CALCULATING PATH OF MOVING OBJECT

Technical report

Institute of Robotics and Cybernetics
Faculty of Electrical Engineering and Information Technology
Slovak University of Technology in Bratislava

Ing. Peter Beňo

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I. Table of Contents

II. Motivation

Recognition of animal movement in a video, and calculating the length of the trajectory it travelled. On video, there is just one moving object – animal in the cage. Video has low quality and low frame rate and it contains reflections caused by dynamic lighting conditions. In this document, we describe our approach for solving this problem.

Achieved result is demonstrated on picture 1:

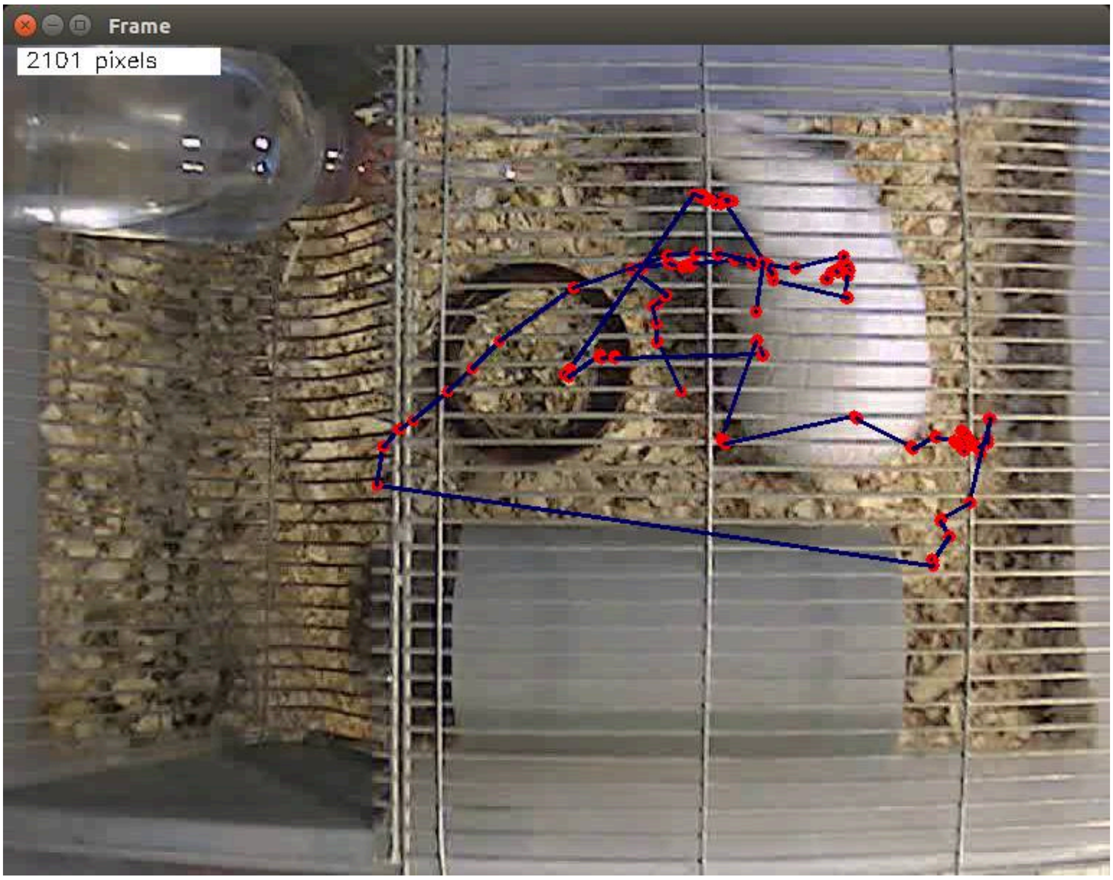

Image 1 –results of our system displayed on last frame of inout video

III. Motion detection

Real-time segmentation of moving regions in image sequences is a essential step in many vision systems. A typical method is background subtraction. Many background models have been introduced to deal with different problems. Background subtraction involves calculating a reference image, subtracting each new frame from this image and thresholding the result. What results is a binary segmentation of the image which highlights regions of non-stationary objects. One of the successful solutions to these problems is to use a multi-colour background model per pixel proposed by Grimson et al. [1,2,3]. These methods suffers from slow learning at the beginning, especially in busy environments, and it is not able to distinguish between moving shadows and moving objects. Method was later improved by P. KaewTraKulPong and R. Bowden [4]. They utilized different update equations at different phases of algorithm. That allowed system to learn faster and adapt effectively