Inspiring Excellence

Department of Electrical & Electronic Engineering

EEE301 & EEE302

DIGITAL ELECTRONICS & DIGITAL ELECTRONICS LABORATORY

PROJECT REPORT

SEMESTER: *Spring 2021*

SECTION: *01*

PREPARED BY:

GROUP*#11*

Group members:

Sl.	***Name***	***ID***	***Email & Phone no.***
1.	*Lazib Sharar Shaiok*	*19121141*	*lazib.sharar.shaiok@g.bracu.ac.bd/ 01676339558*
2.	*Anika Bushra Soha*	*19121139*	*anika.bushra.soha@g.bracu.ac.bd /01740501182*
3.	*Aanika Tabassum*	*19121145*	*aanika.tabassum@g.bracu.ac.bd /01711260742*
4.	*Fariha Nowrin*	*19121144*	*fariha.nowrin@g.bracu.ac.bd /01843923292*

Date of submission:Monday May 17th, 2021

PROJECT TITE

VENDING MACHINE

PROBLEM STATEMENT

Everyday products are marked up in price due to high overhead costs,(labour,electricity and space) and are not available round the clock. Our vending machine will aim to tackle these problems.

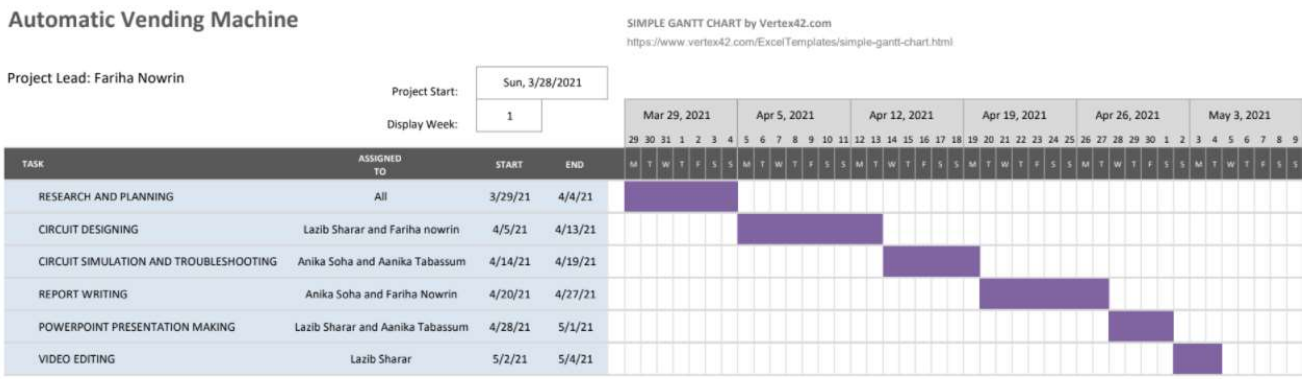
OBJECTIVES

A vending machine core objective is to store dried food,beverages and everyday products and dispense them once the appropriate amount of money has been inserted. It also needs to give back changes if the amount of money is more than the price of the product or give the back the entire sum of money if it is insufficient.

We will try to implement the following features in the vending machine we are designing :

- Vend products at 3 different price points
- Accept 2 kind of coins/notes
- If the amount of money inserted is more than the price of the product, the vending machine will give change back
- Displaying the amount of money inputted
- Display change to be given
- One coin/note can be entered at one time
- Self-starting with the initial coin
- Will display using LED if purchase is successful (GREEN) or unsuccessful (RED)
- If insufficient money is inserted then the vending machine will return the inserted money back as change.

GANTT CHART



DESIGN SPECIFICATION

This vending machine accepts coin/notes of 5tk and 10tk and dispenses goods/ products costing 5tk, 10tk or 15tk and /or money change.

USER INPUT:

- 5tk coin
- 10 tk note

In addition to these user inputs, the machine has one control input for each of the sub- circuit

- CLOCK : a timing signal that determines when and how the Memory elements change their outputs

This machine has three outputs:

- MONEY IN : shows the amount of inserted in the machine
- PURCHASE : the green LED lights up if the transaction is successful or else the red LED lights to show that the purchase was unsuccessful.
- CHANGE: the amount of money that will be returned in change.

LCDs:

- 2 digital 7 - segment LCDS shows the money inputted in the machine
- 2 digital 7 - segment LCDs show the money to be returned as change.

