ISTANBUL TECHNICAL UNIVERSITY

COMPUTER ENGINEERING DEPARTMENT

BLG 222E

COMPUTER ORGANIZATION PROJECT REPORT

PROJECT NO : 2

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GROUP NO : G8

GROUP MEMBERS:

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1 INTRODUCTION

In this project, In this project, we implemented the design of the small computer. We designed Control Unit (CU) over the design in the first project. All the inputs of the Control Unit come from the circuit we designed in our first project, and all the outputs go to the circuit we designed in the first project we designed. By looking at the last 4 bits of the IR input of our Control Unit, one of the 16 opcodes is selected and the IR input is divided according to the opcodes (exp: SRCREG, DESTREG, Adressing Mode, Adress,etc. . .).

2 PROJECT PARTS

2.1 First Project

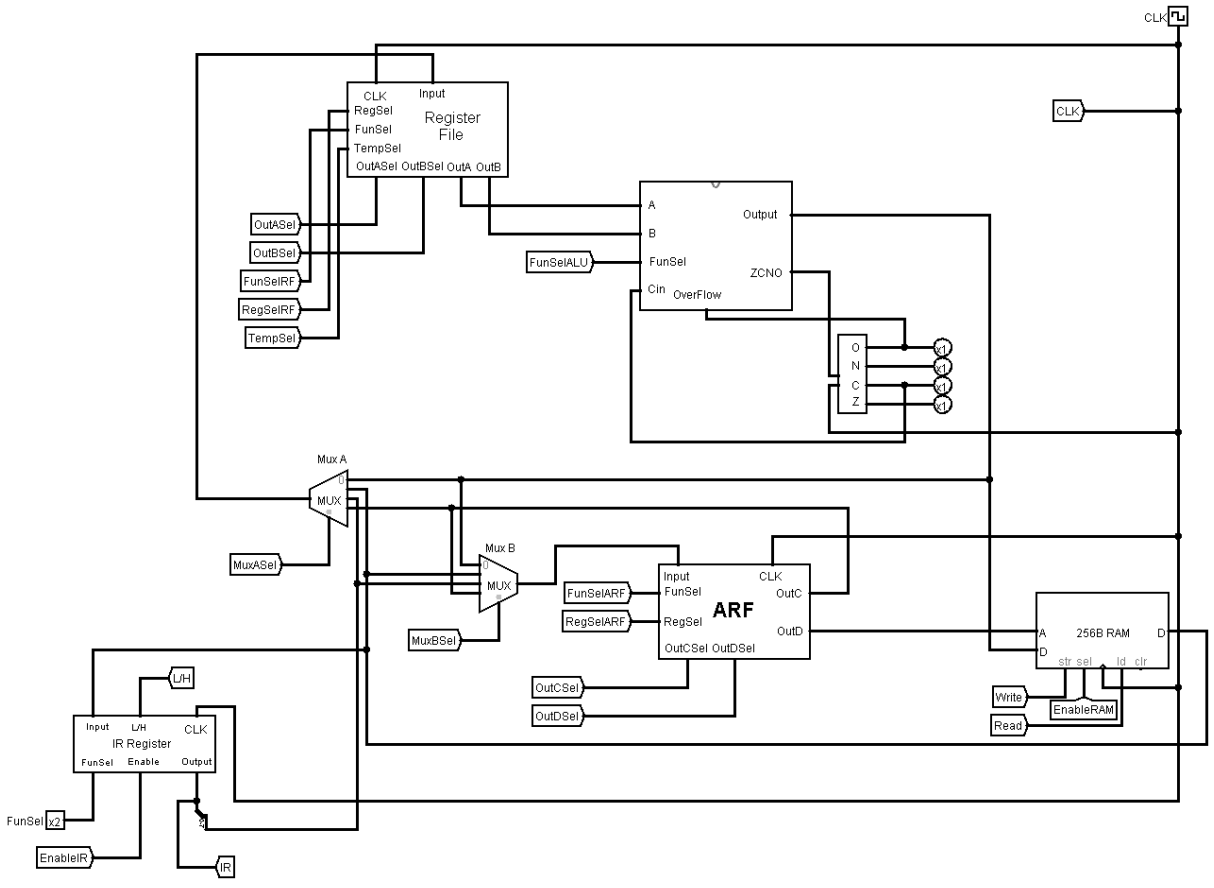

Figure 1: Circuit of First Project

We used the design of Project 1, but we put tunnels instead of inputs and outputs because in this project we will do our operations on the Control Unit.

