ECE 492 - Computer Engineering Capstone Design Project

Coloured-Object Tracking Camera

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Overview

Our goal was to create a tracking camera that tracks coloured objects. To do this, we stream video from a camera, compare each pixel with a threshold value set to the colour of the object we wish to track, and once a frame has ended, calculate the centroid of the cluster of pixels that passed the threshold. With this centroid, we can calculate how much the camera must reorient itself to have the object in the center of the frame. From here we send these values to our PWM (Pulse Width Modulator), which generates the appropriate signals to orient the camera where the object will be centered in the frame. The camera can rotate horizontally and vertically.

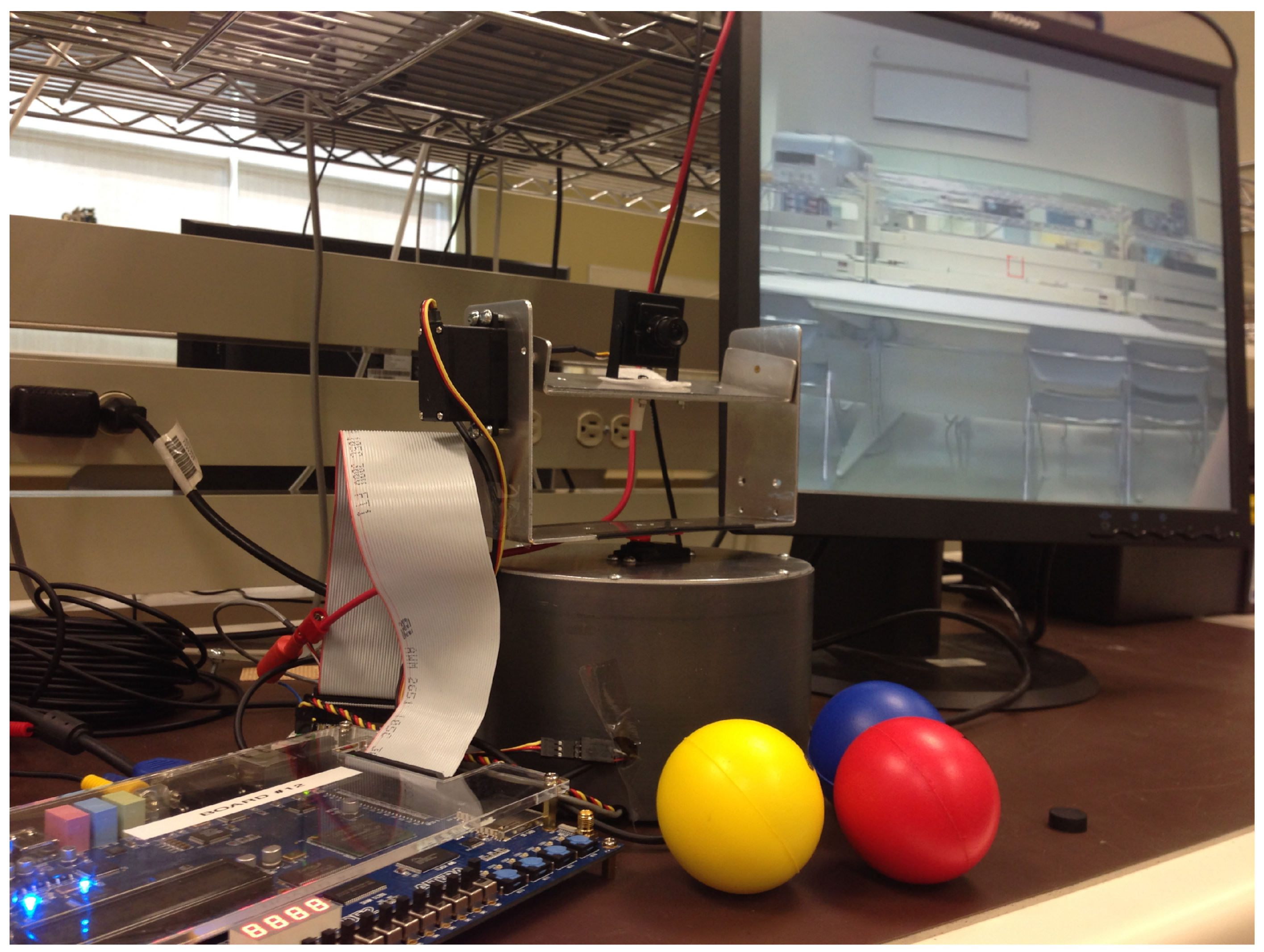

Fig.1 Project review

Usages

- Security and surveillance
- Taking self-portraits
- Independent and autonomous recording (no need for a cameraman)
- Consistently track objects in a dynamically changing backgrounds
- Track objects in unsafe environments

