B. Tech. 3rd Semester
Design of Digital Systems (CS201)

Mini project final report on
BLOOD COMPATABILITY

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ABSTRACT:

A **blood bank** is a center where blood gathered as a result of blood donation is stored and preserved for later use in blood transfusion.

More likely blood tranfusions mistakes occur when incorrect blood is given to a patient ,and it can have catastrophic consequence

- **Donor and patient's blood should be compatible for blood transfusion. so the purpose of this project is to design a circuit to check compatibility for transfusion.**
- **With the help of circuit using logic gates, we detect the possibilities of bloods which donor can give to, and among the possiblities if the patient's blood is matched then we can make transfusion.**
- **And also the donor should not have infections such as syphills etc.**
- **And depending upon the amount of blood loss, priority is given to a patient and chosen for efficiency without any bias towards a patient**

- Introduction

Significance of Blood compatibility

A blood bank is a center where blood gathered as a result of blood donation is stored and preserved for later use in blood transfusion. More likely blood tranfusions mistakes occur when incorrect blood is given to a patient ,and it can have catastrophic consequence

- Donor and patient's blood should be compatible for blood transfusion. so the purpose of this project is to design a circuit to check compatibility for transfusion.

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- And also the donor should not have infections such as syphills etc.

TYPE	YOU CAN GIVE BLOOD TO	YOU CAN RECEIVE BLOOD FROM
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	EVERYONE
A-	A+, A-, AB+, AB-	A-, O-
O-	EVERYONE	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-

Fig 1: chart table of blood compatibility

- From the figure shown , it is clear that , we can't transfer blood to any person without compatible test. a person of random blood group can't receive/donate to everyone .
- From the figure we can see that O- is universal donor and AB+ is universal receiver.
- Blood group can be determined by 3 factors, human can have 2 antigens in RBC , A,B depending on their presence and also rh factor if it is present it is positive else negative . Determines a blood group.

➢ TRUTH TABLE

Ad	Bd	Ap	Bp	Op	ABp
0	0	1	1	1	1
0	1	0	1	0	1
1	0	1	0	0	1
1	1	0	0	0	1

Rh (+/-)	+p	-p
1	1	0
0	1	1

➢ in truth table you can see that Ad and Bd are antigens present in donor are the inputs, and Ap,Bp,Op,ABp represents blood groups of patients if it's 1 he can receive if 0 can't. are outputs .

➢ Rh (+/-) is also a factor in donor is an input and +p,-p are rh factors of patient are output.

➢ <u>Boolean expression</u>

- Ap=~Bd
- Bp=~Ad
- Op=~(Ad+Bd)=~Ad~Bd
- Abp=1
- +p=1
- -p=~Rh

Most Common Blood Group in India

Here is the average blood type distribution in the Indian population:

- O+ = 32.53%
- O- = 2.03%
- A+ = 21.8%
- A- = 1.36%
- B+ = 32.09%
- B- = 2.01%
- AB+ = 7.70%
- AB- = 0.48%

Therefore we see that the **most common blood group in India is O positive**. The second most prevalent blood group in India is B positive. **AB negative is the rarest blood group in India**.