2.2 Control Unit

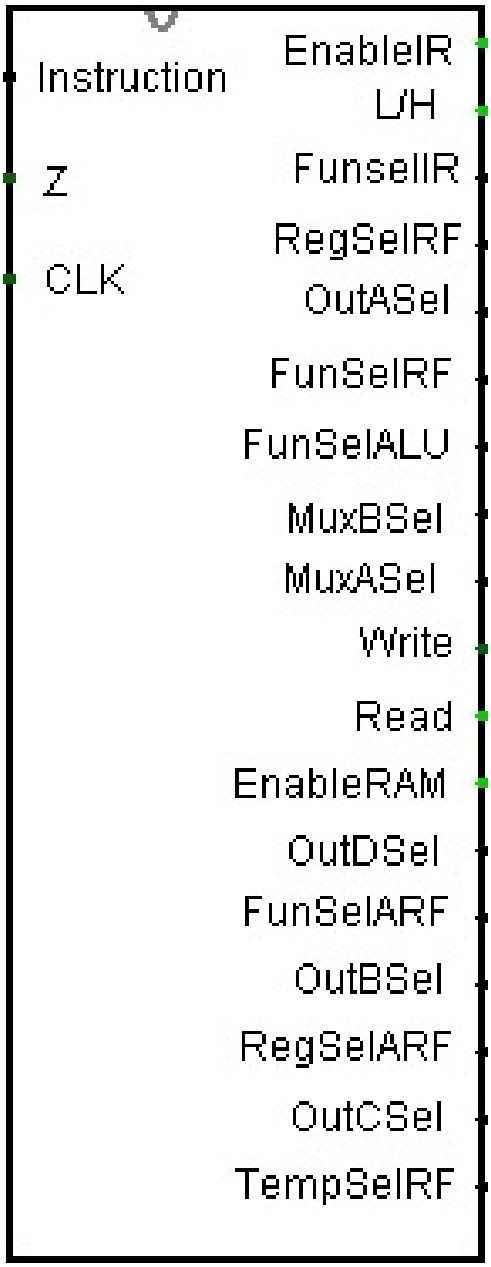

Figure 2: Control Unit

This is how our Control Unit looks. It has 3 inputs, they are Z, CLK and IR. It does all the operations according to these three inputs and gives the outputs shown in the picture above.

2.3 The Inside of the CU

We used a splitter to split the bits of the instruction and figure out its parts.

For Type 1 instruction: OPCODE, ADDRESSING MODE, REGSEL, and ADDRESS

For Type 2 instruction: OPCODE, OPCODE, DESTREG, SRCREG1, and SRCREG2

We used a decoder to figure out the correct OPCODE out of the first 5 bits of the instruction.

