# 3rd Year Digital Systems Design Coursework

By Christopher Tory and Farhan Rahman

## Introduction

This project required the programming of a DE2 board to apply various filters and effects on a video image. This is then displayed on a connected LCD screen.

Our pair completed each of the required tasks in addition to implementing a ripple effect on one of the unused switches.

## Rotation

## Spin

An increased adjustment of theta degrees every 50ms was performed by dividing the clock. A counter increases a register by one per clock cycle up to 5000000 (100Mhz\*50ms). Theta is then added to itself to increase the degree of rotation. To prevent the theta register from overflowing, when it’s value get to 71(71\*5 = 355⁰), it is reset back to 0.

The same theta variable is used as for standard rotation, so as to prevent code repetition. If there is no rotation enabled, the value is passed through.

## CORDIC

CORDIC performs a series of iterations in order to calculate the sine and cosine values. The more iterations performed, the greater the accuracy of CORDIC. The number of iterations matches the amount of shifts made to the constant values of the amount subtracted from z. When µ =0, the value of the constant needs to match the number of iterations to prevent the value becoming 0 too soon. The number iterations comes at the expense of clock cycles needed, and so 12 provides a balance between accuracy and speed. The incoming value of the angle has to be shifted the same amount as the constants for the arithmetic to make sense.

Due to a lack of floating point arithmetic in hardware, the incoming values of x and y need to be shifted left. The greater the shift, the more accurately cosine and sine can be calculated. Greater accuracy however, increases hardware cost. The difference between CORDIC and the LUT table rotation was almost imperceptible with a shift of 8. The resultant values of cosine and sine need to be shifted right the same amount as the original inputs were shifted left, but not until the values have been used, otherwise they will limited to 1 or 0 as cosine and sine generally have small values.

* Iteration - times
* Shifting
  + Z
  + COS REG
* Only works upto 90

## Edge Detection

## Blur

## Ripple

## Timing and Resource