Wroclaw University of Technology

Faculty of Electronics,

Chair of Cybernetics and Robotics,

Intermediate Project

Autonomous security system with use of CCTV camera, people detection algorithm

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Abstract:

Goals:

Main task of the project was to develop an algorithm, which will be used to autonomous surveillance system for single-family house. To achieve this task OpenCV 3.10 library was used on the software part, on the hardware it was Prestigio RoadRunner 519 camera, which was temporally attached to the window around 2.5 m above the ground.

Assumption:

The application should recognize two types of objects: dog and human, using blob ratio and angle between side of fitted rectangle into tracked object and coordinate system of the image. The program should be robust, not influenced by lighting changes, weather and background movement (moving flora etc.). There is no assumption of moving direction of tracked objects.

Results:

High influence to reliability of moving objects matching depends on pre-processing input frames. Noise produced by the video converter was the source of most of the development labour together with changing light conditions (sample video was made during rainy and windy weather).

1. Introduction

Main task of the project was to develop an application to detect people in monitored area, which is one of the most important part of autonomous surveillance system. The program was implemented using OpenCV 3.10 library. There was no assumption to indicate the direction of moving objects, number of detecting objects. The implemented program is study of feasibility of detection algorithms using blob ratio for detection people under bad lighting condition, on backyard of single-family house.

2. Algorithm

Steps of developed algorithm are shown on the fig.1 .

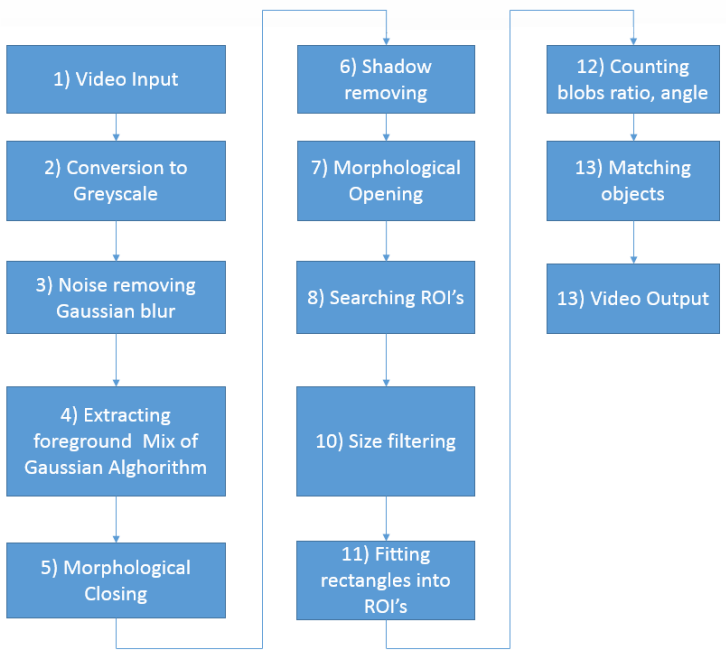

Figure 1: Steps of the implemented algorithm

The first step is camera data acquisition, then to reduce size of the task, RGB video stream was converted into grayscale. To eliminate "running pixels" Gaussian blur filter was used. Then to extract foreground (objects in movement) Mix of Gaussian algorithm was used, the rest noise (which wasn't eliminated by filtering), was reduced by thresholding implemented in MOG2 (Mixture Of Gaussians) function offered by OpenCV library. Morphological closing was used to remove small holes. Threshold operation removed shadows. Then the image of foreground was filtered by morphological opening filter, which removes small objects and smooths the rests. Next step is finding ROIs (Regions Of Interest). It was implemented by extraction of contours from filtered objects. Then contours were filtered by size filter, which removes smallest one made by noise, which was produced by previous steps. On filtered contours (only external ones) were fitted into rectangles. Then program calculates the blobs ratio of obtained rectangles (ratio of sides of rectangles) and the angle between one side of rectangle and the main coordinate system of the picture. This two parameters are compared to two corresponding intervals of constants. If calculated parameters are in these intervals, object is matched as a human or as a dog. Video Output consists of colour image obtained from input, marked on it rectangles with labels of text, which correspond to matched objects. Described steps of algorithm are illustrated by figure 2.

