coordinate Rotation digital computer

(cordic)

seng440: embedded systems

Submitted \_\_\_\_\_\_\_\_\_\_\_

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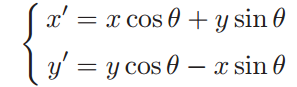
# introduction

A detailed study on various optimization methods of CORDIC algorithm is the goal of this project. First of all an implementation of CORDIC algorithm written in high-level (c) code is derived from general vector rotation equation. Then use it to find sine, cosine, tan functions. And then compile, simulate, and profile it. Function cordic\_V\_fixed\_point() is the bottleneck. Next try to optimize this function through different methods: 1. Optimize the function in c code; 2. Optimize the assembly code get by compiling c code; 3. Write this function in assembly. However, after all the optimizations, function cordic\_V\_fixed\_point() is still the bottleneck. After that to design a new computing unit implementing this function, hardware (VHDL behaviour, timing estimation, automaton design, and specCharts) and firmware solutions was used. Finally, firmware solution gives the best performance to CORDIC algorithm.

# theoretical background

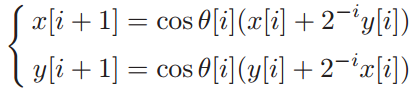
## motivation

All the trigonometric functions can be formalized in terms of vector rotations. Assume that a vector [x, y]T is being rotated with θto a new vector, which is [x/, y/]T. The equation below is the rotated vector expression:



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CORDIC algorithm is cheap and sequential, since it is an iterative method using only shifts and additions. The equation below displays the rotation for iteration i:



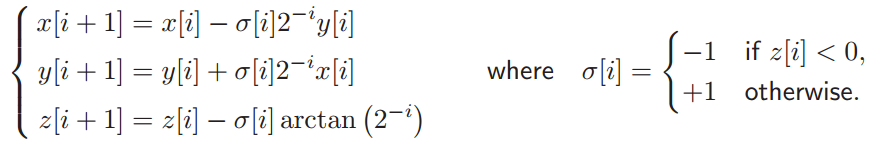
The rotate angle can be defined by the sequence of the directions of the elementary rotations. The arctangent table is the result from file cordic\_TB.c. The rotate angle can be obtained from the iteration of the elementary rotation angles:





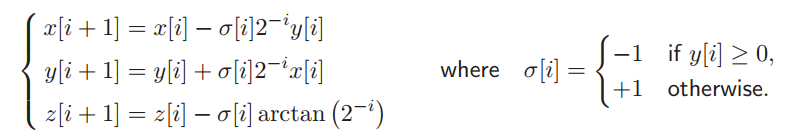
### cordic rotation mode

Given the rotate angle and initial vector, the new vector can be obtained by CORDIC rotation mode. The rotation mode equation shows below:



### cordic vectoring mode

Given the rotate angle and initial vector, the length of new rotated vector can be obtained by CORDIC vectoring mode. CORDIC vectoring mode rotate the input vector to x axis, then get the length of this vector:

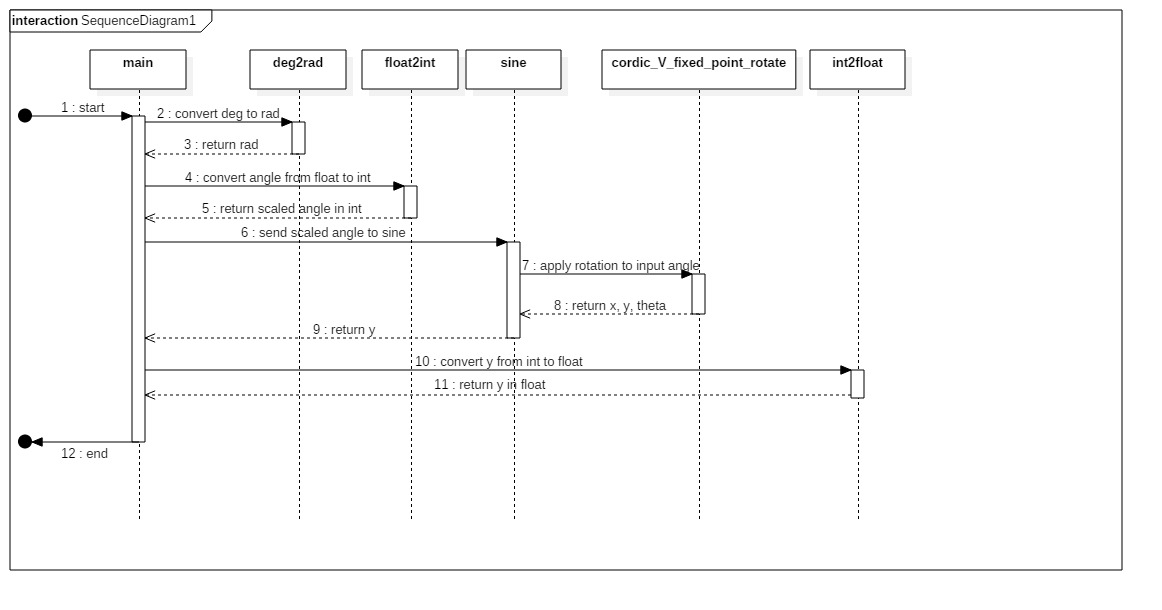


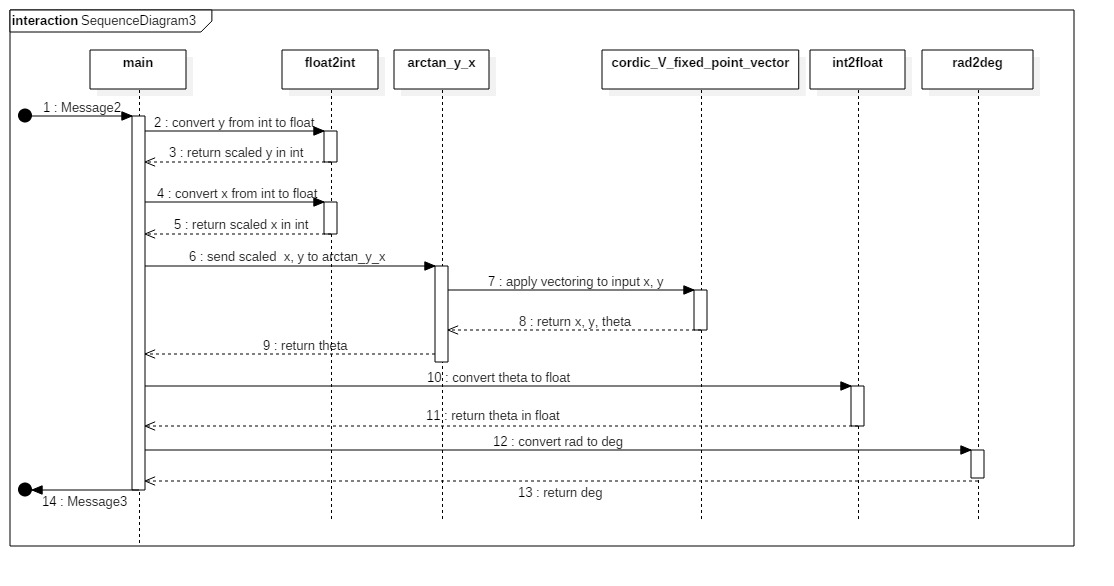
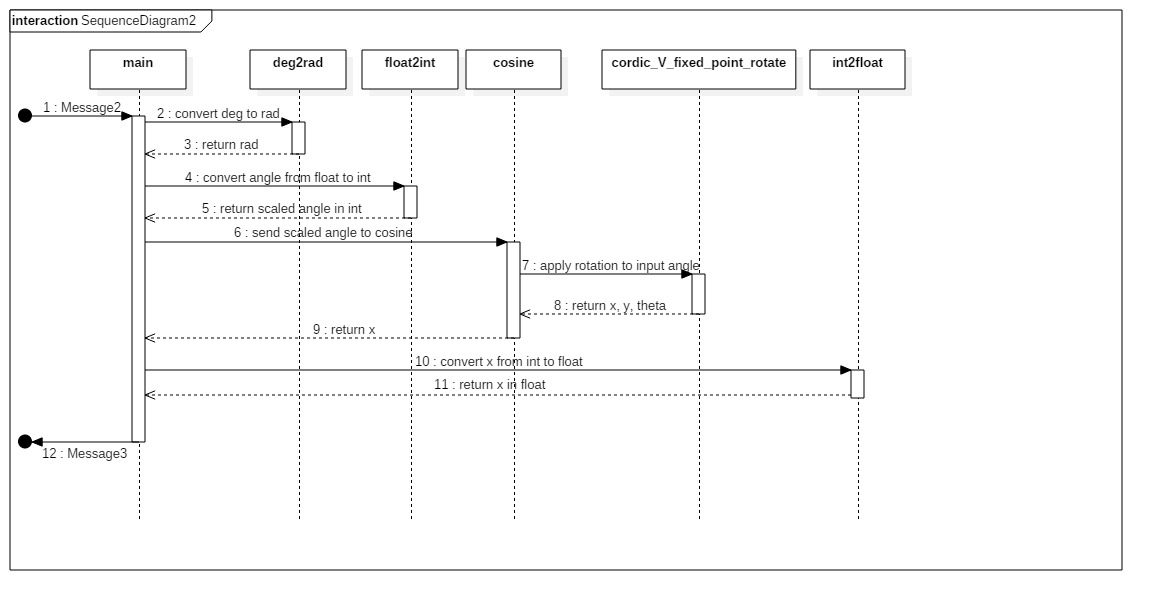
# design process

## implementation of

# UML description

UML sequence diagrams illustrate how the CORDIC algorithm implemented using integer arithmetic in software.





# performance/cost evaluation

# conclusions

# bibliography