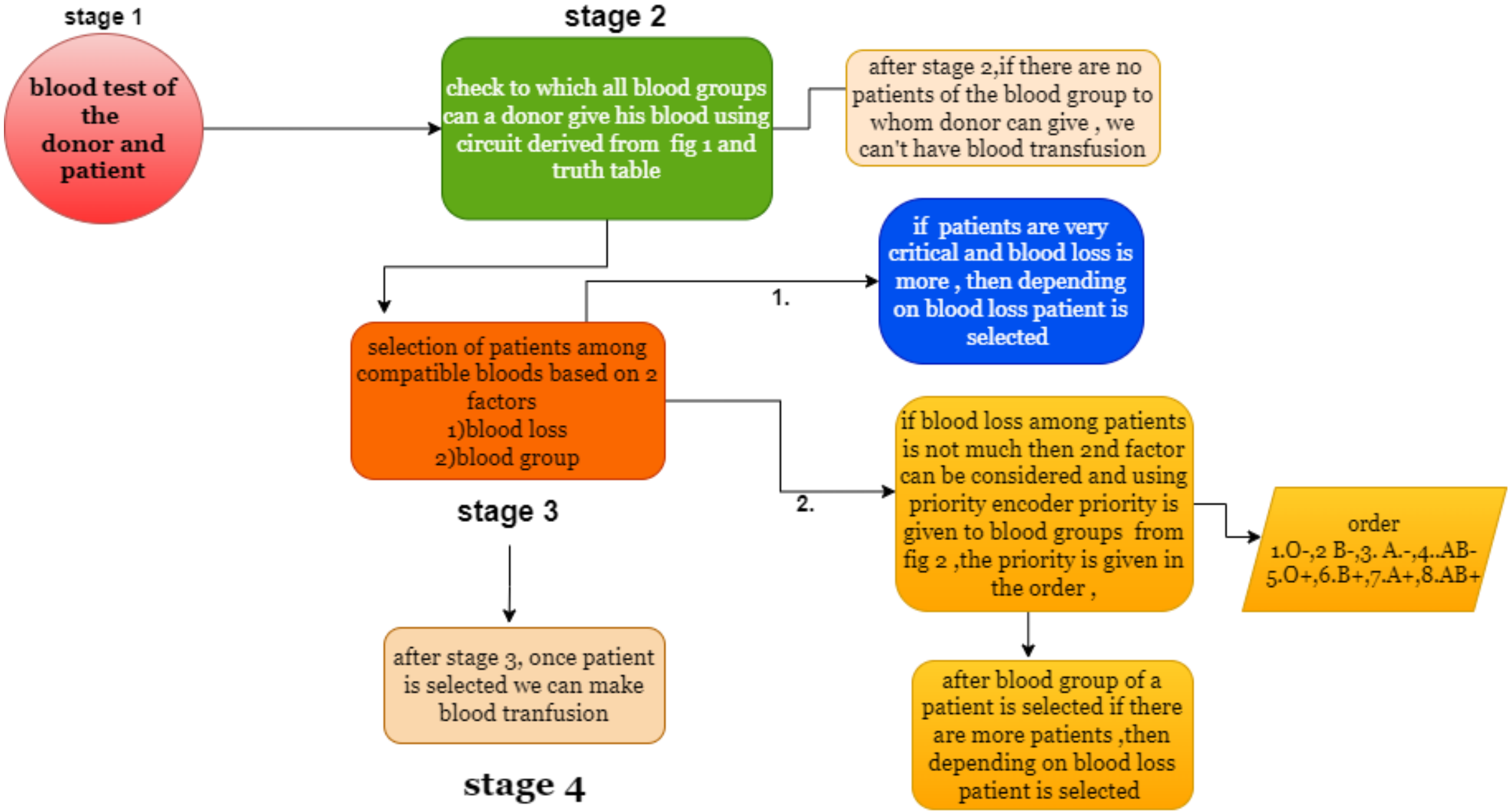
Fig 2 : distribution of blood group in india

Ex: suppose there is a donor of AB- and 2 patient of AB- and O- , O- is selected and given blood because O- receives blood only from O- with few people having it.

