# Scene Overlay Projection for Correlating Distinct Cameras

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***Abstract*—This paper was originally submitted to Xinova as a response to a Request for Invention (RFI) on new event monitoring methods. In this paper, a method to combine all available image sensors into a coherent picture, which generally creates real challenges, is proposed.**

**In more detail, this describes a method of integrating an overlay projector in conjunction with a video camera. In one example the overlay projector is a laser based projector which emits a light pattern.**

## I. Problems

In an ad hoc crowd it is expected that many cameras will be used to monitor the crowd activity. However, combining all the image sensors into a coherent picture presents a difficult challenge. One of the reasons for the challenge is that the constantly changing crowd hinders identifying anchor points for stitching multiple pictures. More ever some or all of the cameras can be in motion, such as cameras mounted on security personal, drones, or acquired from the crowd itself.

## II. Summary of the Invention

The proposed solution is based on integrating an overlay projector in conjunction with a video camera. In one example the overlay projector is a laser based projector which emits a light pattern. The pattern is detected by the ad joint camera as well as by other cameras. The pattern(s) are then used as an anchor to easily combine multiple images. In one example the laser is an infrared laser which is transparent to the crowd and spectators.

## III. How is This Invention Made and Used

A crowd assembles in a location and is monitored by one or more cameras. Examples of cameras can include; fixed cameras, temporary cameras, cameras on drones or UAV, cameras on balloons etc. The cameras can either provide a wide angle picture capturing the major bulk of the crowd or each camera provides a section of the crowd. An example of a crowd and video recording equipment is shown in Figure 1.

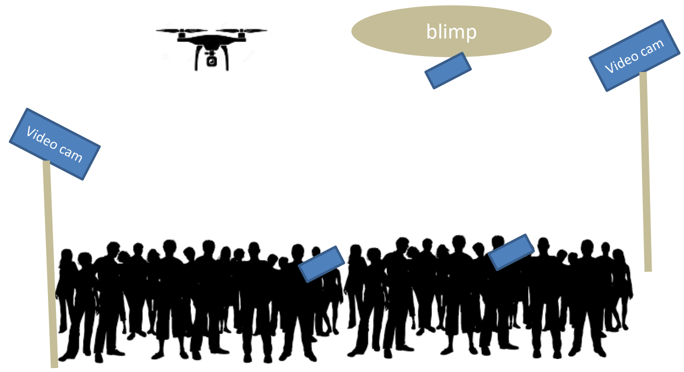


Fig. 1. An example of a crowd and video recording equipment on towers, drones, blimps or held by security personal or by participants in the event. Cameras as depicted as blue rectangles. An example of a frame from a camera is shown in figure 2

Fig. 2. An example of a video frame from a video camera in Fig. 1.

The camera and image projector are shown in Figure 3.

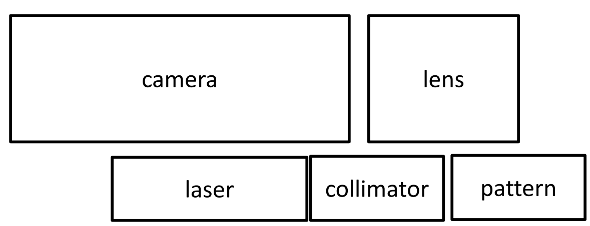


Fig. 3. System level description of the camera and image projector.

## IV. More Detailed Explanation

The system is composed of a standard video camera. Examples of camera pixel size (resolution) can range from a few mega pixels to tens of mega pixels. The lens can be from a wide angle 18mm lens to an 80 mm lens or larger. The laser can be a 850-940 nm laser. These wavelengths are invisible to the human eye, but easily observable with an image sensor. The laser power would depend on the details of the projected image and the required distance. For distances of up to 10 meters laser powers of up to 100 mW are required. For distances of up to 100 meters laser powers of up to 500 mW are required. The collimator optics shapes the laser beam into a collimated beam. The pattern can be a diffractive optics or slide. Diffractive optics are preferred as they are more efficient in the laser energy utilization. Figure 4 is an example of the image from Figure 2, with a pattern overlay which is projected from the laser and pattern.

Fig. 4. An example of the image from Figure 2, with an overlay pattern (yellow).

Figure 4 is an example of an overlay pattern. The line spacing shown in Figure 4 is intentionally unequal. The line spacing can be used to identify the camera as well as align one camera to another. In a dense crowd with many overlapping cameras it is important to have patterns which are easily distinguishable. Figure 5 is an example of the image from Figure 4 with an overlay of its projection (depicted in yellow) as well as the overlay from an adjacent camera (depicted in blue).

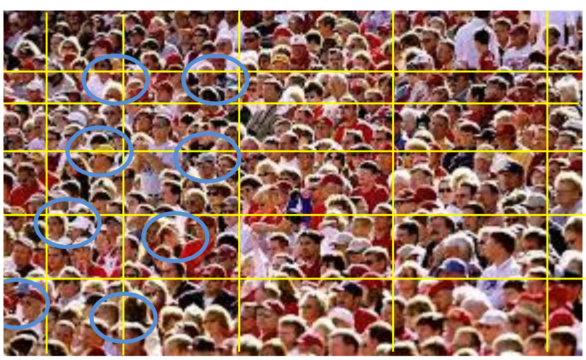

Fig. 5. Example of the image from Figure 4, with an overlay pattern (yellow) and an overlay from an adjacent camera (blue).

Since the overlay patterns are simple to analyze, they enable a low computation and highly reliable means of registering and connecting multiple images even with low resolution cameras. Morever, using 3D imaging techniques which relate the dimensions of the overlay pattern to the distance from the camera, each of the cameras can identify the 3D location of elements in the crowd as well as the location of the adjacent cameras. Since the technique is highly robust and requires low overhead in computing, this technique is extremely important in rapidly moving cameras as expected from cameras mounted on security personal, drones, vehicles and autonomous vehicles.

To sum, the proposed solution report provides method to resolve image stitching, camera identification and object recognition across multiple cameras using a low complexity laser based registration method.

## V. Conclusion

As summarization, the proposed solution provides method to resolve image stitching, camera identification and object recognition across multiple cameras using a low complexity laser based registration method. Other stitching approaches require extensive computation complexity, high resolution cameras or stationary cameras.


## Acknowledgment

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