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# Autonomous Sentry System

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ECE532 Digital System Design

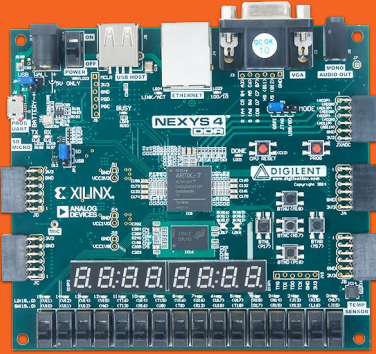
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# Motivation

**Original plan: Demonstration of autonomous camera-controlled robot with FPGA**

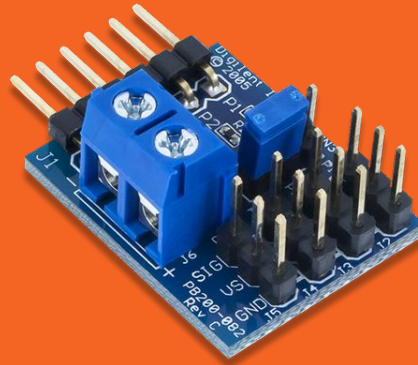
- 1. Use image recognition (originally neural network) to identify target on camera output**
- 2. Aim and Fire Nerf gun at target using servomotors**

# Project Overview: Components



Nexys 4 DDR FPGA

Servo Motor Controller

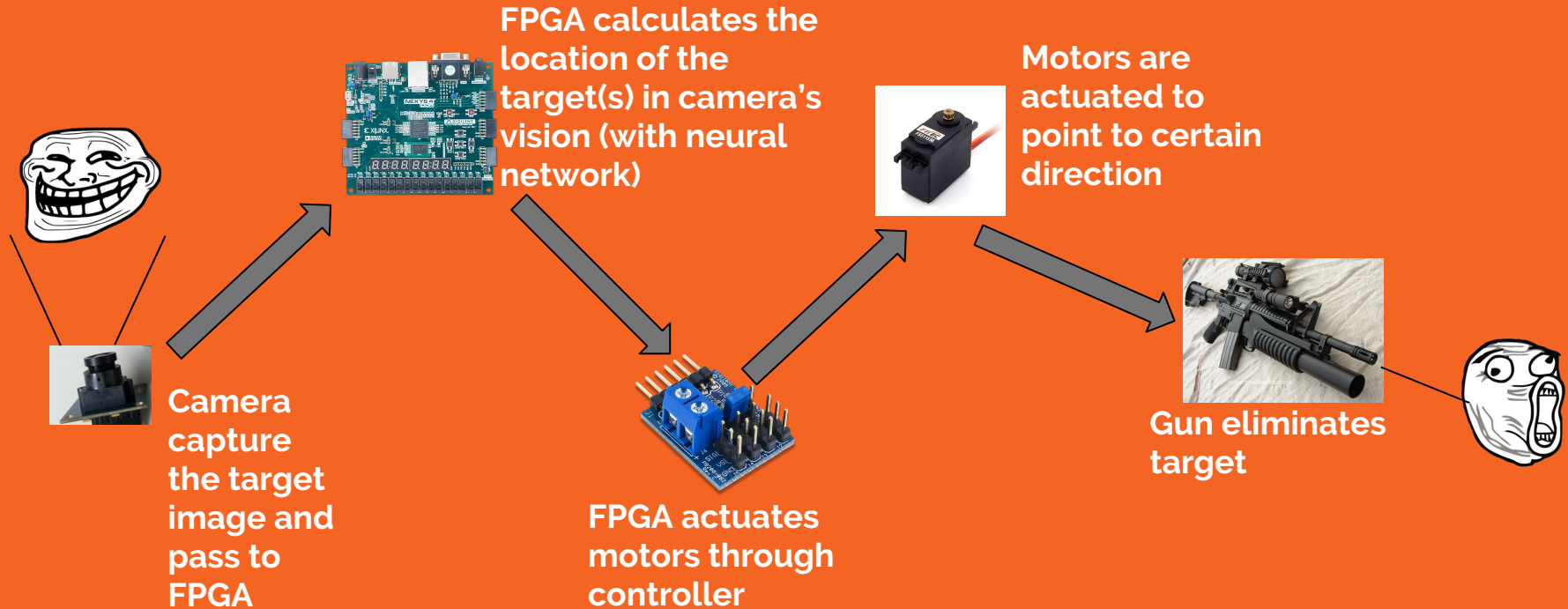


Pmod Camera

Servo Motors



# Project Overview: Functionality



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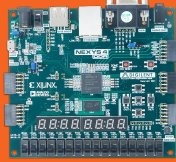
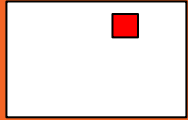
**However,**

