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A video surveillance framework for animal behavior analysis

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Abstract: A video surveillance monitoring system is used to examine animal behavior analysis particularly in cow behavior. In animal behavior analysis, changes in behavioral patterns of animal is an important factor for animal health and welfare management system. Thus, this video based monitoring system will become a use full technology. This system is based on image processing technique, which relatively low cost and simple enough to implement. Proposed cattle monitoring system is composed of various components. The first component is high resolution camera which collects the video. Different types of algorithm are used to extraction target. Markov random walk model is used for detection of various types of behaviors among the target.

Keywords: A video surveillance system, animal behaviors, target extraction, Markov random walk model.

1. Introduction

In modern societies, living objects behavior study has become challenging research area in which both animal and human being behavior analysis are carried out for different and multiple purposes. In animal behavior studies, the purposes are mainly concern with health and welfare management. In this concern, farmers, animal health professionals and researchers have well recognized that analysis of changes in behavioral pattern of cattle is an important factor for an animal health and welfare management system. Also, in today dairy world, farm sizes are growing larger and larger, as a result the attention time limits for individual animals smaller and smaller. Thus, video based monitoring system will become an emerging technology approaching to an era of intelligent monitoring system .It has been long recognized that the annual costs to the dairy industry is very high due to lack of monitoring enough to the cows in times. In addition, the quantity and quality of labor required for successful detection is an important factor to productivity gains, especially on larger farms. Such cattle monitoring system could support cattle reproduction by improving cow behavior detection.

One of the important issue in the management of group-housed live stock is to make early detection of abnormal behaviors of cow. Such as, identifying unhealthy or poor health cows for example lameness through analysis of measured motion data. It is important to detect lameness behavior in right time otherwise it will become big health and welfare issue in modern intensive dairy farming. By monitoring sick cow can be identified and removed from the herd much faster to protect herd health.

Thus, the proposed intelligent video surveillance system for animal behavior analysis is proposed to be by using background subtraction model for target or target extraction, Markov model for detection of various types of behavior among the target. The behaviors may include sexual behaviors such as standing for mounting or to be mounted, cow riding another cow. Health care behaviors such as, cow collapse due to lameness or attack. Associated behavior as Cow feeding.

2. Relevance

The main purpose of this work is, to improve behavior and healthiness of dairy cows by early detection of abnormal changes in behavioral patterns of cattle. It has been long recognized that the annual costs to the dairy industry is very high due to lack of monitoring enough to the cows in time. In addition, the quality and quantity of labors required for successful detection is an important factor to productivity gains, especially on larger farms. Such cattle monitoring system could support cattle reproduction by improving cow behavior detection. This will lead to a successful in breeding as well as an increase in milk production. In addition, by analyzing the detected motion data and the uncommon behavior data, one can diagnose some unhealthy forms of patterns. Image processing technology used in the dairy farming increasingly. Image processing techniques offer the possibility to quantify the visual information continuously, without contact and human presence.

3. Literature Review

3.3. ThiThiZin, Ikuo Kobayashi, Pyke Tin [2016]

In this paper, author has developed cattle monitoring system framework which is composed of three components set of cameras, processing box and decision making. The set of cameras, which collects videos or

images. Processing box will performs various operation or image processing on the captured image. The concerned algorithms such as motion detection, background modeling and background subtraction, object tracking, object classification technique. The parameters are estimated to infer the behavior of cattle from features extracted of digital image. Markov random walk model is used for tracing the graph. Finally decision making is classify the types of actions and interaction among the monitored cows.

3.2 Cho NilarPhyo, Member, IAENG, ThiThiZin , PykeTin,Hiromitsu Hama, Ikuo Kobayashi [2018]

In this paper, author has developed a system which focus on identification of individual cows based on black and white pattern of the cow's body. This system is mainly consist of two main components; first one is automatic detection and cropping of cow's body region using inter-frame differencing between two consecutive frames of cow's videos in order to detect the moving pole location. Then this result is transformed into binary image. And we got horizontal histogram of occurrence of white pixels in binary image. Then image is cropped with predefined height and width. After cropping which includes black and white pattern we train them into deep convolution neural network to identify the cow's ID.

3.3 Sosuke Imamura, ThiThiZin, Yoyichiro Horii [2017]

In this paper author has developed the system evaluation of cow's body condition scoring using 3D cameras; which is method to identify the fatness or thinness of the cow's body. Root mean square derivation and convex hull is used as feature on the surface to quantify the unevenness of the body. The data is extracted line by line and plotted on the graph. Approximated parabola is drawn Root mean square derivation value is calculated which represents unevenness in the cow's body. Convex hulls are a technique often used for shape feature analysis in image processing. By applying convex hull to 3D space, the surface unevenness is quantified. Consider convex hulls for cow 3D data and take the difference between the convex hull volume and the original cow data volume. By using appropriate formula BCS is calculated.

