Pipelined Processor

EE309 Course Project

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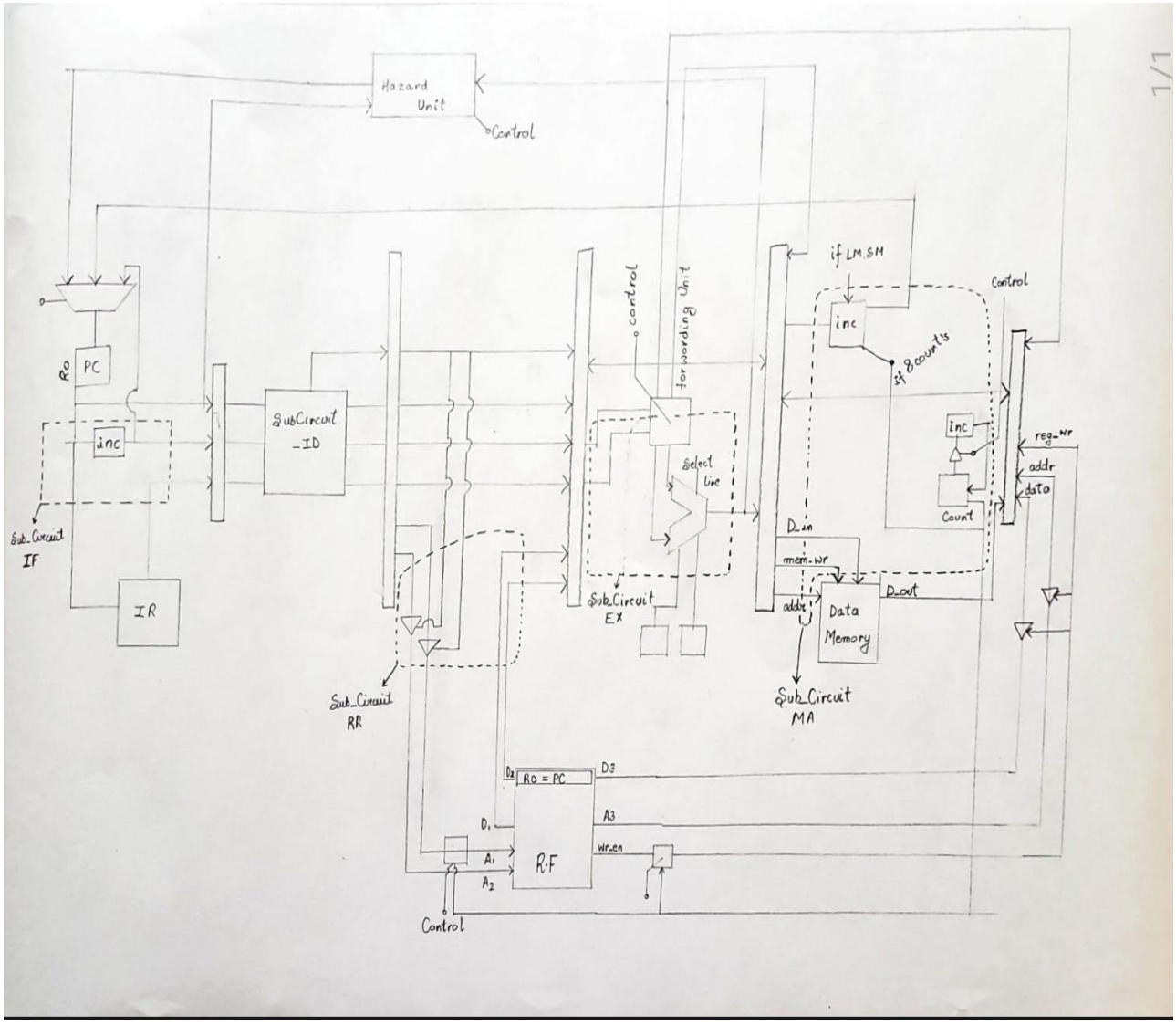
FlowChart IITB-RISC-23