REQUIREMENTS

EQUIPMENT LIST

- 7 Segment Common Cathode Display
- Dual D-Type Flip flop (with Set and Reset)
- Inverter
- Two Input and Three input AND Gate
- Two Input and Three input OR Gate
- Green and Red LED
- Logic Probe
- Logic Toggle
- D-Clock
- Button

[All of these Equipments were picked from the library of PROTEUS 7.7 Professional

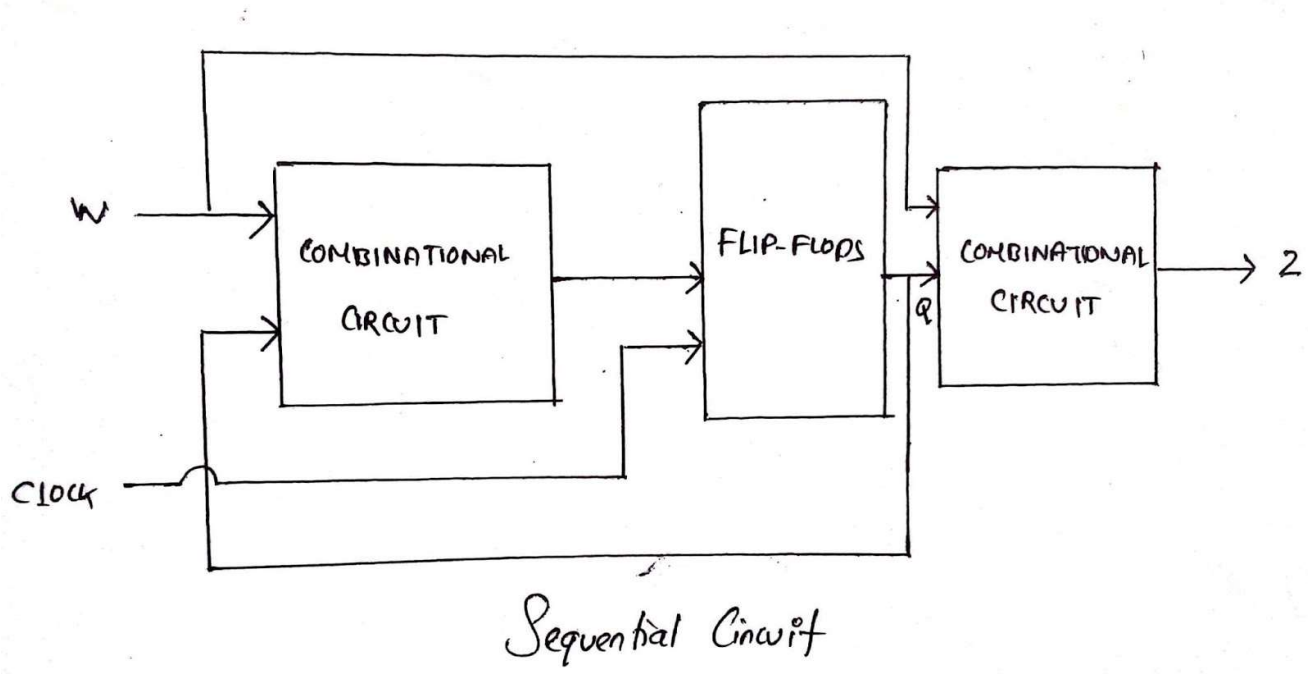
Some equipments were taken of different variety.]

SOFTWARE

- Proteus 7.7 Professional

METHODOLOGY

To implement the vending machine we designed a sequential circuit whose output depends not only on the present value of the input signals but also on the past input variables. A sequential circuit consists of combinational circuits connected to memory elements. Here we designed the combinational circuits using basic AND, OR and NOT gates and used D Flip-Flops as Memory element.