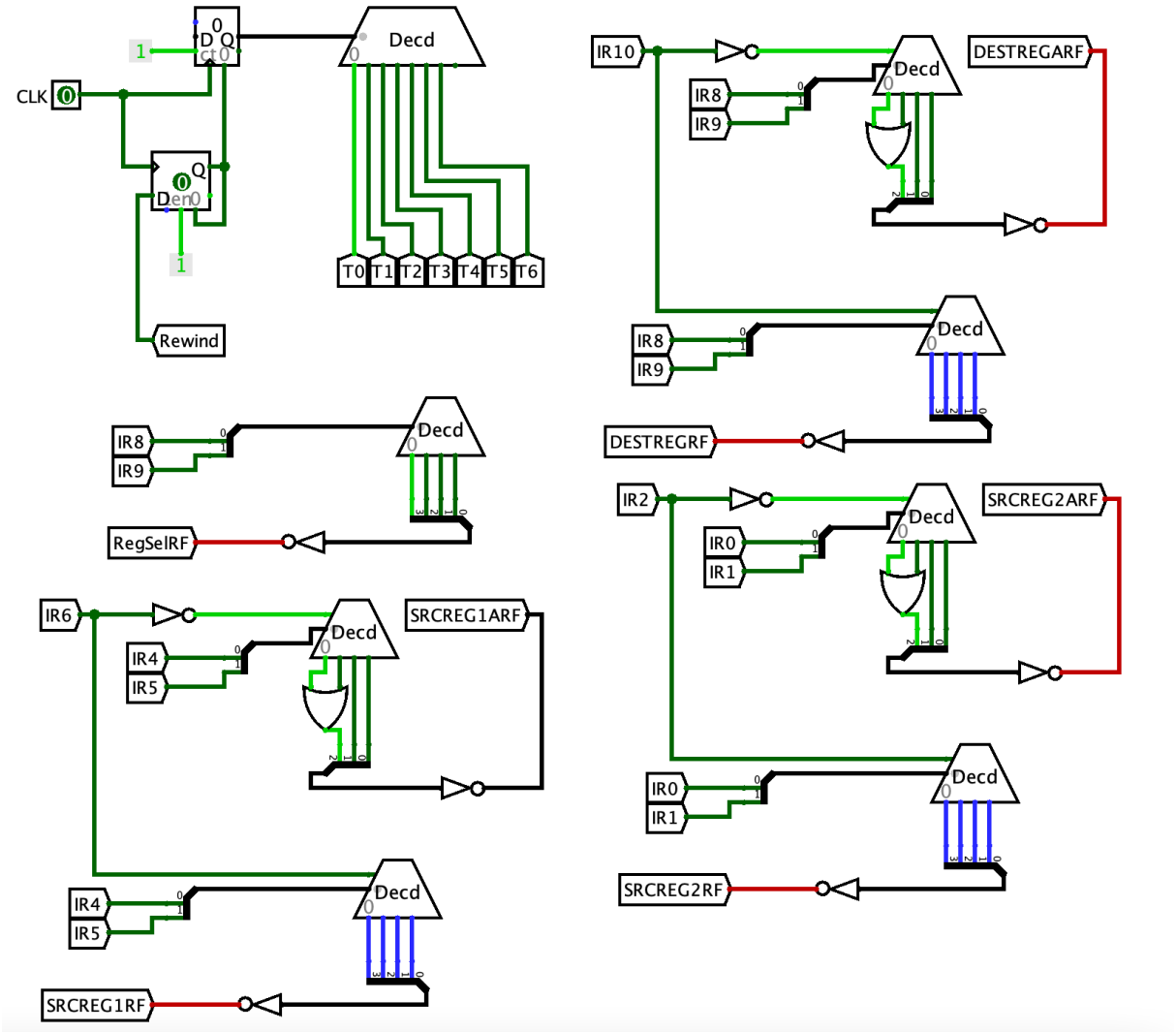

Figure 3:

We used some decoders to decode the instruction's parts. Decoded version of the 8th and 9th bits of instruction is RegSel for RF. We used third bits of every part as an enable input. It allowed us to select between ARF and RF. For example, when IR10 is 1, IR8 and IR9 are going to be decoded and be DESTREG of RF. Otherwise, they are going to be DESTREG of ARF. We designed a counter and a decoder to show the times (T0,T1,T2...T7) during which actions are taken in the circuit. Each action needs different

numbers of the clock cycle to work. Rewind is for restarting the counter to T0 when the instruction is completed.

Figure 4 shows how Rewind works. Each Opcode needs different number of clock cycles. We used basic logic gates.