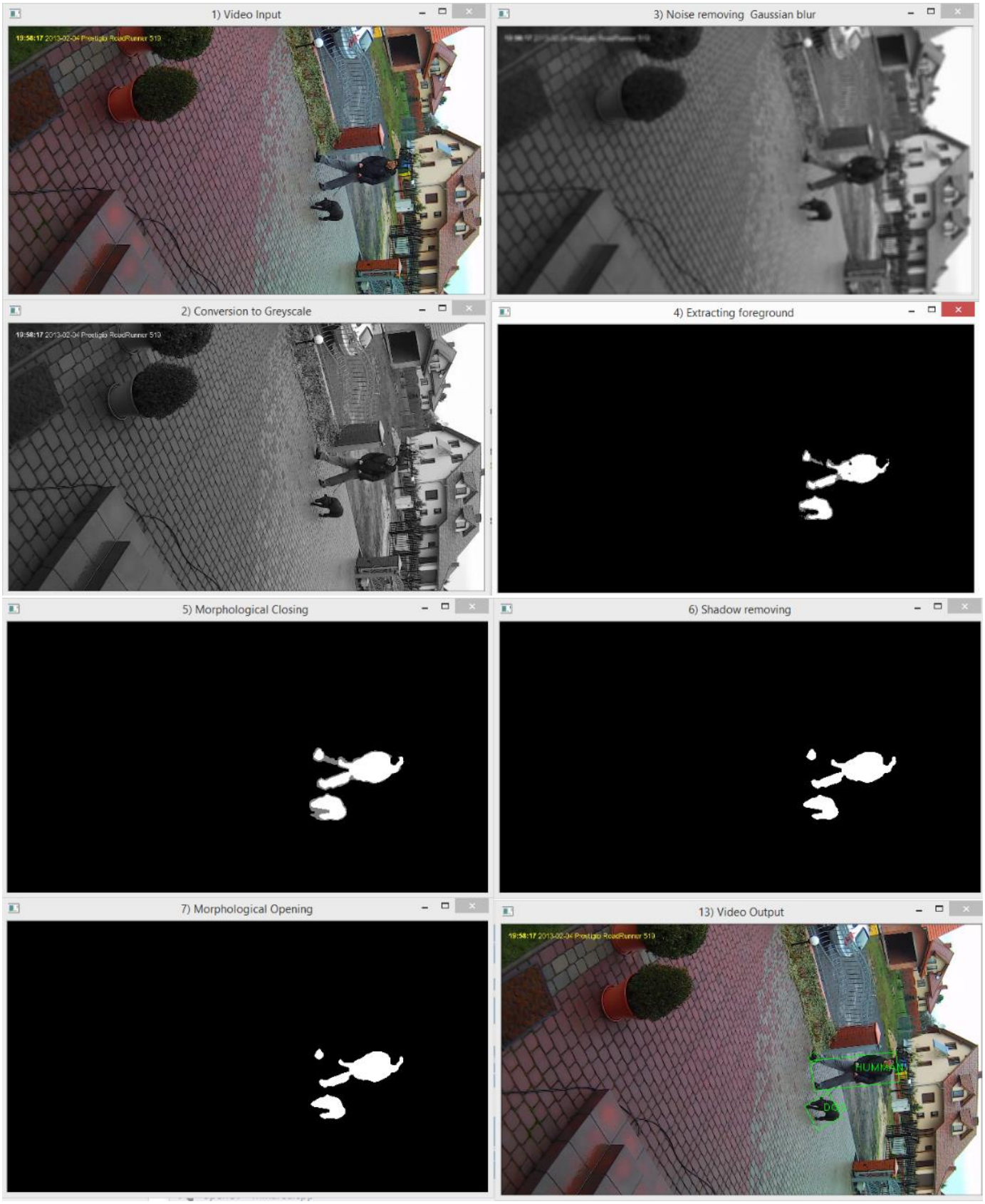

Figure 2: Illustration of algorithm steps.