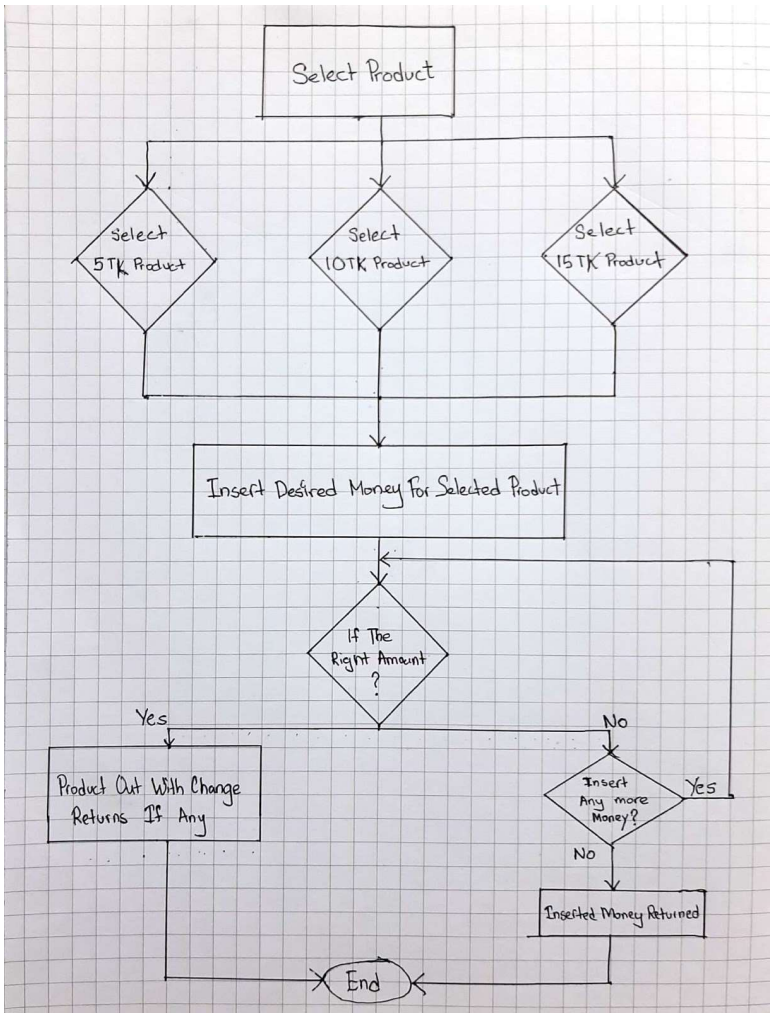


This vending machine is an example of a Finite State Machine in that it consists of a finite number of states and based on the current state and given inputs, it performs state transitions and produces outputs. Here we implemented the Mealy state machine since the output depends on both the current state and the current input.

We started by assigning values to the states and then formed the state diagrams for each price point. From the state diagrams, we obtained the state table and state

assigned table. Then, using K-maps we obtained expressions for inputs Y1 and Y2 and outputs C1, C2 and Z (using SOP and POS implementation).

SYSTEM DESIGN FLOW



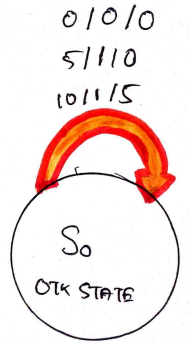
Price Points: 5tk, 10tk, and 15tk
Money to be accepted: 5tk and 10tk
State assigned:

So = 00	0tk = 00
S1 = 01	5tk = 01
S2 = 10	10tk = 10
X = 11	X = 11

[Legend : Money In / Purchase / Change]

FOR 5TK PRICE POINT

STATE FLOW DIAGRAM



STATE TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	**01**	**10**	**11**	**00**	**01**	**10**	**11**	**00**	**01**	**10**	**11**
S_0	S_0	S_0	S_0	X	0	1	1	X	00	00	01	X

STATE ASSIGNED TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	**01**	**10**	**11**	**00**	**01**	**10**	**11**	**00**	**01**	**10**	**11**
00	00	00	00	X	0	1	1	X	00	00	01	X
01	X	X	X	X	X	X	X	X	X	X	X	X

10	X	X	X	X	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X	X	X	X	X

Kmaps

For Y2

	00	**01**	**11**	**10**
00	0	0	X	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

Y2= y2

For Y1

	00	**01**	**11**	**10**
00	0	0	X	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

Y1= y2

For C1

	00	**01**	**11**	**10**
00	0	0	X	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

C1= w1

For C2

	00	**01**	**11**	**10**
00	0	0	X	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

C2= y2

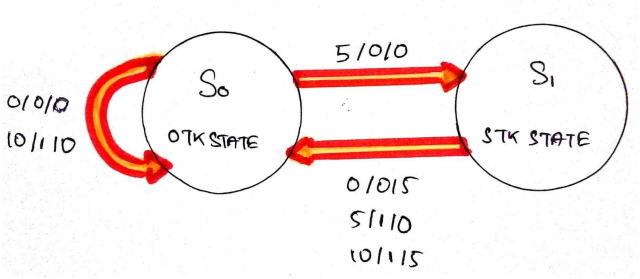
For Z

	00	**01**	**11**	**10**
00	0	1	X	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