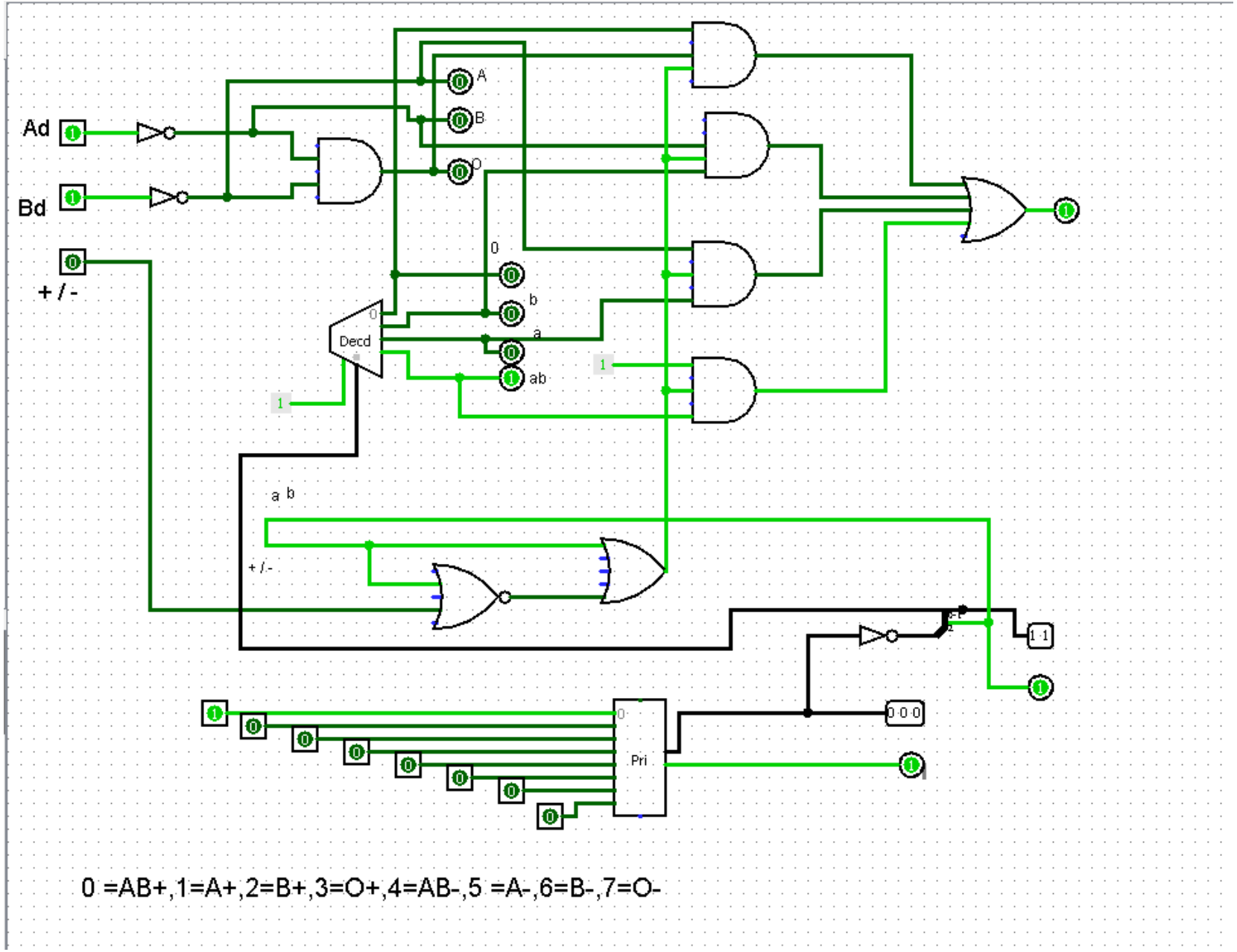
- From the data of blood type distribution shown in the source , we can see that every blood group is not equally distributed , hence with few donors and more patients it is necessary to prioritize among patients .
- so priority given to patient in order

1)O- 2)B- 3)A- 4) AB-
5)O+ 6)B+ 7)A+ 8)AB+

➢Flowchart


stage 1
blood test of the donor and patient
stage 2
check to which all blood groups can a donor give his blood using circuit derived from fig 1 and truth table
after stage 2,if there are no patients of the blood group to whom donor can give , we can't have blood transfusion
if patients are very critical and blood loss is more , then depending on blood loss patient is selected
1.
selection of patients among compatible bloods based on 2 factors
1)blood loss
2)blood group
2.
if blood loss among patients is not much then 2nd factor can be considered and using priority encoder priority is given to blood groups from fig 2 ,the priority is given in the order ,
order
1.O-,2 B-,3. A.-,4..AB-
5.O+,6.B+,7.A+,8.AB+
stage 3
after stage 3, once patient is selected we can make blood tranfusion
after blood group of a patient is selected if there are more patients ,then depending on blood loss patient is selected
stage 4

