Crowd Behavior Detection at Sporting Events for CSCE 473 Computer Vision

Sam Adams, Matt Keller, and Tom McClenahan

Abstract—

Index Terms—

1 Introduction

SPORTING events have long been a highly profitable activity, and gathering information from these events, including from crowds of spectators, can also likely be valuable. In the future, computer vision may be used to gather information about crowds at sporting events. This information could greatly benefit team owners, advertisers, and security efforts. Team owners could keep track of when the crowd reacted to different situations happening during the event. Advertisers could possibly pay more or less for screen time depending on the current state of the crowd. Security could also benefit from knowing the crowds emotional state to determine the likelihood of possible situations such as riots, fights, or rushing the court.

2 Related Work

In the paper *Estimating the density of the people and counting the number of people in a crowd environment for human safety*, the authors are able to count the number of people in a given area, using techniques such as "canny edge detector", "connected component labeling" method and "bounding box with centroid" [1]. Although this paper addresses the task of counting people in a surveillance setting, for example, in a mall or other public place, we believe that the techniques used may be applicable to our needs as well. Additionally, in the paper *Abnormal crowd behavior detection based on local pressure model*[2], a different approach is used to model the general activity of a crowd, and detect anomalies. Again, this paper is addressing these issues as they apply to surveillance, but it seems like the approach could be adapted to suit our needs. Finally, the article titled *Facial emotion detection considering partial occlusion of face using Bayesian network* describes a method of detecting emotions using machine learning [3]. This resource may be of use in determining a suitable method of facial emotion detection, which might be applicable to crowds for the purpose of determining their general emotions. Facial clues are not the only way to infer emotions from crowds, but they can potentially enhance our results. Our group has some experience in machine learning, and the computer vision framework we plan to use has machine learning support.

3 Problem Definition

The three objectives we hope to accomplish are as follows:

- Determining crowd density. We would like to measure how tightly the people in the crowd are packed, or how much of the background shows through.
- Identifying the crowds actions as a whole. This involves whether or not the crowd is sitting, standing, or cheering.
- Infer the general emotions being felt by the crowd. A crowd can be identified as angry, happy, or neutral.

4 Images

For our images, we will select a variety of images from a Google Image search on sports crowds as well as frames taken from YouTube videos of sporting events. These images will be selected so that they contain a variety of crowd behaviors and emotions.

5 Approach

For our framework, we will use Python with the open-source OpenCV library, which has many built-in capabilities useful for our project. We will start by implementing a crowd density detector. This can be based on Canny edge detection and connected components, which are features of OpenCV. After crowd density can be estimated to a reasonable degree of accuracy, we will move on to analysis of crowd behaviors by texture processing. For this, we can use processed versions of the image, such as Histograms of Oriented Gradients (HOGs) and fourier texture analysis. Using examples of images with different crowd behaviors, we can identify whether the crowd is cheering or standing. Afterwards, if we are able to successfully identify these crowd behaviors, we will move on to detect crowd emotion. Progress in this area will require more research in the area of facial emotion detection.

6 Evaluation

To evaluate our results, we will take a set of test images and manually assign them attributes based on their crowd behaviors (examples are shown below). Then we will see how well our approach is able to produce comparable results.

Fig. 1. High Density, Cheering, High Excitement

Fig. 2. High Density, Standing, Low Excitement

7 Implementation Plan and Timeline

The important milestones for the project are determining crowd density, identifying actions, and establishing a general emotion of the crowd. We would like to have crowd density finished by March 20, action identification by April 6, and emotion detection by April 20. The code will be written primarily in Python. The code, along with image sets, documentation, and any data sets we produce, will be hosted on GitHub to help collaboration amongst members even though our schedules may not line up.

Acknowledgments

References

[1] P. Karpagavalli, "Estimating the density of the people and counting the number of people in a crowd environment for human safety", *Communications and Signal Processing (ICCSP), 2013 International Conference on* , pp.663,667, 3-5 April 2013 doi: 10.1109/iccsp.2013.6577138

[2] Hua Yang; Yihua Cao; Shuang Wu; Weiyao Lin; Shibao Zheng; Zhenghua Yu, "Abnormal crowd behavior detection based on local pressure model," *Signal & Information Processing Association Annual Summit and Conference (APSIPA ASC), 2012 Asia-Pacific* , pp.1,4, 3-6 Dec. 2012

[3] Miyakoshi, Y.; Kato, S., "Facial emotion detection considering partial occlusion of face using Bayesian network," *Computers & Informatics (ISCI), 2011 IEEE Symposium on* , pp.96,101, 20-23 March 2011 doi: 10.1109/ISCI.2011.5958891