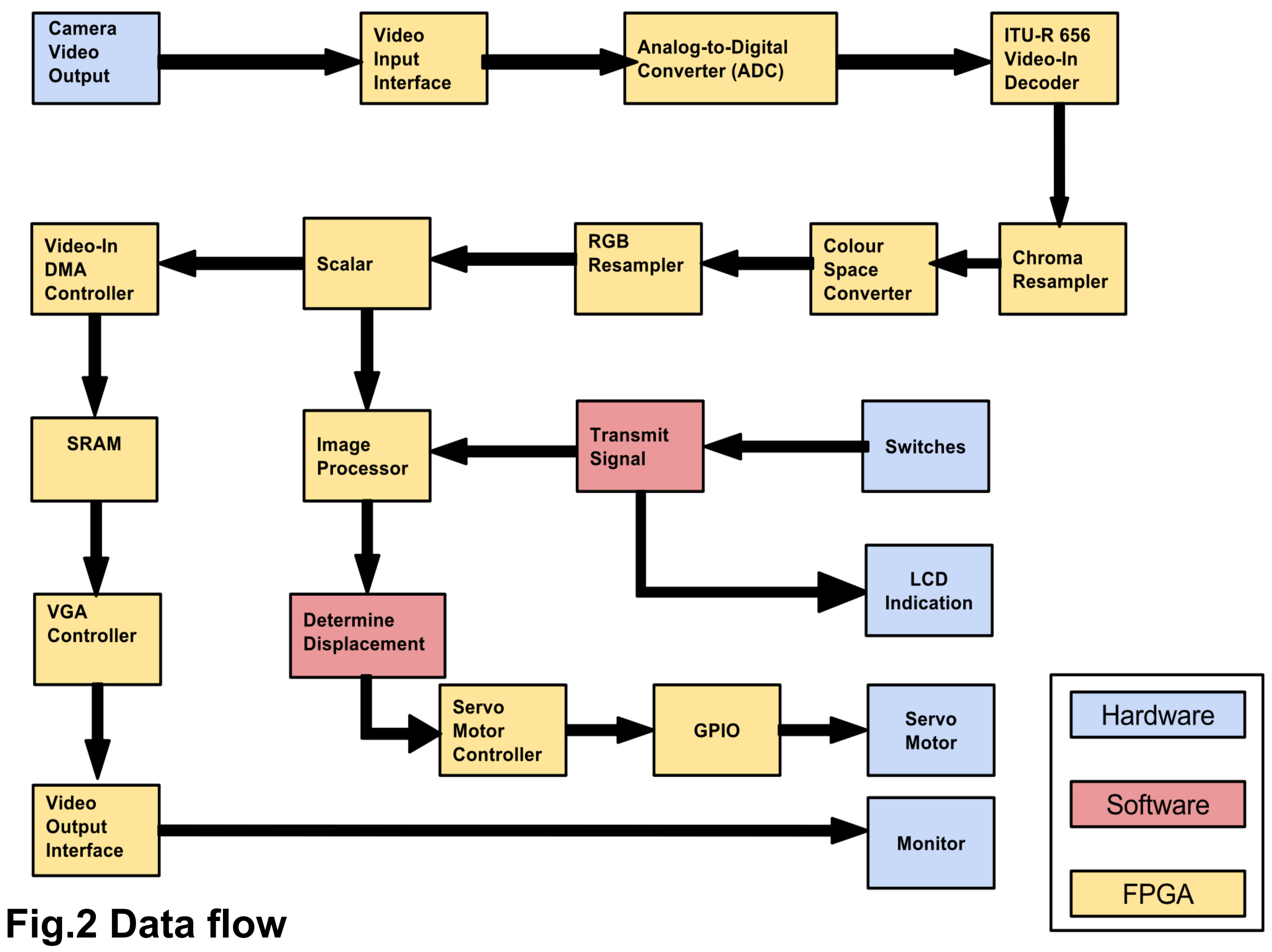

Fig.2 Data flow

Working Principle

1. Camera inputs NTSC formatted video through the Composite Video input port.
2. Input video stream is decoded and converted to 24-bit RGB colour map format.
3. The video stream of the signals is sent through our Image Processor that converts pixels from RGB to HSV for thresholding, which are then used to calculate the coordinates of the centroid of the coloured object.
4. The centroid position of the coloured object is sent to the software layer where the amount of rotation the camera must undergo is determined (centroid of object is compared to centre of frame).
5. Calculate and send the appropriate signals to the PWM to orient the servos accordingly.
6. The video stream is written to a buffer where the video is outputted to a monitor using the VGA output port.