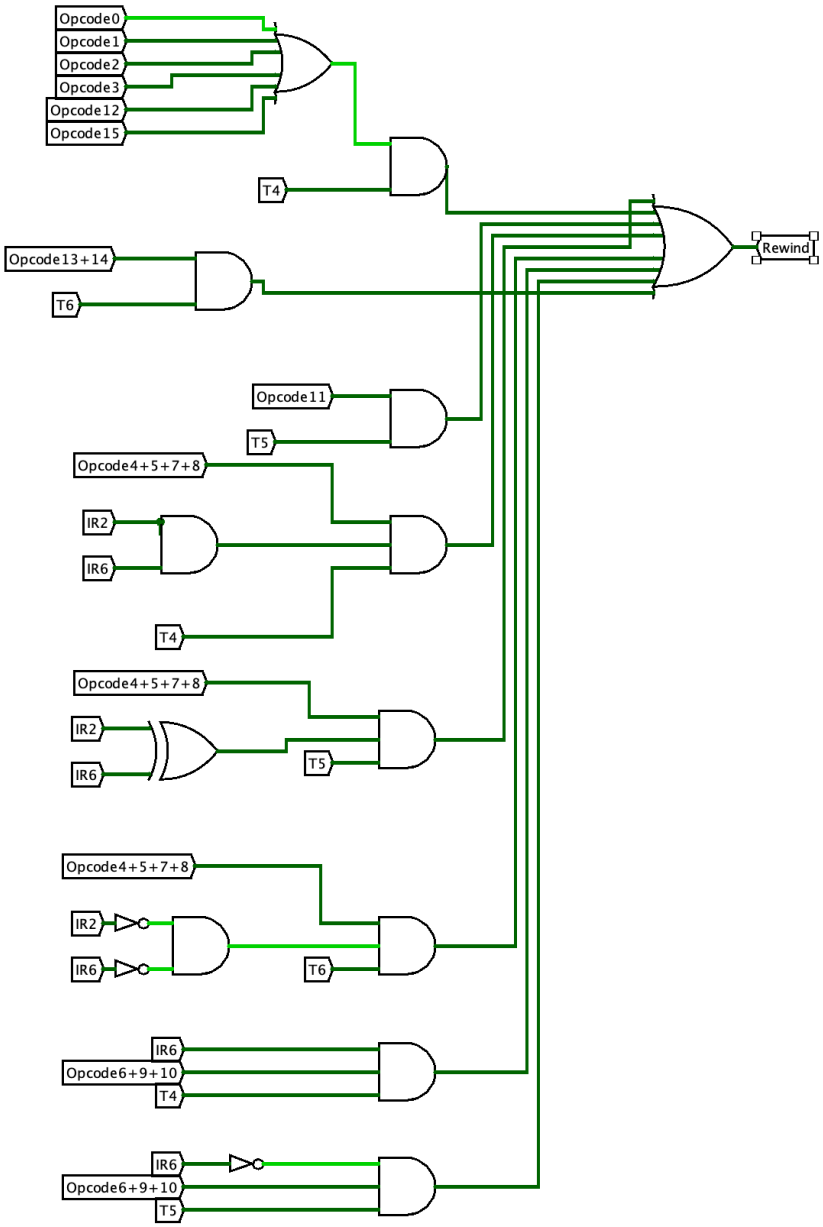

Figure 4:

For each input (Regsel RF, OutASel, OutBSel, etc.) we designed a circuit like Figure 4.

For example, in Figure 5, RegSel ARF output is constructed by a series of AND gates and OR gates. We used IR, Time values, and Opcodes for doing it. We designed most of the other outputs by using same method.