Z1=w1+w2

FOR 10TK PRICE POINT

STATE FLOW DIAGRAM



STATE TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	**01**	**10**	**11**	**00**	**01**	**10**	**11**	**00**	**01**	**10**	**11**
S_0	S_0	S_1	S_0	X	0	0	1	X	00	00	00	X
S_1	S_0	S_0	S_0	X	0	1	1	X	01	00	01	X

STATE ASSIGNED TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	**01**	**10**	**11**	**00**	**01**	**10**	**11**	**00**	**01**	**10**	**11**
00	00	01	00	X	0	0	1	X	00	00	00	X
01	00	00	00	X	0	1	1	X	01	00	01	X
10	X	X	X	X	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X	X	X	X	X

Kmaps

For Y2

	00	01	11	10
00	0	0	X	0
01	0	0	X	0
11	X	X	X	X
10	X	X	X	X

For Y1

	00	01	11	10
00	0	1	X	0
01	0	0	X	0
11	X	X	X	X
10	X	X	X	X

Y2= y2

Y1= y1′ w1

For C1

	00	01	11	10
00	0	0	X	0
01	1	0	X	1
11	X	X	X	X
10	X	X	X	X

For C2

	00	01	11	10
00	0	0	X	0
01	0	0	X	0
11	X	X	X	X
10	X	X	X	X

C1= y1w1′

C2= y2

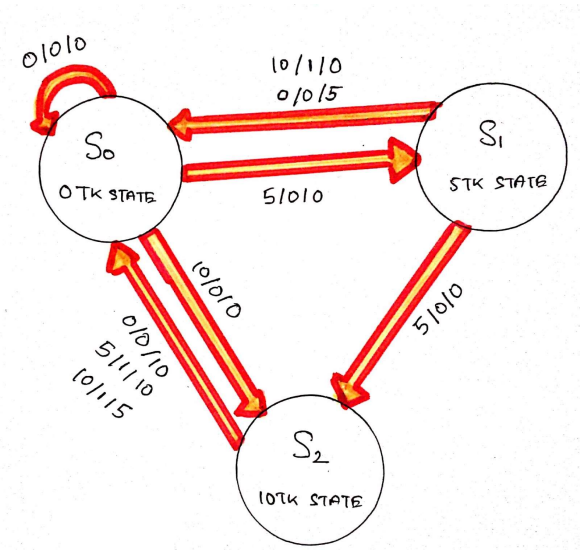
For Z

	00	01	11	10
00	0	0	X	1
01	0	1	X	1
11	X	X	X	X
10	X	X	X	X

Z= w2 + y1w1

FOR 15TK PRICE POINT

STATE FLOW DIAGRAM



STATE TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	**01**	**10**	**11**	**00**	**01**	**10**	**11**	**00**	**01**	**10**	**11**
S_0	S_0	S_1	S_2	X	0	0	0	X	00	00	00	X
S_1	S_0	S_2	S_0	X	0	0	1	X	01	00	00	X
S_2	S_0	S_0	S_0	X	0	1	1	X	10	00	01	X

STATE ASSIGNED TABLE

Present State	Next State (Y2Y1)	Output	
(y2y1)	***(w2w1)***	***Z (w2w1)***	***C2C1 (w2w1)***

	00	01	10	11	00	01	10	11	00	01	10	11
00	00	01	10	X	0	0	0	X	00	00	00	X
01	00	10	00	X	0	0	1	X	01	00	00	X
10	00	00	00	X	0	1	1	X	10	00	01	X
11	X	X	X	X	X	X	X	X	X	X	X	X