3. Problems with “running pixels”

The running pixels causes usage of high filtering before and during extraction of the foreground. Level of details has strongly decreased. Small movement of trousers caused by wind has been omitted, what was resulting in discontinuity of tracked person’s silhouette which contributed to fitting additional rectangles (fig.3) and not correct blobs ratio counting -> mismatching objects.

Figure 3: Discontinuity of the silhouette of tracked person, errors caused by "running pixels"

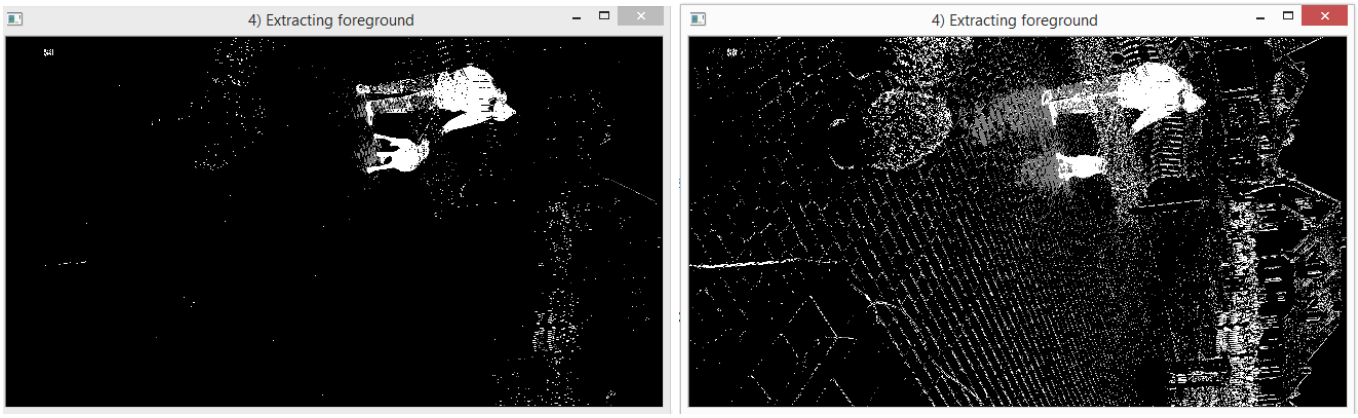

Figure 4: Compressing influence of running pixel threshold’s value on extracted without pre-filtering foreground: right side –high, left side –small threshold value

4. Results

During program examination were occurring situation, where group of people was not classified or classified as a dog. Also making movement with hands was changing blobs ratio, what causes mismatching. The problem of the discontinuity described before wasn't resolved, additional rectangles unable correct matching.

Figure 5: Example of output's frame. Additional rectangles, mismatch of person making some gestures

Figure 6: Example of output's frame. Mismatch of group of people

5.Conclussion and summary

Main goal of the project was accomplished. It has been noticed that to improve object detection, the history of matching should be stored. The final match should make use of probability, based on previous matching. To improve results the camera should be installed higher to increase view angle, then background would be more uniform (more area of tracked silhouette would be on uniform pavement) and it would acquire an image without details of outfit of traced person. Due to generated noise by the camera, such device is not correct for this type of task. Implemented algorithm didn't recognize groups of people. For people recognizing tasks it would be a better strategy to check symmetry of silhouette or recognize body parts .

5. References:

1.”OpenCV 2 Computer Vision Application Programming Cookbook”, Robert Laganière, May 2011;

2.”Learning OpenCV”, Gary Bradski and Adrian Kaehler, September 2008;

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4. “Autonomous Road Surveillance System: A Proposed Model for Vehicle Detection and Traffic Signal Control”. MD. Hazrat ALI, Syuhei Kurokawa, A. A. Shafie, “Procedia Computer Science” 19 (2013) 963 – 970 ;

5. “Foreground Object Detection from Videos Containing Complex Background”, Liyuan Li, Weimin Huang, Irene Y.H. Gu, Qi Tian, Conference: “Proceedings of the Eleventh ACM International Conference on Multimedia”, Berkeley, CA, USA, November 2-8, 2003;