➢ Circuit diagram

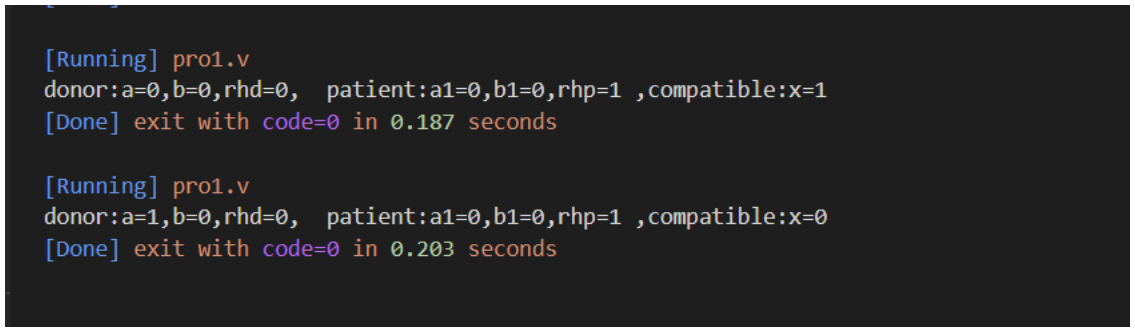


- Verilog code
- Version 1

```
timescale 1ns/1ns

module candonate(input a ,b ,rh , output ap, bp, op,abp ,p1 ,p2
);

   assign ap=!b;
   assign bp=!a;
   assign op=!(a+b);
   assign abp=1;
   assign p1=1;
   assign p2=!rh;

endmodule

module bdec(input a,b,output ap,bp,op,abp);

assign op=(!a)&(!b);
assign bp=(!a)&(b);
assign ap=(a)&(!b);
assign abp=a&b;

endmodule
```

```
module bmatch(input
ad,bd,od,abd,rhd,ap,bp,op,abp,rhp,output x);
wire t=(!(rhd|rhp))|rhp;
assign x=t&((ad&ap)+(bd&bp)+(od&op)+(abd&abp));

endmodule



module pro;

reg a,b,rhd,a1,b1,rhp;
wire ap, bp, op,abp,p1,p2,ad,bd,od,abd,x;

candonate t1(a,b,rhd,ad,bd,od,abd,p1,p2);
bdec t2(a1,b1,ap,bp,op,abp);
bmatch t3(ad,bd,od,abd,rhd,ap,bp,op,abp,rhp,x);

initial
begin
a=0;b=0;rhd=0;a1=0;b1=0;rhp=1;
end
```

```
initial
begin

$monitor("donor:a=%d,b=%d,rhd=%d,
patient:a1=%d,b1=%d,rhp=%d
,compatible:x=%d",a,b,rhd,a1,b1,rhp,x);

end

endmodule
```



