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Design and Simulation of Automated Sound System to Protect the Agriculture Farms

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ABSTRACT: Autonomous control system is designed for fields which require minimum supervision and attention. The system is needed for protection of fields from animals particularly monkey, blue bulls, cow and elephant. In peculiar countries animals are used to live in the fields or agriculture areas and damage the crop. In this paper, firstly the motion of animal is detected using ultrasonic sensor. The ultrasonic sensor gives the values of serial monitor which shows the distance of the animal from the field. If distance of animal is less than 3m from the field, the command is given to turn on the camera. The camera will monitor the field area and import videos to MATLAB using ORB algorithm, a particular animal is identified. ORB is used over SURF algorithm because time taken by ORB is much lesser than the SURF. After identification of particular animal cow, blue bull, monkey and elephant a buzzer is played according to particular animal because different animal having different hearing ranges. Particular irritating frequency of sound is produced to keep away animals from the field.

KEYWORDS: Ultrasonic sensor, Camera, Buzzer, ORB, SURF, MATLAB, Serial Monitor etc.

I.INTRODUCTION

Agriculture is the main frame of our country over 60.47% of land is dedicated for agriculture. So to protect the wastage done by animals need to change in the strategies for the protection of the fields from animals. Monkey and blue bull alone count for about 50% to 60% of total crop damage in the villages. According to farmers 75% of the total agriculture area is badly damaged by the blue bull that leads to make their surrounding into barren lands. 70% tehsil areas of the hill state are badly affected by the wild animal harm and farmers in higher hills have left their agriculture land after suffering repeated losses. Previous research work [1] is focused on a control system for the protection of the greenhouse from unwanted animals by electric fence and detecting motion using IR sensor than applying electricity in fencing. The authors [2] worked on design a system when farmer is not present in the field area, RFID wireless technology used to transform the level of livelihood and give protection from birds and animals which damage the crop like wheat, gram, jawar, etc. this system yield perfect results to the problem generally faced by the farmers and versatile because of wireless system. Author [3] previously worked on a circuit which wires are grounded, when animal touches the wire it will triggered and buzzer will also activated and with the use of LDR it identify the intensity of light, if it is less it will concentrate light .so, by using it animals are keep away from the field. A fencing system [4] is used by farmers to reduce unnoticed entry of animals or birds in the field. In order to modernize the whole agricultural environment, an image processing technique is adopted in this system to sense the images of animals or birds which are entering the field unexpectedly and give warning to them. The idea of vibration sensor [5] is used to detect the entry of the animal in the field area. If the vibration sensor is interrupted moderately, then vibrations are generated by the sensor, then farmers aware about the entrance of animals in the field. By using vibration sensors they program to give shock to the animals entering the field area. Interfacing Relay board is used with the vibration sensor to give slight shock to the animals entering the field. In previous research work [6], they discuss about a variety of accident of household and wild animals like buffalo, cow and nilgai etc. Avoiding such type of accident are the communal problems. So, an intellectual system is intended which can be get rid of possibilities of accidents. Basic idea following planned work is that to produce the sound signal which is inaudible to human and annoying for animals. In previous research experimental environment [7] is OpenCV2.3.1 and Visual Studio2010. It shows that the calculating speed has

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been enhanced when receiving more accurate matching points. Median filter and RANSAC algorithm can find better matching points and improve the calculating speed of matching the object. In this research author [8] uses 3D point recognition with SIFT descriptors if ANNS matching. To obtain accuracy better than binary descriptor base matching, shade and depth in turn are used. In this research work [9] fast shot boundary detection is used by author employing candidate segments selection, most of the non-boundary frames are removed before GT and CT detection. Singular value decomposition used to decrease the aspect of features. These aspects help us to achieve a high detection speed. In this [10], author introduced a original content-responsive retargeting method for stereoscopic video. Moreover, the preset critical state and crop window guide to effortless volumetric cropping for better of time motion protection, compared with the retargeting using dissimilar critical region in video frames.

