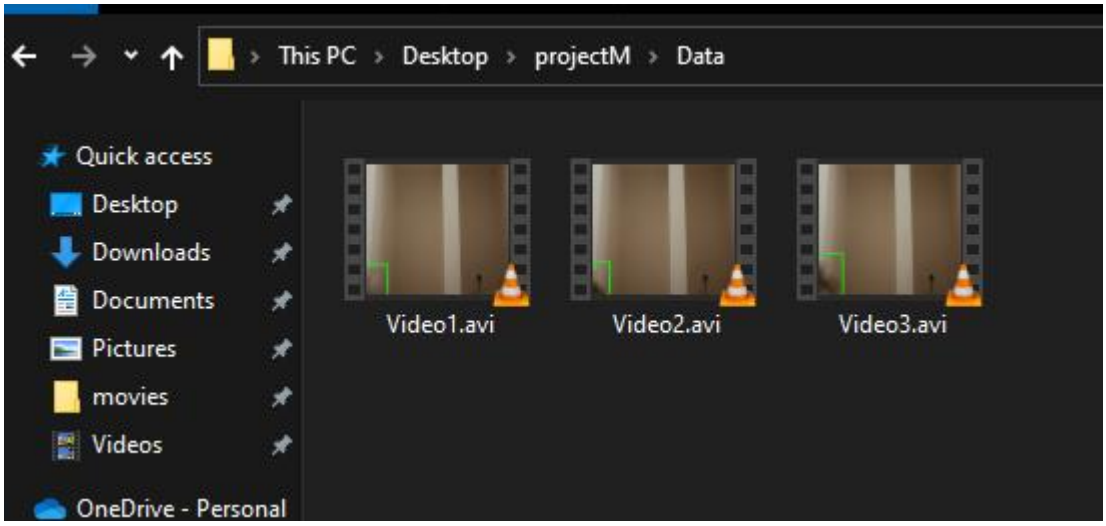

Fig-8: video record of movement

CONCLUSION

In the present project, moving object is detected by the method of motion detection, which composes of frame difference method and morphological operations. The obvious keystone of the work is studying the principle of frame difference method and to resolve the various problems. The experiment shows that the method has good performance and efficiency. Future enhancement may include alerting the user by sending intimations. In future, we are planning to implement this project into Animal repellent System in agricultural applications. To prevent animals entering into the agriculture fields and causing damage.

Advantages & Applications

- A component of security cameras, motion detectors activate recording when movement is identified. This eliminates hours of unusable, non-applicable video consuming large amounts of memory and storage. It also improves battery life and conserves energy. This occurs whether you're home, or away.
- Motion detection also recognizes security camera-scene activities through analysis differentiation—called pixel matching or frame referencing. This detects images that don't match previously programmed camera settings—including possible intruders.
- The object or intruder entered into the frame will be captured using the camera and also stores the entry and exit data.
- This can be used in Security systems to prevent the intruders to enter.

Limitations

- By using this project, we cannot detect the far away moving objects.
- It won't perform well in low light area or atmosphere.
- If the reference frame is disturbed, we cannot detect moving objects or intruders.
- The proposed method also detects the motion due to the movement in air. As the air moves, the camera not remains in the position of static so when there is no movement of object then also it results motion and shows holes in the binary output image.

FUTURE SCOPE

As of now this project is implemented for detecting objects and capture those images of the objects and also vary the entry time of the object and end time of the object. In future this project will be implemented to detect the objects which are captured by surveillance camera and also implement for identifying the objects captured in system. We had seen many cases about Animals enter farmer's fields and destroy crops. It has become a common problem for them and the growers have been left troubled and worried. The moment stray animals enter their fields, farmers run after them and chase them out. To overcome from this problem we are detecting the animals by using Motion detection and we record the video data of entry and exit time of that animal. In future, we want to develop a system that detects animals and chase them out from the farmer's fields. In future, we want to develop Animal Repellent system using Motion detection using Digital image processing in agricultural applications.

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