		IF	ID	RR	EX	MA	WB
ADA	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a RF_D2 => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ADC	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a RF_D2 => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ADZ	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a RF_D2 => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
AWC	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a RF_D2 => alu_b C=> alu_cin alu_out=>data_out alu_cout=>C alu_z => Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ACA	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a not(RF_D2) => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ACC	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a not(RF_D2) => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ACZ	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a not(RF_D2) => alu_b alu_out => data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ACW	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_D1 =>alu_a not(RF_D2) => alu_b C=> alu_cin alu_out=>data_out alu_cout=>C alu_z => Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
ADI	I	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Ra => RF_A1	RF_A1=>alu_a imm6=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rb => RF_A3 data_out => RF_D3
NDU	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a RF_A2=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
NDC	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a RF_A2=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3
NDZ	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a RF_A2=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3

FlowChart IITB-RISC-23

		IF	ID	RR	EX	MA	WB		
NCU	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a not(RF_A2)=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3		
NCC	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a not(RF_A2)=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3		
NCZ	R	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-3) => addr_Rc IR(2)=> complementBit IR(1-0)=>CZ	addr_Ra => RF_A1 addr_Rb => RF_A2	RF_A1=>alu_a not(RF_A2)=>alu_b alu_out=>data_out alu_cout => C alu_z=>Z	M_wr=0	addr_Rc => RF_A3 data_out => RF_D3		
LLI	J	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-0) => imm9		imm9=>Ra(lower 9bit) 00_0=>Ra(higher 7bit)	M_wr=0			
LW	I	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Rb => RF_A2	RF_D2=>alu_a imm6=>SE6=>alu_b alu_out=>data_out	data_out=>DMem_a	addr_Ra=> RF_A3 DMem_d => RF_D3		
SW	I	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Rb => RF_A2	imm6=>SE6=> alu_a RF_D2 => alu_b alu_out=>data_out	data_out=>DMem_a	addr_Ra=> RF_A1 RF_D1=>DMem_d		
LM	J	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-0) => imm9						
SM	J	pc=>inc,IMem_A inc=>PC IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-0) => imm9						
BEQ	I	pc=>inc,IMem_A inc=>pc IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Ra => RF_A1 addr_Rb => RF_A2	if reg A=reg B imm6 => alu1_a 2 => alu1_b alu1_out => alu2_a PC => alu2_b alu2_out=>PC	M_wr=0	NONE		
BLT	I	pc=>inc,IMem_A inc=>pc IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Ra => RF_A1 addr_Rb => RF_A2	if reg A<reg B imm6 => alu1_a 2 => alu1_b alu1_out => alu2_a PC => alu2_b alu2_out=>PC	M_wr=0	NONE		
BLE	I	pc=>inc,IMem_A inc=>pc IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Rb IR(5-0) => imm6	addr_Ra => RF_A1 addr_Rb => RF_A2	if reg A(</=)reg B imm6 => alu1_a 2 => alu1_b alu1_out => alu2_a PC => alu2_b alu2_out=>PC	M_wr=0	NONE		
JAL	J	pc=>inc,IMem_A inc=>pc,pc_init IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-0) => imm9	addr_Ra => RF_A1	imm9 => alu1_a 2 => alu1_b alu1_out => alu2_a PC => alu2_b alu2_out=>pc	M_wr=0	addr_Ra=>RF_A3 pc_init => RF_D3	pc_init is carry forwarded till WB	
JLR	I	pc=>inc,IMem_A inc=>pc,pc_init IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-6) => addr_Ra IR(5-0)=>000000	addr_Ra => RF_A1	pc=>alu_a 2=>alu_b alu_out=>pc	M_wr=0	addr_Ra=>RF_A3 pc_init => RF_D3		
JRI	J	pc=>inc,IMem_A inc=>pc IMem_D=>IR	IR(15-12) => opCode IR(11-9) => addr_Ra IR(8-0) => imm9	addr_Ra => RF_A1	imm9 => alu1_a 2 => alu1_b alu1_out => alu2_a RF_A1 => alu2_b alu2_out=>pc	M_wr=0	NONE		

DATAPATH


Hazard Unit
Control
PC
R0
inc
IR
Sub_Circuit IF
SubCircuit -ID
control
forwarding Unit
Select line
Sub_Circuit EX
if LM,SM
inc
± 8 counts
Control
inc
Count
reg_wr
addr
data
D_in
mem_wr
addr
Data Memory
D_out
Sub_Circuit MA
Sub_Circuit RR
R0 = PC
D3
A3
wr_en
R.F
A1
A2
Control