II.SYSTEM METHODOLOGY

The Autonomous control system is designed for fields which require minimum supervision and attention. The system is developed for protection of fields considering four animals particularly monkey, blue bulls, cow and elephant. In peculiar countries animals are used to live in the fields or agriculture areas and damage the crop. The main objective is that to keep away animals from the using autonomous control system so, that it requires minimum attention of farmers. In the present work, first of all, the motion of animal is detected using ultrasonic sensor. The ultrasonic sensor gives the values of serial monitor which shows the distance of the animal from the field. If distance of animal is less than 3m from the field command is given to the camera and camera gets on from turn off position. The camera will monitor the field area and import videos to MATLAB. First features are extracted from the video frames and matched with the images present in the database. ORB algorithm is used to extract the features from the images. After animal identification, the name of particular animal is displayed on the frame if no match found nothing is displayed on the frames. .After identification of particular animal cow, blue bull, monkey and elephant, a buzzer is played according to particular animal because different animals are having different hearing ranges and some animals can hear the frequencies below human frequency range. Particular irritating frequency of sound is produced to keep away animals from the field.

The flow chart is shown in Fig.1 and it is explained in following steps:

Steps involved in ORB algorithm:

Step 1: The input is given from the camera and videos are imported to MATLAB.

Step 2: Features has been extracted from the images first using FAST key point detector the features are I_m and I_{m+1}. I_m is the features extracted from the database images and I_{m+1} is the feature extracted from the imported video frames.

Step 3: Than using a BRIEF descriptor these features are converted to the binary format $P(I_m)$ and $P(_{Im+1})$. $P(I_m)$ is the binary format of database image and $P(_{Im+1})$ is the binary format of imported image from the video frames.

Steps 4: After extraction of feature from the images, it is converted to binary format P(Im) and P(Im+1) are matched.

Step 5: If any match found, the name is displayed on the video frame and buzzer is played and if match is not found than nothing is displayed on video frame.

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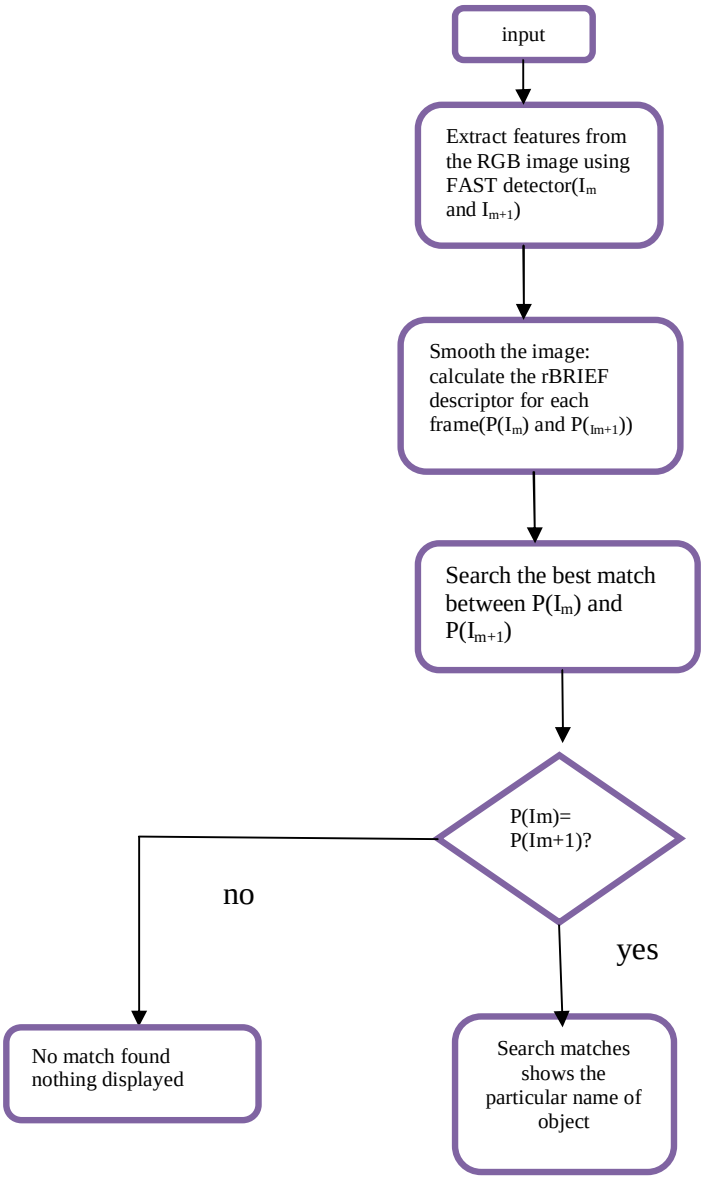

Fig.1 Flow chart of ORB algorithm

III.RESULT AND DISCUSSION

The motion detection is obtained by using Ardunio Uno IDE software in which serial monitor gives the reading of motion detection. The description of field area of the field is 300msq. , sensors are placed at 30cm distance from the ground at a distance of 4m from each other and camera are placed at 2m from the one corner. After that extraction of features and identification of particular animal is done by MATLAB software. The 1456 images are trained and features are extracted and for identification of particular animal videos are taken from National Zoological Park, Delhi from which animal identification done.