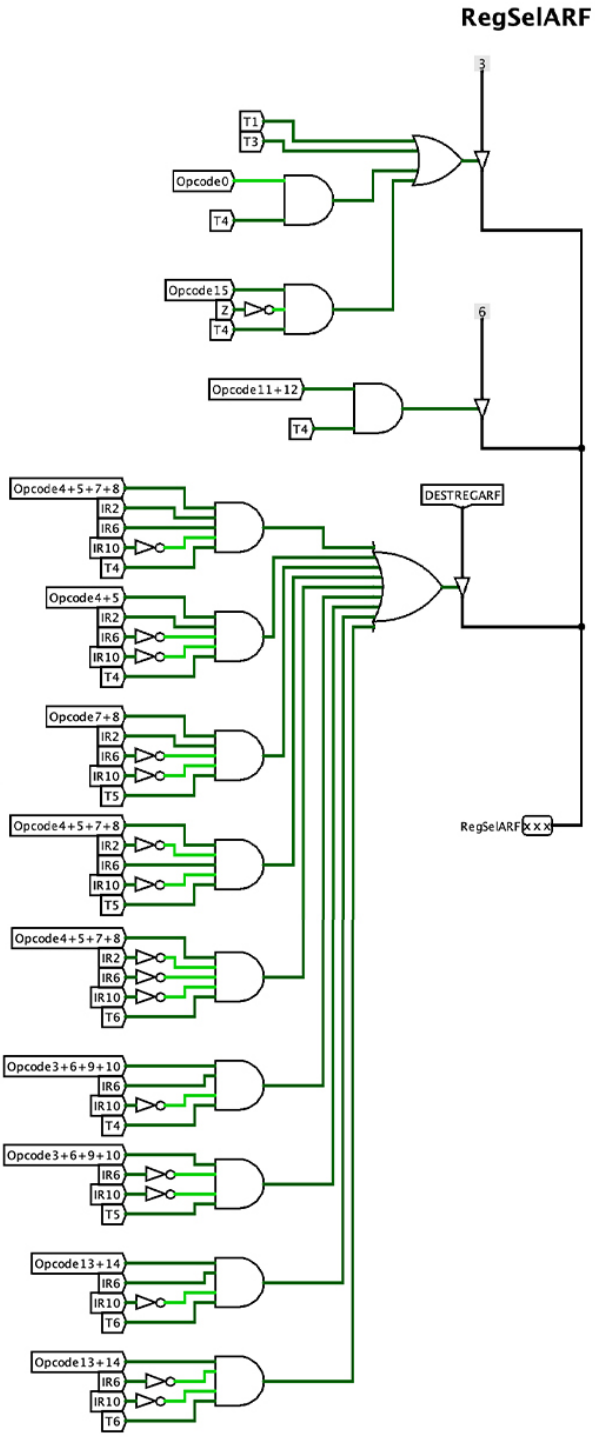
RegSelARF
3
T1
T3
Opcode0
T4
Opcode15
Z
T4
6
Opcode11+12
T4
DESTREGARF
Opcode4+5+7+8
IR2
IR6
IR10
T4
Opcode4+5
IR2
IR6
IR10
T4
Opcode7+8
IR2
IR6
IR10
T5
Opcode4+5+7+8
IR2
IR6
IR10
T5
Opcode4+5+7+8
IR2
IR6
IR10
T6
Opcode3+6+9+10
IR6
IR10
T4
Opcode3+6+9+10
IR6
IR10
T5
Opcode13+14
IR6
IR10
T6
Opcode13+14
IR6
IR10
T6
RegSelARF

Figure 5:

3 RESULTS

In this project we implemented a hardwired control unit that can perform a set of operations, using the instructions that are given.

Instructions are written by the user to RAM that we used in the previous project. Then the system takes these instructions and passes them to the control unit. The control unit determines the inputs of the components that we designed in the previous project and performs that operation.

4 DISCUSSION

First we divided the whole process into smaller parts. We analyzed each opcode with different inputs for MUXSelectors, OUTSelectors, REGSelectors, FUNSelectors and other inputs. We also analyzed it in a way that values of inputs and outputs can be clearly observed in every clock cycle. After that we designed the smaller parts to design the whole process.

- **T0: IR[0-7]** $<-M[PC]$
  OutDSel 00
  RAM Read = 1.
  L/H = 1.
  EN= 1
  FunSelIR 10

- **T1 : PC** $<-PC+1$
  RegSel 011
  FunselARF 01
  Read 0
  Write 0
  EnableIR 0

- **T2: IR[8-15]** $<-M[PC]$
  L/H = 0.
  READ = 1
  EnableIR 1
  FunSelIR 10

- **T3**

RegseARF 011
FunselARF 01
Read 0
Write 0
EnableIR 0

Up to T3, it will be same in every instruction. Now we will investigate how our circuit will behave for different opcodes and instructions.

