Cellular processor array based UAV safety system

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Abstract — Embedded sensor-processor system is being developed for on-board UAV (Unmanned Aerial Vehicle) safety applications. The role of the device is to detect intruder airplanes which are on or close to collision course. Due to weight, power, size, and cost requirements, the visual approach leads to feasible solution only. In our design, 5 cameras are applied to collect visual data from a large field of view. The image flows are processed by 3 different virtual cellular processor arrays, which are implemented in FPGA.

I. INTRODUCTION

UAV safety system developments are critical nowadays to enable these autonomous flying objects to conquer the sky. One of the desperately needed safety equipments which is still missing for small UAVs is the collision avoidance system. In our demonstration, the already operational data acquisition, processing, and archiving parts are shown.

The system is constructed of 5 pieces of miniature global shutter cameras with wide VGA (WVGA, 720x480) resolution (Figure 1.). The uncompressed output data streams of the synchronized cameras are connected to the FPGA through parallel busses. Three cellular processor arrays are mapped to the FPGA (Figure 2.). The first is responsible for full frame processing. It implements adaptive thresholding and identification of the locations of the suspicious objects on the entire image. The second and the third processors work on the selected 128x128 sized windows. They provide the necessary grayscale and binary operations for detecting the intruder aircrafts. The raw flight data is saved to an SSD for ground based test and verification purposes.

Figure 1. The image capturing, processing, and storing hardware components

Figure 2. Block diagram of the image processing architecture

Figure 3. Early version of the collision avoidance sensor processor system

II. DESCRIPTION OF THE DEMONSTRATOR

During the demonstration, the first version of the device (Figure 3.) will be shown. It will be able operate either from images collected through its optical input, from previously acquired videos, or on-line synthesized scenes.
ACKNOWLEDGMENT

The ONR Grants (N62909-11-1-7039, N62909-10-1-7081) is greatly acknowledged.

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