to changing environments. They also improved algorithm by introducing shadow detection scheme, which is based on computational color space that makeds use of background model. Their results were significantly better, what we can see on image 3. Their method in implemented in OpenCV (Open Source Computer Vision) library in MOG background substractor class.

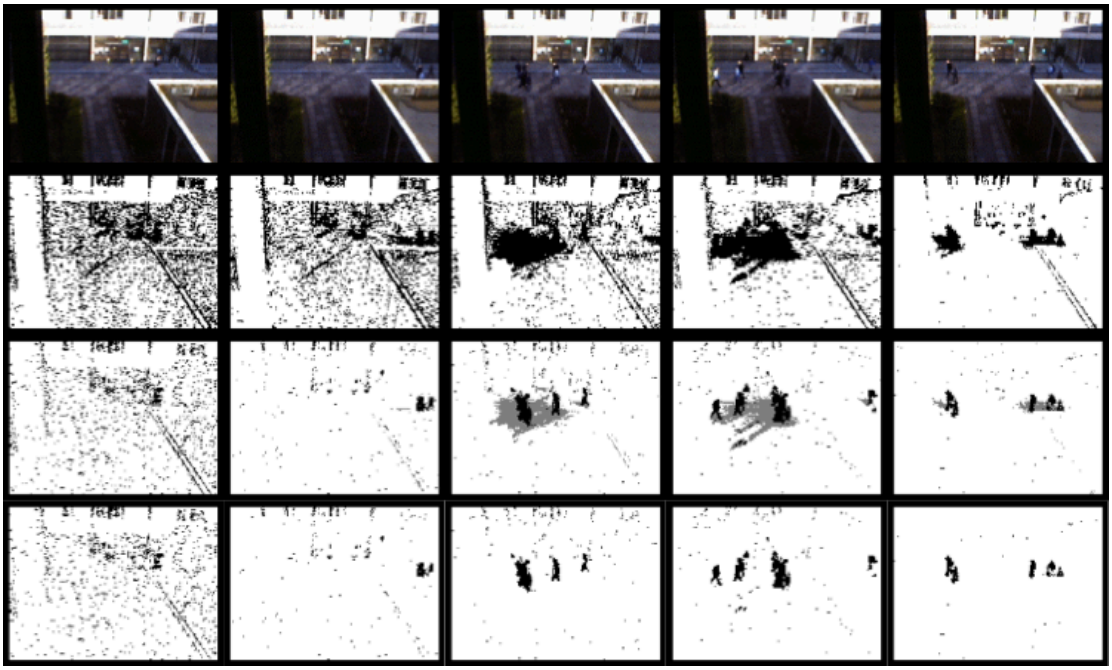

Image 2 - The top row displays the original sequence at frames 15, 105, 235, 290 and 1200 respectively. The second row shows the results from Grimson et al's. The last two rows are the results of P. KaewTraKulPong's and R. Bowden's method with and without moving shadows displayed in the images. The shadows are shown in grey. [4]

IV. The algorithm

Firstly, we use median filter to remove background reflections from the processed frame. Then our algorithm uses MOG background subtractor to detect moving object and create binary image for each frame processed. We reduce noisy pixels in binary image with erosion, then we restore image with dilation. At last, we calculate center of mass of moving pixels in current frame and add coordinates of this point into pose graph as new node. Each inserted node is connected to the previous node by line segment. Number of nodes in the pose graph is not equal to number of frames in video, because we drop frames either when detected pose is too close to last detected pose (less than 10px in this test), or when there are not enough moving pixels in the frame – for example in situation, when animal moves only its head. To get total length of trajectory which animal travelled in pixels, we calculate length of all line segments connecting graph nodes. Conversion of pixel length to metric length is trivial, if we know dimensions of the cage.