- **Opcode0**

T4:
MuxBSel 10
FunSel(ARF) 10 (Load)
RegSelARF 011

- **Opcode1**

Adressing Mode = D
T4:
OutDSel = AR
Read=1
Write = 0
MuxASel = 01
Regsel(RF) = (IR(9-10) decoded)
FUnSel(RF) 10

Adressing Mode = IM
T4:
MuxASel = 10
Regsel(RF) = (IR(9-10) decoded)
FunSel(RF) 10

- **Opcode2**

T4:
Regsel(RF) = (IR(9-10) decoded)
OutASel = IR(9-10) Decoded
Funsel(ALU) = 0000
MuxBSel = 00
Funsel(ARF) = 10
Regsel(ARF) 101

- **Opcode3**

T4:
IR6 = 1, IR10 = 1
OutASel = (IR 4-7 Decoded)
FunSel(ALU) = 0000
MuxASel = 00
FunSel(RF) = 10
Regsel RF = (IR 8-11 Decoded)
IR6 = 1, IR10 = 0
T4:
OutASel = (IR 4-7 Decoded)
FunSel(ALU) = 0000
MuxBSel = 00
FunSel ARF = 10
Regsel ARF = IR(8-11 Decoded)
IR6 = 0, IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
Funsel RF = 10
RegSel RF = (IR 8-11 Decoded)
IR6 = 0, IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxBSel = 11

Funsel ARF = 10
Regsel ARF = (IR 8-11 Decoded)

- **Opcode4**

T4:
IR3 = 1, IR6 = 1, IR10=1
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0111
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 =1 , IR6 = 1, IR10 = 0
T4:
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0111
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0111
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 0, IR6 = 1, IR10 = 0
T4:

OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0111
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0 ,IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0111
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 = 0, IR6 = 1 ,IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0111
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10

IR3 = 0, IR6 = 0, IR10 = 1

T4:

OutCSel = IR(0-3 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 0111

T5:

OutCSel = IR(4-7 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 1011

T6:

OutASel: 100

OutBSel: 101

FunSel ALU = 0111

MuxASel = 00

FunSel RF = 10

RegSel RF = (IR 8-11 Decoded)

IR3 = 0, IR6 = 0, IR10 = 0

T4:

OutCSel = IR(0-3 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 0111

T5:

OutCSel = IR(4-7 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 1011

T6:

OutASel: 100

OutBSel: 101

FunSel ALU = 0111

MuxBSel = 00

FunSel ARF = 10

RegSel ARF = (IR 8-11 Decoded)

- **Opcode5**

T4:
IR3 = 1, IR6 = 1, IR10=1
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 1000
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 =1 , IR6 = 1, IR10 = 0
T4:
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 1000
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 1000
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 0, IR6 = 1, IR10 = 0
T4:
OutCSel = IR(0-3 Decoded)

MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 1000
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0 ,IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 1000
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 = 0, IR6 = 1 ,IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 1000
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10

IR3 = 0, IR6 = 0, IR10 = 1

T4:

OutCSel = IR(0-3 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 0111

T5:

OutCSel = IR(4-7 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 1011

T6:

OutASel: 100

OutBSel: 101

FunSel ALU = 1000

MuxASel = 00

FunSel RF = 10

RegSel RF = (IR 8-11 Decoded)

IR3 = 0, IR6 = 0, IR10 = 0

T4:

OutCSel = IR(0-3 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 0111

T5:

OutCSel = IR(4-7 Decoded)

MuxASel = 11

FunSel RF = 10

TempSel = 1011

T6:

OutASel: 100

OutBSel: 101

FunSel ALU = 1000

MuxBSel = 00

FunSel ARF = 10

RegSel ARF = (IR 8-11 Decoded)

- **Opcode6**

IR6 = 1, IR10 = 1 T4: OutASel = IR(4-7 Decoded) FunSel ALU = 0010 MuxASel = 00 RegSel RF = (IR 8-11 Decoded) FunSel RF = 1 IR6 = 1, IR10 = 0 T4: OutASel = IR(4-7 Decoded) FunSel ALU = 0010 MuxBSel = 00 FunSel ARF = 10 RegSel ARF = (IR 8-11 Decoded) IR6 = 0, IR10 = 1 T4: OutCSel = IR(4-7 Decoded) MuxASel = 11 TempSel = 1110 FunSel RF = 10 T5: OutASel = 100 FunSel ALU = 0010 MuxASel = 00 RegSel RF = (IR 8-11 Decoded) FunSel RF = 10 IR6 = 0 ,IR10 = 0 T4: OutCSel = IR(4-7 Decoded) MuxASel = 11 TempSel = 1110 FunSel RF = 10 T5: OutASel = 100 FunSel ALU = 0010 MuxBSel = 00 RegSel ARF = (IR 8-11 Decoded) FunSel ARF = 10