**We are nice and peaceful people.....**

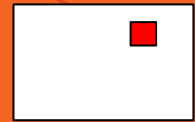
**———— Group 4**

## Project Overview: Functionality (con't)

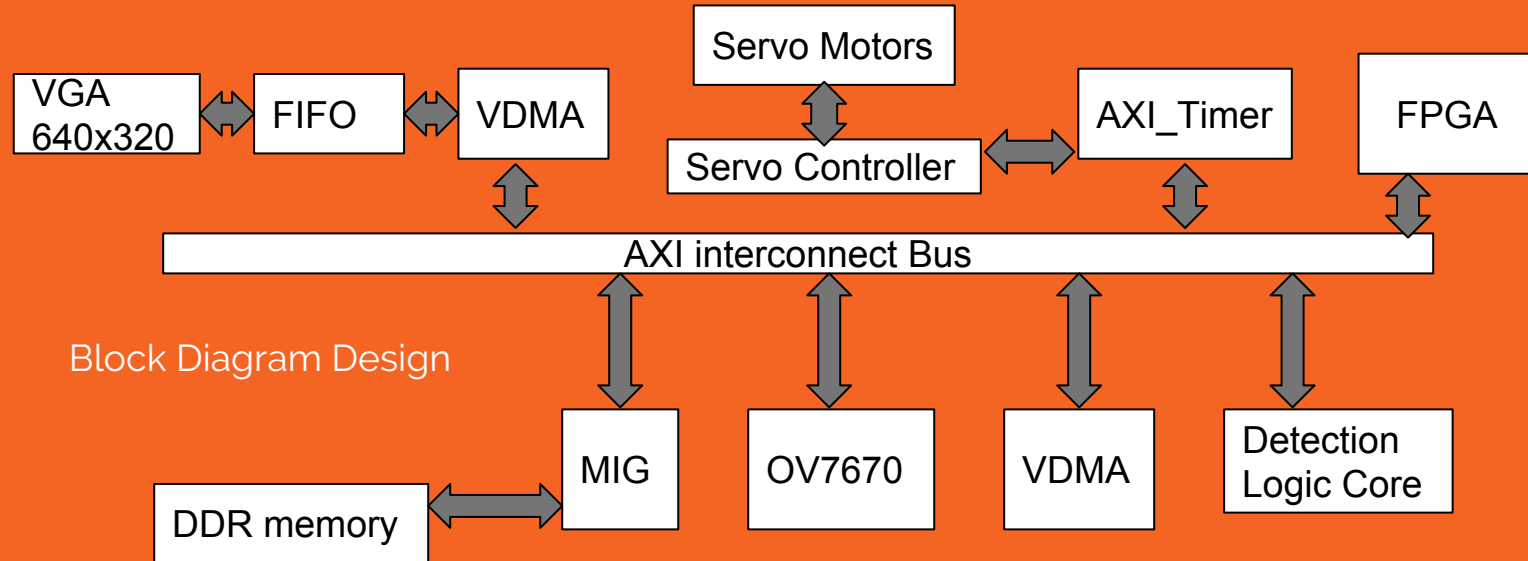
Instead, team used white target paper with distinguishable colour as bullseye



