**Calculator**

*Cypher*

*Date*

***Important Notes:***

* ***The descriptions in italics in this document (except for some section headings) are exemplary and explanatory and must be removed from the completed report.***
* ***Identify which section of this report was created by which team member***
* ***Your documentation should have ca. 8 pages (content! Without cover sheet, references, appendix etc.).***

# Team members

1. Sheikh Muhammad Adib Bin Sh Abu Bakar
2. Zafirul Izzat Bin Mohamad Zaidi
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# Introduction

Introduction into your project

Why are FPGAs and VHDL important for your project domain?

For our project we plan to make a calculator that can do multiplication, division, subtraction and addition with integer with value up to 65536. To have better interface with the user, this calculator get input from keypad with number printed on it and the output will be displayed in integer format instead of binary. This calculator also capable of storing a value to make further calculation.

In this project we will use FPGA to prototype our own application specified integrated circuit for the calculator that can do all operation including storing values according to our requirements. To realize that, we first model our solution and how we approach them with model diagram to build the calculator and then we will model their structure and behavior in VHDL that will be uploaded into FPGA. By using VHDL means that we already reduce the complexity in building the circuit because the synthesis operation will be done automatically.

# Concept description

*Block diagram of your target application.*

*What is the main application for your prototype?*

*To build our calculator, we reduce the complexity by modelling the structure and behavior of the calculator in a few blocks diagram. Our main target that we could have a concreate system architecture so that we could split the calculator into a few components. Modeling diagram not only help us in building a system in more organized way, it also helps us as a team to work together parallelly.*

*To do that we first start with requirement diagram to put every requirement that we want to achieve either functional or non-functional related to the calculator that we want to build.*

*We then create a use case diagram to set the boundaries of the calculator system. With use case diagram we can analyst the component that could exist in the calculator. After that we model each action in use case using activity diagram with possible scenario. Next, we analyze all the diagram to build a concrete calculator system architecture, means that we are ready to do the state chart and state machine diagram so that later we can synthesis them using VHDL.*

1. Requirement Diagram

The first phase of our project began with a pre-study where basic knowledge on Calculator was gathered. The aim of the pre-study was to get a summary of our calculator project in general. The pre-study also enabled the search for content to be used as a guide in this research, such as details on calculator.

Now, we documented the requirements for this project with the functionalities. The important requirements of our calculator are operation that the calculator can do. The maximum and minimum number are also included. The calculator also can display the answer, symbol and can show error if the wrong output is produced.

*Diagram

Description automatically generated* 

1. Use Case Diagram

*Diagram

Description automatically generated*

The use case diagram for calculator is shown in the figure above. As we can see, this system has only one actor, which is the user. In this system, the user can insert a number, select an operator, and obtain the result. This system simply has four operators: subtraction, addition, multiplication, and division. This system also has a display function that can display a number as well as a result. The calculation in this system also can handle error.

1. Activity Diagram

*Diagram

Description automatically generated*

Figure above explains how scenario for calculator. At first, the first number is inserted. Then, if the user choose to get result, then the result is directly displayed. If the user choose the operation, so the second number will be inserted, then lastly the result will be out.

1. System architecture

*Diagram

Description automatically generated*

Figure above describes the system architecture of calculator showing how the interface are connected to our calculator.

1. State Machine Diagram

*Diagram

Description automatically generated*

Figure above shows how the behavior of the calculator system. There are 5 states : listen 1, store, listen 2, calculate and result.

# Project/Team management

*Which project methods you used in your project?*

*Breakdown: How you managed your tasks?*

*What are the different tasks/roles of the team members in the project?*

*Describe which team member did which tasks.*

# Technologies

# *Describe the technological approaches you will use to implement your project.*

* *VHDL*
* *Eagle*
* *FPGA*
* *If necesseray other technologies*

# VHDL Implementation

*Describe the implementation of your digital design in VHDL/FPGA*

*Provide a detailed block diagram for this purpose and briefly explain the used modules.*

*Describe how you verified your solution. Testbench!!*

*Provide the results for your FPGA Implementation (Results summary + Hardware results if necessary)*

# PCB Design

*Describe the implementation of your schematic and PCB design*

*Give a summary about your PCB design results (BOM, Costs, Size usw.)*

# Sources/References

*Provide the sources on the technologies and algorithms you used in your project (Github).*