- **Opcode7**

T4:
IR3 = 1, IR6 = 1, IR10=1
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0100
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 =1 , IR6 = 1, IR10 = 0
T4:
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0100
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10

T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0100
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 0, IR6 = 1, IR10 = 0
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0100
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0 ,IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0100
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 = 0, IR6 = 1 ,IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11

TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0100
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10

IR3 = 0, IR6 = 0, IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 0111
T5:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 1011
T6:
OutASel: 100
OutBSel: 101
FunSel ALU = 0100
MuxASel = 00
FunSel RF = 10
RegSel RF = (IR 8-11 Decoded)

IR3 = 0, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 0111
T5:
OutCSel = IR(4-7 Decoded)

MuxASel = 11
FunSel RF = 10
TempSel = 1011
T6:
OutASel: 100
OutBSel: 101
FunSel ALU = 0100
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)

- **Opcode8**

T4:
IR3 = 1, IR6 = 1, IR10=1
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0110
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 =1 , IR6 = 1, IR10 = 0
T4:
OutASel = IR(0-3 Decoded)
OutBSel = IR(4-7 Decoded)
FunSel ALU = 0110
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:

OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0110
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 0, IR6 = 1, IR10 = 0
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0110
MuxBSel= 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR3 = 1, IR6 = 0 ,IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel RF= 0111
FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(0-3 Decoded)
FunSel ALU = 0110
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR3 = 0, IR6 = 1 ,IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
TempSel RF= 0111

FunSel RF = 10
T5:
OutBSel = 100
OutASel = IR(4-7 Decoded)
FunSel ALU = 0110
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10

IR3 = 0, IR6 = 0, IR10 = 1
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 0111
T5:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 1011
T6:
OutASel: 100
OutBSel: 101
FunSel ALU = 0110
MuxASel = 00
FunSel RF = 10
RegSel RF = (IR 8-11 Decoded)

IR3 = 0, IR6 = 0, IR10 = 0
T4:
OutCSel = IR(0-3 Decoded)
MuxASel = 11
FunSel RF = 10
TempSel = 0111
T5:
OutCSel = IR(4-7 Decoded)
MuxASel = 11

FunSel RF = 10
TempSel = 1011
T6:
OutASel: 100
OutBSel: 101
FunSel ALU = 0110
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)

- **Opcode9**

IR6 = 1, IR10 = 1
T4:
OutASel = IR(4-7 Decoded)
FunSel ALU = 1010
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 1
IR6 = 1, IR10 = 0
T4:
OutASel = IR(4-7 Decoded)
FunSel ALU = 1010
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR6 = 0, IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel = 1110
FunSel RF = 10
T5:
OutASel = 100
FunSel ALU = 1010
MuxASel = 00

RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR6 = 0 ,IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel = 1110
FunSel RF = 10
T5:
OutASel = 100
FunSel ALU = 1010
MuxBSel = 00
RegSel ARF = (IR 8-11 Decoded)
FunSel ARF = 10

- **Opcode10**

IR6 = 1, IR10 = 1
T4:
OutASel = IR(4-7 Decoded)
FunSel ALU = 1011
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 1
IR6 = 1, IR10 = 0
T4:
OutASel = IR(4-7 Decoded)
FunSel ALU = 1011
MuxBSel = 00
FunSel ARF = 10
RegSel ARF = (IR 8-11 Decoded)
IR6 = 0, IR10 = 1
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel = 1110