1) Motion detection-The Fig.2 represents the distance of object from the ultrasonic sensor in centimetres. These values are serially transmitted to the MATLAB through serial port 0 to converse with other devices that have serial ports, or to communicate with the USB port. Each serial port wires one Serial Transmit and one Serial Receive block, one block

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per pin at a as distance less than 3m. The camera is turned on and captured the area under field than video frames are imported to MATLAB.

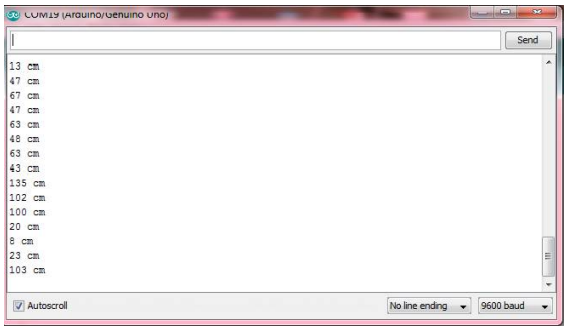

Fig.2 Serial monitor readings

2) Comparison between SURF and ORB- The table.1 represents results of comparison between SURF and ORB algorithms. The performance of ORB is better than SURF in three parameters. When comparing the image with varying intensity, SURF takes 0.08sec and ORB takes 0.05sec, matching at 180 rotating angle matching percentage of SURF is 88% and ORB gives 95%,result of comparing image with its scaled image SURF takes 0.06sec and ORB takes 0.02sec.so,so the ORB algorithm is used in this project for matching of animals.

TABLE.1 Comparison between SURF and ORB

Features	SURF	ORB algo.
Result of comparing the image with varying intensity	0.08 sec	0.05 sec
Matching at 180 rotating angle	88%	95%
Result of comparing image with its scaled image	0.06 sec	0.02 sec.

3) Feature extraction-

Fig.3 shows the extraction of features. 1456 images are trained from which the features are extracted. These features are eyes, ears, texture, color, tusk, tail, shape, trunk, nose. Images in database are from different angles of a animal so that we can easily identify the animal in the video. First FAST points of the images are detecting. FAST takes only one limitation, the strength verge among center pixel and circular ring on the center. Using FAST keypoints, N number of keypoints are detected. Set the verge low sufficient to obtain more than N keypoints, then place them according to Harris measure, and pick top N points. FAST does not create multi-scale features. After finding N FAST keypoints, these are converted to binary format using rBRIEF descriptor.

Fig.3 Feature extraction from images

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4) Detection of animal from the video-

In Fig.4 we detect the animal from the video using background subtraction method. The moving pixels are examined and subtract the background. A pixel shrewd median filter is applied over time for a number of seconds to video (typically 20-40 seconds) to differentiate between moving pixels and stationary pixels from the frames and moving frame is displayed as animal. These animals are cropped from the video and features are extracted from them these features than matches with existing database images.

Fig.4 Animal detection in videos

5) Particular Animal Identification-

In Fig.5 animals are cropped from the video and FAST keypoint detector extract the features from the images then features of the image are converted to binary format using rBRIEF descriptor $P(I_{m+1})$, then matched with the existing database features $P(I_m)$ using nearest neighbor ratio method. If match is detected then the name of particular animal is displayed on the video frame and accordingly different frequency is played through buzzer.

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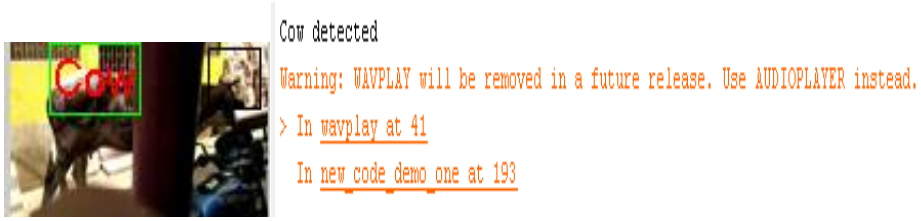

Fig.5 Particular animal identification and producing particular frequency

6) Confusion matrix-

It is a special kind of matrix, contains two sets (actual and predicted) and identical set of classes in both dimensions. In Fig.6 confusion matrix represents the positive results only i.e., 96% of cow detected as a cow and 4% are detected as a monkey,14% monkey are detected as a cow and remaining 86% are detected as a monkey, 2% elephant are detected as a cow and 98% are detected as a elephant,10% blue bull detected as a monkey and 90 are detected as a blue bull. So the errors are very less.

