**CHAPTER 1**

# **Introduction**

When a processor for a custom ISA is designed, we should have a tradeoff in hardware complexity, user/ programmer friendliness, performance, size and cost. Specially when your processor supposes to do a specific task your instruction set, register pool should be able to perform that task efficiently using available resource/for a given cost.

For us our specific task was to down sample an image by a factor of two. Available resources were **Xilinx Spartan – 6 FPGA** with UART interface to communicate between Processor and Computer. We were able to achieve our task by optimized processor for looping operations, a memory which can be used to store two 256x256 images at one time and UART transceiver which can be used to send/ receive data from memory. Verilog HDL was used to implement modules and Xilinx ISE Design suite as our programming environment.

DPUT Processor is an 8 – bit processor with 64kb (4096x16 bit) instruction memory and 1024kb (131072x8 bit) data memory. Even though this is an 8-bit processor (which has 8-bit dram) all the data registers inside the processor are 16-bit registers. This enables programmer to multiply 2 8-bit values without overflow. Excluding special purpose registers DPUT has 15 general purpose registers which reduces frequent memory access which improves the performance of the processor.

Since lot of looping operations are involved in image processing algorithms, we have introduced a new instruction with a special register and a flag which can be reduced no of clock cycles w.r.t normal ISA. Also, instruction set with only 15 instructions have reduced the programming complexity. Since instructions are categories into 5 instruction types with a meaningful way instruction set is simple and easily understandable by the programmer.

We have also implemented a python compiler which reads a .txt file into a binary machine code which can be imported to instruction memory. In addition to compiler we also implemented a python-based simulator which reads a instruction txt file and displays the values of the registers when an instruction is getting executed. This can be used to debug your algorithm without repeatedly synthesize your modules. Also, OUT port can be connected to any inside bus and it can also be used to debugging your modules/algorithms.