Aarhus Universitet

ERTS - Group 2

Rapport

Assignment 2

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Kapitel 1

INTRODUCTION

This report describes a project for using HW/SW Co-design in designing and modeling a "Route Optimization using Genetic Search Algorithm" (ROGSAnne). The project is about defining a methodology and using it to describe a model of a system. After this some of the system will be designed for the software part, and an IP core will be modeled and tested using the Vivado tool chain.

1.1 The problem

The purpose of the system is to find an optimum route between a series of points, minimizing the total traveled distance. This problem is commonly known as the "Traveling Salesperson Problem" [ref: wiki?].

The optimized route plan is intended to be used within a Drone Delivery System, in which a drone has to deliver an amount of packages (e.g. 100, it's a very large drone) to different locations. It is imagined that the ROGSAnne-system would be implemented on the server-side of a system, allowing for a route plan to be calculated, provided the locations of the points to visit for a drone.

The problem is that the number of possible candidate solutions raise exponentially (maybe do some calculations?) with the number of points to visit. Instead of calculating the traveled distance of each possible route, an optimization algorithm can be used to find the best route. In this case, the meta-heuristic optimization algorithm "Genetic Algorithm" is used.

While using an optimization algorithm can speed up the process of finding the optimum route, it is still a computationally heavy task. Thus, it is of interest to speed up the process using hardware acceleration, allowing more drones to utilize the same server.

As the production of each new candidate solution in a new "generation" is independent of each other, it is assumed that the process can be parallelized, greatly improving calculation speed.

In a real system, the coordinates would be provided by the Drone Delivery System. In this project, the coordinates will be read from a file on an SD card.

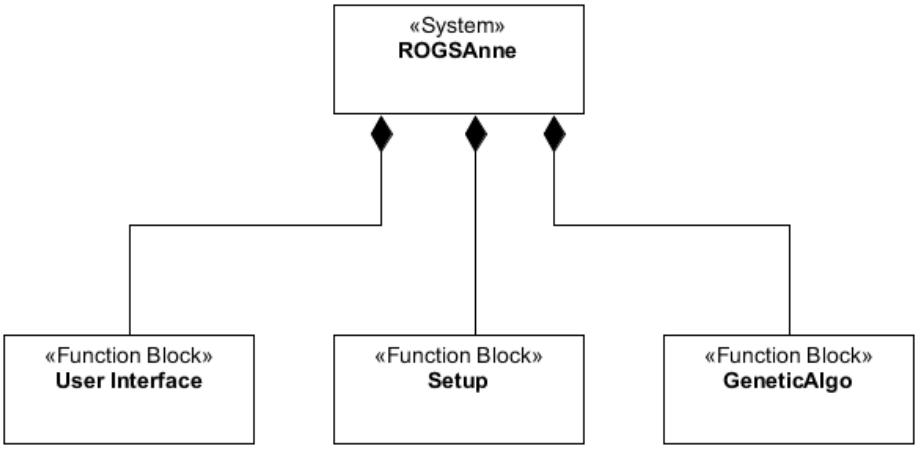
Kapitel 2

METHODOLOGY

The following chapter will describe the groups methodology and show multiple diagrams that show the behaviour of the system. These diagrams will be the following.

- **Block Definition Diagram(BDD):** To provide an overview of the hardware structure.
- **Internal Block Diagram (IBD):** To provide an overview of the connection between IP-blocks.
- **Class Diagram:** To describe the logical partitions of the implemented software, and their dependencies and associations.
- **Activity Diagram:** To provide an overview of the overall system flow.

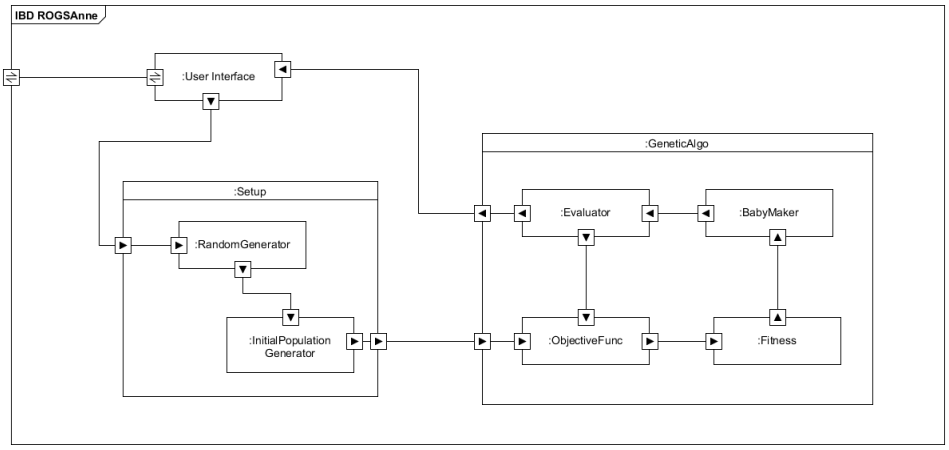
The block definition diagram show the overall context of the system and what the it consists of.



Figur 2.1: Block definition diagram of ROGSAnne

The system consists of three function blocks. These blocks encapsulates some sort of functionality.

- **User Interface** handles the interface between user and system. This is done through a console.
- **Setup** handles the initial creation of a population for the genetic algorithm.
- **GeneticAlgo** will handle the optimization of the route with a genetic search algorithm.



Figur 2.2: Internal block definition diagram of ROGSAnne

Kapitel 3

THEORY

This section will describe the theory behind the problem.

3.1 Traveling Salesperson Problem

The problem can be

3.2 Genetic Algorithm