3.4 Ahmad Poursaberi, Claudia Bahr, Arno Pluk, Daniel Berckmans [2011]

The author has developed the system for real time lameness detection using image processing based on Body Movement Pattern (BMP). The system classify the lameness degree based on back posture and head position. Firstly, back posture extraction is done using separation algorithm where only cow's back area is considered. This area is binarized and object which having area more than fixed value are removed or denoted as cow. The normalized cross correlation and sum of squared distance is used to determine cow body region. Two ellipses are fitted on front and back side of the reference point which is highest point on cow's body. The Body Movement Score formula is used for evaluation of lameness. The features are calculated for four frames per cow. Per hind hoof two frames were taken, where hoof was fully placed on the floor. The summation of two frames of each hoof is calculated and maximum value is selected for lameness evaluation.

3.5 KosukeSumi, ThiThiZin, Ikuoo Kobayashi, Yoichiro Horii [2017]

In this paper, the author has developed cow monitoring system for calving process. In this the system is proposed an image technology based method for detecting calving process by analyzing motion feature. First, the location of cow is detected using inter frame difference of previous and current frame. Then binarization of image is done to calculate the centroid of region. Centroid is used for tracking cow . Then white pixels in processing area is counted, histogram is calculated, cumulative frequency and second order difference is performed on this basis movement of cow is detected. If frequency of movement is greater than threshold then alarm is enable for calving process attention.

3.6 GaoRonghua, GuJingQui, Liang Jubao [2017]

The method developed in this paper is focused on the cow behavioral identification problem such as estrus and hoof disease under complex background. The cow's daily behaviors were real time monitored high-definition camera. Firstly, cow object in the video was extracted. Then, the continuous moving behavior was obtained via dynamic tracking. Entropy is combined with clustering algorithm in order to get cow body region. The intersection area between the minimum bounding boxes are calculated for analysis of estrous behavior. And the area of minimum bonding box is calculated using the image moment calculation. When targeted cows in video intersects, the center coordinates of minimum bounding boxes of targeted cows are calculated. When the distance between two centers coordinates is less than minimum width then it indicates cow is suspected of estrous. And the hoof disease is detected by degree of back curvature.

3.7 Anaswara S Mohan, Resmi R [2014]

In this paper object detection and segmentation is proposed and they are compared using background subtraction algorithm or object detection and segmentation algorithm using thresholding and edge detection. The proposed method is aims at extracting the moving objects in an input image from their background. The method is based on using background subtraction algorithm. The morphological process is used to remove the noise region. The close operation is effective for eliminating the background noise and open operation is effective for removing noise within the object region itself. Next is, image segmentation is based on two steps. In the beginning, image is converted into binary image and then thresholding and edge detection is applied to segment object. The edge detection is done in four steps; smoothing, enhancement, detection and localization. Smoothing suppresses as much as possible noise without destroying the true edges. In enhancement, filters are applied to enhance the quality of edges in image. Detection is carried out for determine which edge pixel should be discarded as noise and which should be retain. Localization determines the exact location of edge.

4. Proposed work

4.1 Objectives

- To collect videos high resolution camera is used and preprocessing is done as per the requirement
- To extract the features key points are used.
- To detect the specific behavior Markov random walk model is used.

4.2 Methodology of Implementation

A. Detailed explanation of flowchart

Proposed cattle monitoring system is composed of various components. The first component is high resolution camera which are connected to monitor the cattle behavior. Which collects the and broadcast the video through a data channel after specific time period. So, by using camera acquisition of image is done. Next the frame is resized as per the requirement. Then preprocessing is done for each frame came from the camera.

The processing of system is perform in two steps.

Step 1- is acquisition of sample image. After the extraction of feature of image is devoted to the labelling anatomical features on the acquired digital image. These extracted features of the sample image are used to analysis of the specific behavior of the new test image during the second step.

Step 2- acquisition of unlabeled sample is done, then the feature of new test image is compared with features of sample image in first step. If any similarities are obtained in the features of test image. Then these images are goes to Markov random walk model which is chain model. The clustering of these images is done at Markov random walk model. If there is similarity in the behavior of cow it detects the specific behavior and alerts to the owner or farmer. If system is not detecting any behavior from the frame sequence then acquisition of next image is done.