Block diagram of our algorithm is displayed on image 2.

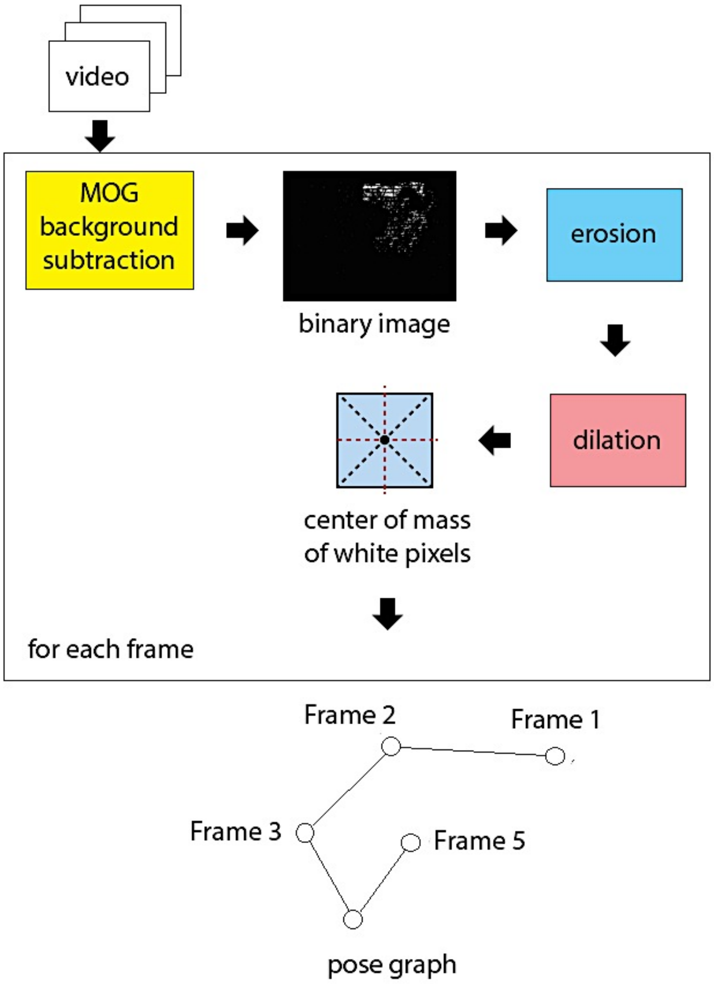

Image 3 - block diagram of our algorithm

V. Results

Proposed solution calculates length of trajectory of moving animal in a cage. Results are not equal in multiple runs of algorithm because of non-deterministic nature of MOG background substraction algorithm. However after multiple runs of algorithm, we can calculate average value of trajectory length, which appears to be constant for same input video. Algorithm detects false movements on places where light reflections are present, but we were successfully able to remove this detections with erosion and dilation on binary image. We were able to successfully filter out false animal movement detections in frames where animal moves only its head by dropping out frames where absolute amount of moving pixels detected is smaller than in average frame, where animal moves. Further improvements of algorithm can be:

1. Further improvements of frame dropping techniques
2. Pose graph optimizations

VI. References

[1] Grimson Wel, Stauffer C. Romano R. Lee L. *Using adaptive tracking to classify and monitor activities in a site*. in *Proceedings. 1998 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (Cat. No.98CB36231). IEEE Comput. Soc. 1998*. 1998.

[2] Stauffer C, Grimson W. E. L. *Adaptive background mixture models for real-time tracking*. in *Proceedings. 1999 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (Cat. No PR00149). IEEE Comput. Soc. Part Vol. 2, 1999*.

[3] Stauffer C, Grimson W. E. L., *Learning patterns of activity using real-time tracking.* IEEE Transactions on Pattern Analysis & Machine Intelligence, 2000. **22**(8): p. 747-57.

[4] P. KadewTraKuPong and R. Bowden, *An improved adaptive background mixture model for real-time tracking with shadow detection*, Proc. 2nd European Workshop on Advanced Video-Based Surveillance Systems, 2001: http://personal.ee.surrey.ac.uk/Personal/R.Bowden/publications/avbs01/avbs01.pdf