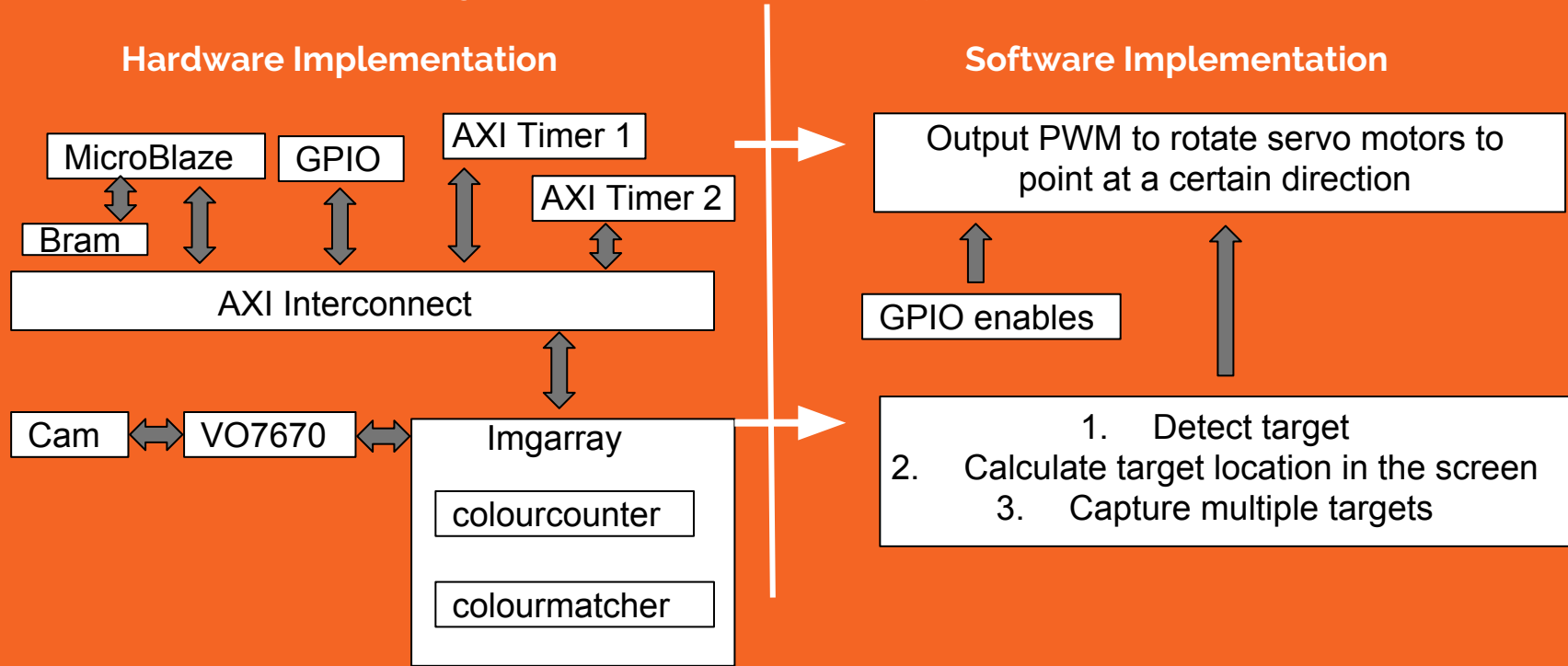
Laser points at target colour



# System Block Diagram: Initial Plan

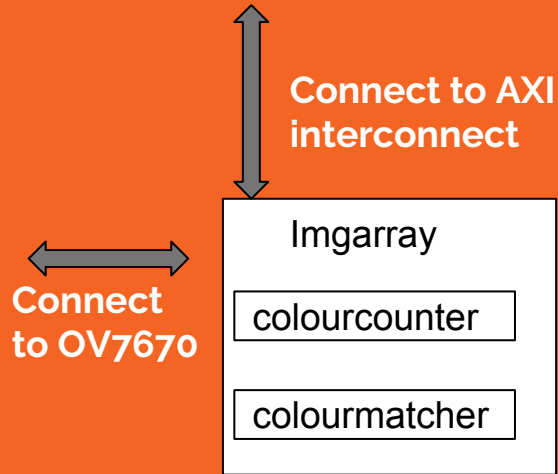


# System Block Diagram: Final Plan





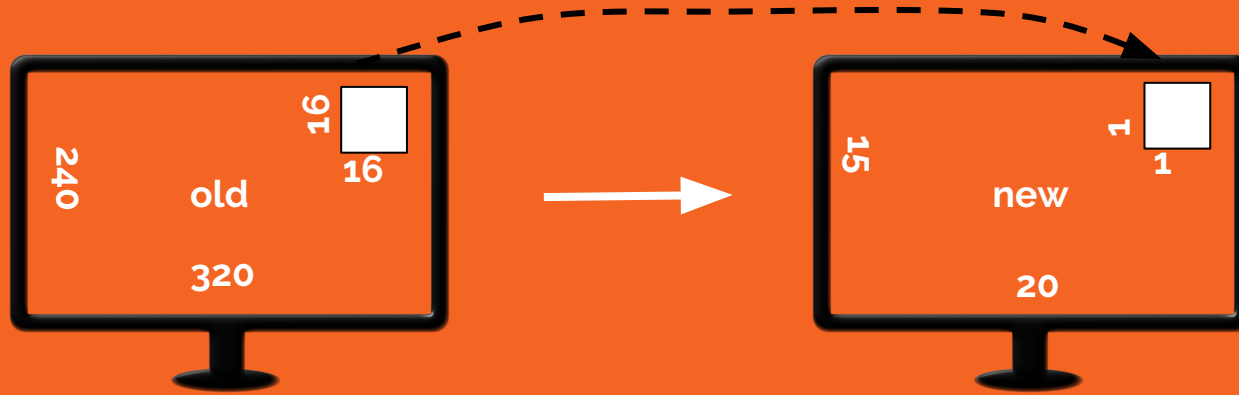
# System Block Diagram: Imgarray block



## Purpose of this block:

1. Handle pixel data input from OV7670 block which intakes camera signal (RGB444)
2. Resolution modification from 320x240 to 20x15
3. Colour averaging within each modified resolution unit

## System Block Diagram: Imgarray block (con't)



- Each new resolution unit contains 16x16 old resolution pixels
- Colour averaging in new resolution unit is based on associated 16x16 block of pixels

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## System Block Diagram: OV7670

- Packaged into an IP
- Take in 12 bits of pixel data as it is in RGB444
- Act as AXI slave, to communicate with imgarray

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## System Block Diagram: Timer

- Genuine AXI timer is used to output PWM signal to control servo motors
- Two timers are configured in PWM mode for vertical and horizontal movement of two servo motors

# Design Process

Week 1

Initial implementation of  
multiple video capture solutions

Week 2

Final implement of  
video capture solutions

AXI Timer PWM  
implementation

Week 3,4

Imgarry IP

Package  
OV7670 IP

Software motor control  
implementation

Week 5

Integration

Mechanical  
Structure

Week 6

Calibration and Testing

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# Challenge

## 1: Electrical

- Corrupted image from camera
- Motor connection issues
- Timer low-level driver

## 2: Mechanical

- Calibrating the sentry gun to point at objects in camera
- Assembling the chassis and connecting components together

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# DEMO