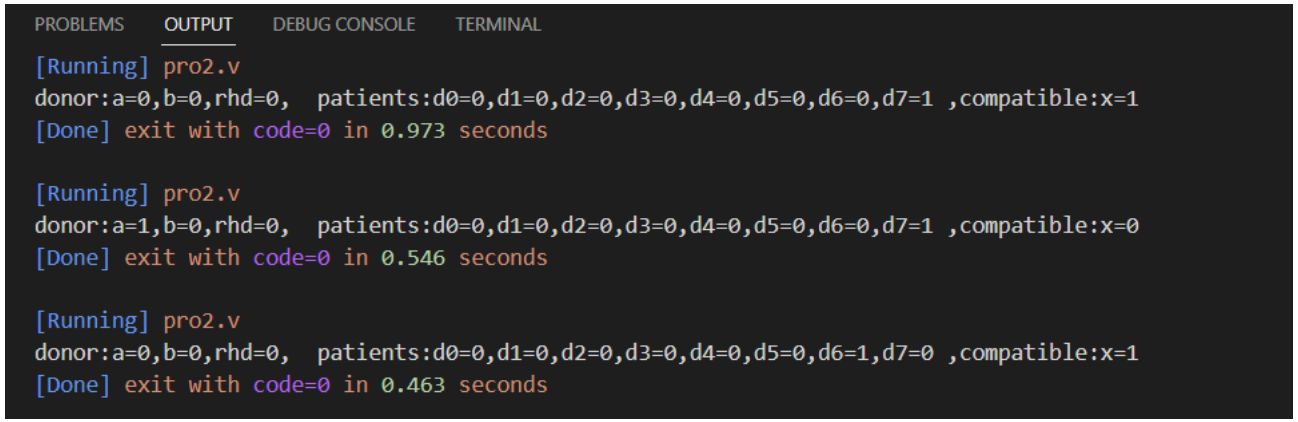
- Version 2:

```
`timescale 1ns/1ns

module candonate(input a ,b ,rh , output ap, bp, op,abp ,p1 ,p2 );

   assign ap=!b;
   assign bp=!a;
   assign op=!(a+b);
   assign abp=1;
   assign p1=1;
   assign p2=!rh;

endmodule

module bdec(input a,b,output ap,bp,op,abp);

assign op=(!a)&(!b);
assign bp=(!a)&(b);
assign ap=(a)&(!b);
assign abp=a&b;

endmodule
```

```
module bmatch(input
ad,bd,od,abd,rhd,ap,bp,op,abp,rhp,output x);
wire t=(!(rhd|rhp))|rhp;
assign x=t&((ad&ap)+(bd&bp)+(od&op)+(abd&abp));

endmodule

module bprio(input d0,d1,d2,d3,d4,d5,d6,d7,output x,y,z);

assign x=!(d7|d6|d5|d4);
assign
y=!(((!(d7|d6|d5|d4|d3))&d2)|((!(d7|d6|d5|d4))&d3)|d7|d6)
;
assign
z=!(d7|((!(d7|d6))&d5)|((!(d7|d6|d5|d4))&d3)|((!(d7|d6|d5|
d4|d3|d2))&d1));

endmodule
```

```
module pro;

reg a,b,rhd,d0,d1,d2,d3,d4,d5,d6,d7;
wire ap, bp, op,abp,p1,p2,ad,bd,od,abd,x,rhp,a1,b1;

bprio test(d0,d1,d2,d3,d4,d5,d6,d7,rhp,a1,b1);
candonate t1(a,b,rhd,ad,bd,od,abd,p1,p2);
bdec t2(a1,b1,ap,bp,op,abp);
bmatch t3(ad,bd,od,abd,rhd,ap,bp,op,abp,rhp,x);

initial
begin
  d0=0;d1=0;d2=0;d3=0;d4=0;d5=0;d6=0;d7=1;a=0;b=0;rhd=0;
end

initial
begin

$monitor("donor:a=%d,b=%d,rhd=%d,
patients:d0=%d,d1=%d,d2=%d,d3=%d,d4=%d,d5=%d,d6=%d,d7
=%d ,compatible:x=%d",a,b,rhd,d0,d1,d2,d3,d4,d5,d6,d7,x);

end
```

➢ output


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
[Running] pro2.v
donor:a=0,b=0,rhd=0, patients:d0=0,d1=0,d2=0,d3=0,d4=0,d5=0,d6=0,d7=1 ,compatible:x=1
[Done] exit with code=0 in 0.973 seconds
[Running] pro2.v
donor:a=1,b=0,rhd=0, patients:d0=0,d1=0,d2=0,d3=0,d4=0,d5=0,d6=0,d7=1 ,compatible:x=0
[Done] exit with code=0 in 0.546 seconds
[Running] pro2.v
donor:a=0,b=0,rhd=0, patients:d0=0,d1=0,d2=0,d3=0,d4=0,d5=0,d6=1,d7=0 ,compatible:x=1
[Done] exit with code=0 in 0.463 seconds

➢ Conclusions and future work

- the circuit can be used in blood banks in order to verify the blood compatibility between the donor and patient blood,and can avoid incorrect transfusions which leads to catastrophic consequences.
- it can increase the efficiency in blood banks , can choose the critical patients and serve them first without any bias .
- this circuit can be linked to blood test machine where the output of the machine can be given as input to the the circuit and can give us quick results .
- the circuit may be simple but crucial and beneficial.

References:

- Digital design morris mano.
- Blood Type Compatibility | Memorial Blood Centers (mbc.org)
- Blood compatibility testing - Wikipedia