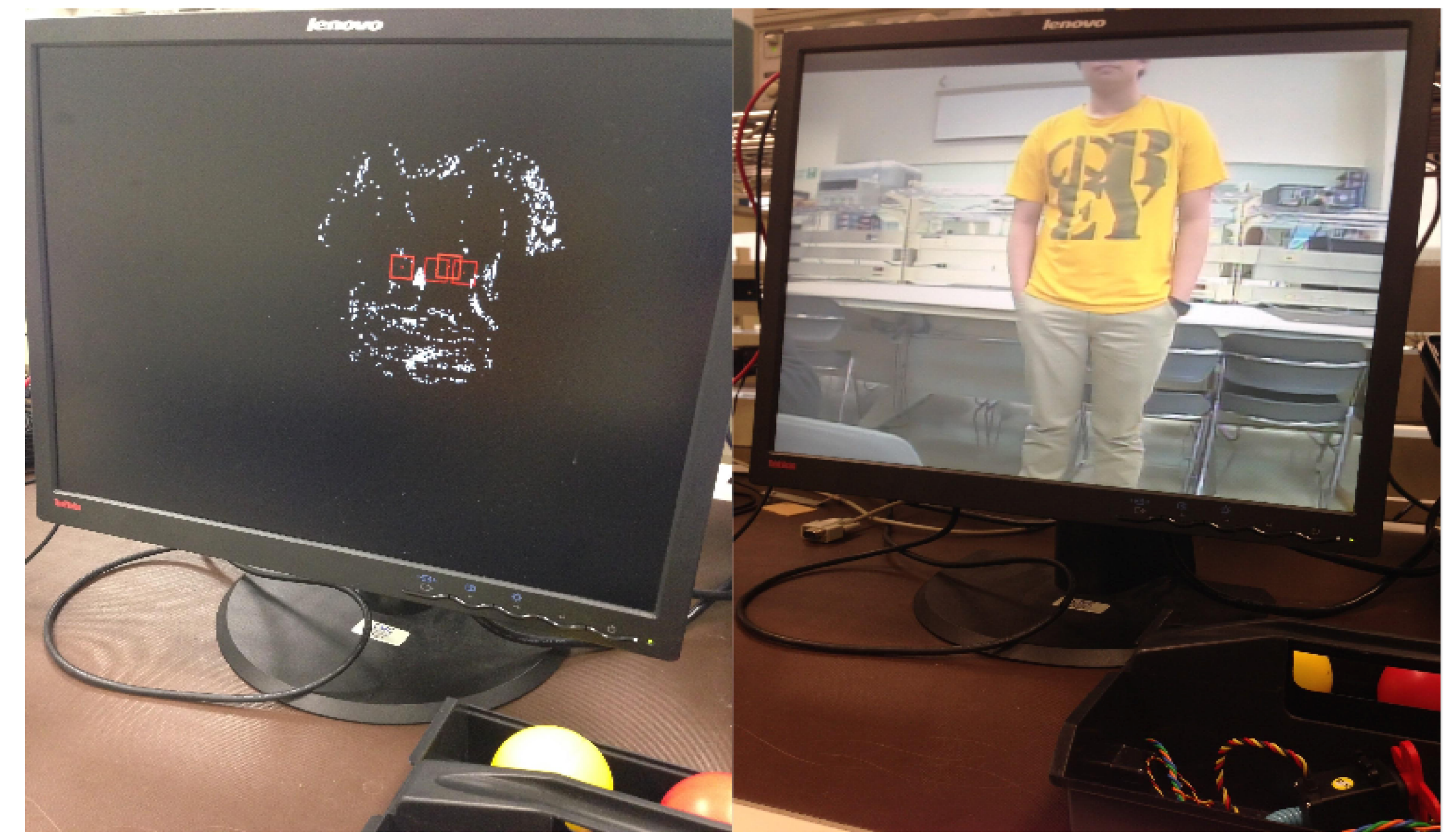

Fig.3 Threshold Testing

Testing

We output the pass-fail value from our Image Processor to the monitor to have an exact view of what is being tracked. Shown in the figure above, all the pixels that are within the threshold range will be shown as white, while the rest of pixels are shown as black. The white balance of the camera and the reflection of light cause drastic changes to colours in the frame, which hinders accuracy and quality of the images. Due to the reflection of light, Hue values will vary according to the positions of the light sources with respect to the object being tracked. To resolve this, a reasonable threshold range is essential for high quality tracking. If the threshold range is set too high, the camera tends to pass irrelevant pixels. If the threshold range is too small, the camera will ignore pixels that are intended to be found. Finding appropriate ranges required a trial and error approach.

Future Work

1. Offset tracked object and boundary threshold setting.
2. Minimize form factor to make the system transportable and accessible.
3. Improve tracking algorithm to increase accuracy and filter out more noises and irrelevant pixels.

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