B. Flowchart

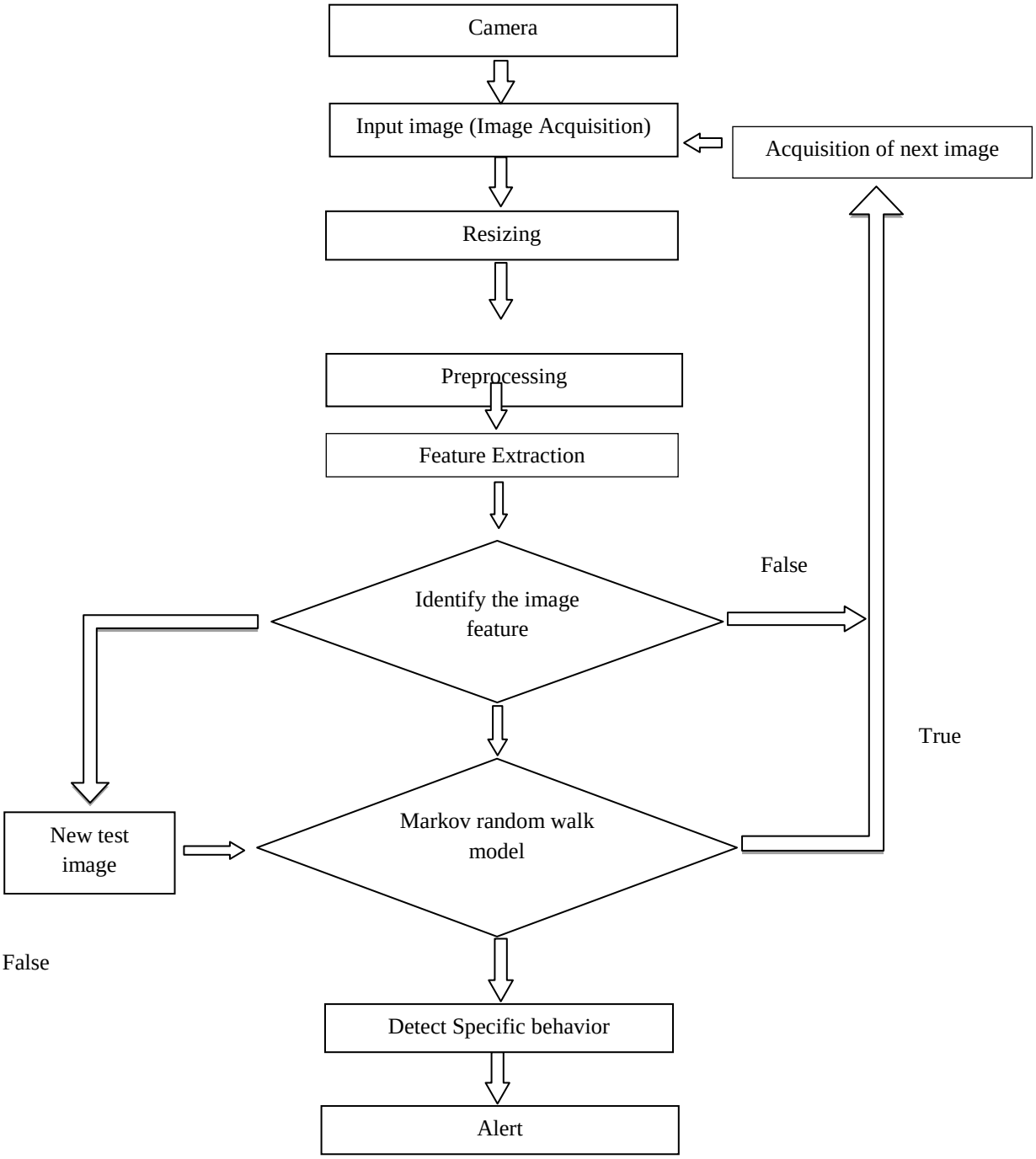

Figure 1.1 Proposed video surveillance monitoring system

The goal of this work is to develop a video surveillance system for detection of abnormal animal behavior. This can be applicable to any animal, this system is proposed for detection of cow's behavior. This can be carried out by applying different type of algorithm to detect object and extract specific features to analyze behavior.

4.3 Evaluation technique:

The evaluation technique of intelligent video surveillance monitoring system for detection of abnormal behavior of animals. To detect it, we extract the image features and compare the test result with predefined values or previous frames. If any abnormal behavior is detected then system will alert to owner or farmer.

4.4 Performance metrics:

We evaluate following behaviors of the animal

(i) Cow feeding,
(ii) Cow riding another cow
(iii) Cow standing to be mounted.
(iv) Cow collapse due to lameness or attack.

In order to investigate various types of animal behavior recognition, the concerned algorithms rely on the core technology available such as motion detection, background modeling and background subtraction, object tracking, object classification techniques and decision making process etc.

5. Conclusion

In this paper, we proposed a general video surveillance system to explore and examine some problems in animal behavior particularly in cow behavior. Specially, this system is concerned about improving the behavior and healthiness of dairy cow by early detection of changes in behavioral pattern.

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