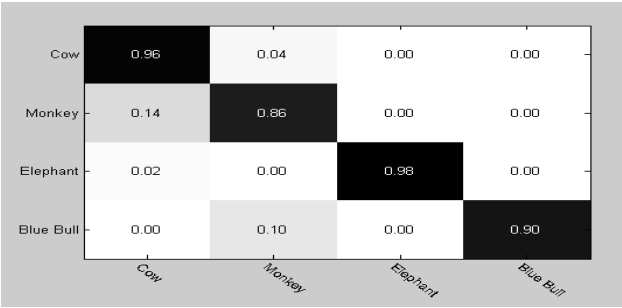

Fig.6 confusion matrix of ORB algorithm

6) Precision Recall Graph-

Precision of ORB algorithm is 1.000000. It denotes the true matching of the algorithm. Recall of ORB algorithm is 0.980000. It implies the false no. of matching in the animal identification process. Recognition rate of ORB algorithm is 0.925000. It denotes the accuracy the overall true and false matched correctly.

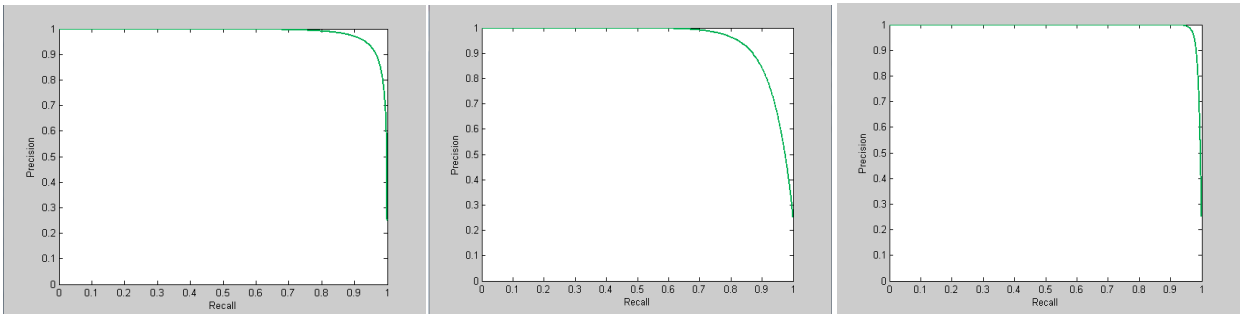

Fig.6 PR graphs of ORB algorithm

7) Frequency generation-

Table.2 shows the different frequency ranges for different animals these frequencies are being produced by the buzzer. Each animal has a specific irritating frequency. In the designed system, a particular irritating frequency will buzzer after identifying the animal. The animal will move away after hearing this frequency [6].

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Table.2 Frequency range for different animals [6]

Animals	Irritating frequencies (hz)
Cow	23-35,000
Elephant	16-12,000
Monkey	34.8-45,000
Blue bull	33-50,000

VI.CONCLUSIONS

Based on results presented, the following conclusions are drawn:

1. The performance of ORB is better than SURF in three parameters.
2. When comparing the image with varying intensity, SURF takes 0.08sec and ORB takes 0.05sec, matching at 180 rotating angle matching percentage of SURF is 88% and ORB gives 95%, result of comparing image with its scaled image SURF takes 0.06sec and ORB takes 0.02sec.so. So ORB is preferred for matching of particular animal.
3. 1456 images are trained and features are extracted from them and these features are converted to binary format. The result obtained from matching is represents by confusion matrix. Confusion matrix shows all positive results. True positive and false positive results after detection in this matrix are, 96% of cow detected as a cow and 4% are detected as a monkey, 14% monkey are detected as a cow and remaining 86% are detected as a monkey, 2% elephant are detected as a cow and 98% are detected as a elephant, 10% blue bull detected as a monkey and 90 are detected as a blue bull. The precision, recall and recognition rates are 1.000000, 0.980000 and 0.925000. The following results give the accuracy of the algorithm more clearly.
4. After recognition of animals, respective frequencies are produced i.e. 23-35,000 Hz for cow, 34.8-45,000 Hz for monkey, 16-12,000 Hz for elephant, 33-50,000 Hz for blue bull.

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