FunSel RF = 10
T5:
OutASel = 100
FunSel ALU = 1011
MuxASel = 00
RegSel RF = (IR 8-11 Decoded)
FunSel RF = 10
IR6 = 0 ,IR10 = 0
T4:
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel = 1110
FunSel RF = 10
T5:
OutASel = 100
FunSel ALU = 1011
MuxBSel = 00
RegSel ARF = (IR 8-11 Decoded)
FunSel ARF = 10

- **Opcode11**

  T4:
  FunSel ARF = 01
  RegSel ARF = 110
  T5:
  OutDSel = 11
  Read = 1
  Write = 0
  MuxASel = 01
  RegSel RF = (IR8-9 Decoded)
  FunSel RF = 10
  Opcode12

  T4: OutASel = (IR8-9 Decoded)
  FunSel ALU = 0000

OutDSel = 11

Write = 1

Read = 0

FunSel ARF = 00

RegSel ARF = 110

Opcode13

Srcreg1-¿4-7 desteg 8-11

IR6 = 1, IR10 = 1

T4:

OutASel = IR(4-7 Decoded)

FunSelALU = 0000

MuxASel = 00

TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 01

T6

OutASel 100

FunSelALU 0000

MuxASel = 00

RegSelRF= IR(8-11 Decoded)

FunSelRF = 10

IR6 = 1 IR 10 = 0

T4:

OutASel = IR(4-7 Decoded)

FunSelALU = 0000

MuxASel = 00

TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 01

T6

OutASel 100

FunSelALU 0000

MuxBSel = 00

FunSelARF = 10

RegSelARF = IR(8-11 Decoded)

IR6 = 0 IR10 = 1

T4

OutCSel = IR(4-7 Decoded)

MuxASel = 11

TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 01

T6

OutASel 100

FunSelALU 0000

MuxASel = 00

RegSelRF= IR(8-11 Decoded)

FunSelRF = 10

IR6 = 0 IR10 = 0

T4

OutCSel = IR(4-7 Decoded)

MuxASel = 11

TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 01

T6

OutASel 100

FunSelALU 0000

MuxBSel = 00

FunSelARF = 10

RegSelARF = IR(8-11 Decoded)

Opcode14

Srcreg1-¿4-7 desteg 8-11

IR6 = 1, IR10 = 1

T4:
OutASel = IR(4-7 Decoded)
FunSelALU = 0000
MuxASel = 00
TempSel = 0111
FunSel RF = 10
T5
TempSel = 0111
FunSelRF = 00
T6
OutASel 100
FunSelALU 0000
MuxASel = 00
RegSelRF= IR(8-11 Decoded)
FunSelRF = 10
IR6 = 1 IR 10 = 0
T4:
OutASel = IR(4-7 Decoded)
FunSelALU = 0000
MuxASel = 00
TempSel = 0111
FunSel RF = 10

T5
TempSel = 0111
FunSelRF = 00
T6
OutASel 100
FunSelALU 0000
MuxBSel = 00
FunSelARF = 10
RegSelARF = IR(8-11 Decoded)
IR6 = 0 IR10 = 1
T4
OutCSel = IR(4-7 Decoded)
MuxASel = 11
TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 00

T6

OutASel 100

FunSelALU 0000

MuxASel = 00

RegSelRF= IR(8-11 Decoded)

FunSelRF = 10

IR6 = 0 IR10 = 0

T4

OutCSel = IR(4-7 Decoded)

MuxASel = 11

TempSel = 0111

FunSel RF = 10

T5

TempSel = 0111

FunSelRF = 00

T6

OutASel 100

FunSelALU 0000

MuxBSel = 00

FunSelARF = 10

RegSelARF = IR(8-11 Decoded)

Opcode15

Z = 0

T4:

MuxBSel = 10

RegSel ARF = 011

FunSel ARF 10

5 CONCLUSION

In order to complete Project 2 we must understand the details of other parts to design the control unit. We can say we understood what we did in project 1 better and also understood the instruction decoder cycle as well as how the control units work.

Another part is we had a hard time dividing the whole process to smaller parts, it was a challenging part but we managed to do it. By doing it we really got a better understanding in control unit logic, fetch and decode logic and so on.

In overall it was easy to implement after we got the logic right. We think it was an important project to understand the logic behind the basic computer and how control logic is being done.