Kmaps

For Y2

	00	01	11	10
00	0	0	X	1
01	0	1	X	0
11	X	X	X	X
10	0	0	X	0

For Y1

	00	01	11	10
00	0	1	X	0
01	0	0	X	0
11	X	X	X	X
10	0	0	X	0

Y2=y2′y1′w2 + y1w1

Y1=y2′y1′w1

For C1

	00	01	11	10
00	0	0	X	0
01	1	0	X	0
11	X	X	X	X
10	0	0	X	1

For C2

	00	01	11	10
00	0	0	X	0
01	0	0	X	0
11	X	X	X	X
10	1	0	X	0

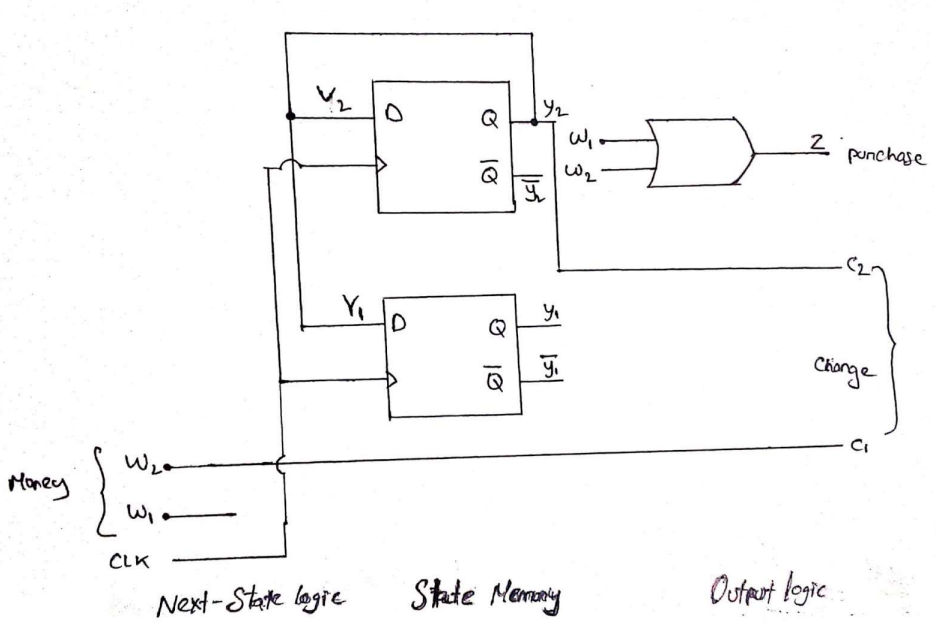
For Z

	00	01	11	10
00	0	0	X	0
01	0	0	X	1
11	X	X	X	X
10	0	1	X	1

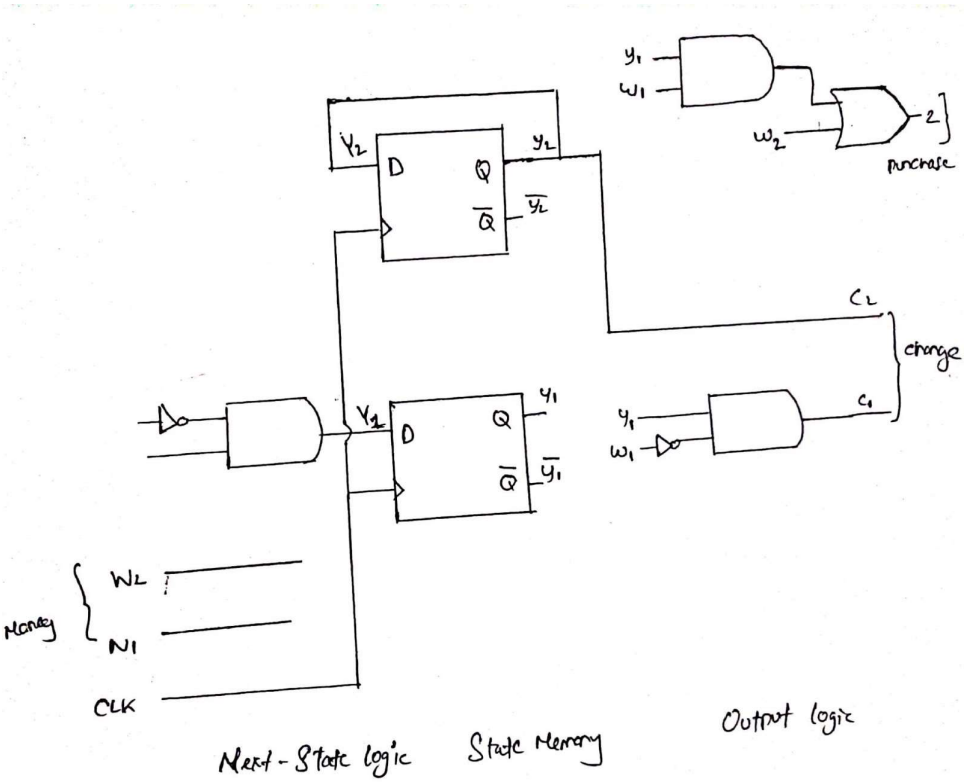
Z=y1w2 + y2w1 + y2w2

Using the expressions obtained from the K maps, the following circuits were designed for each price point. Also, along with the combinational circuit, 2 D Flip-Flops are used for each circuit as a Memory element.

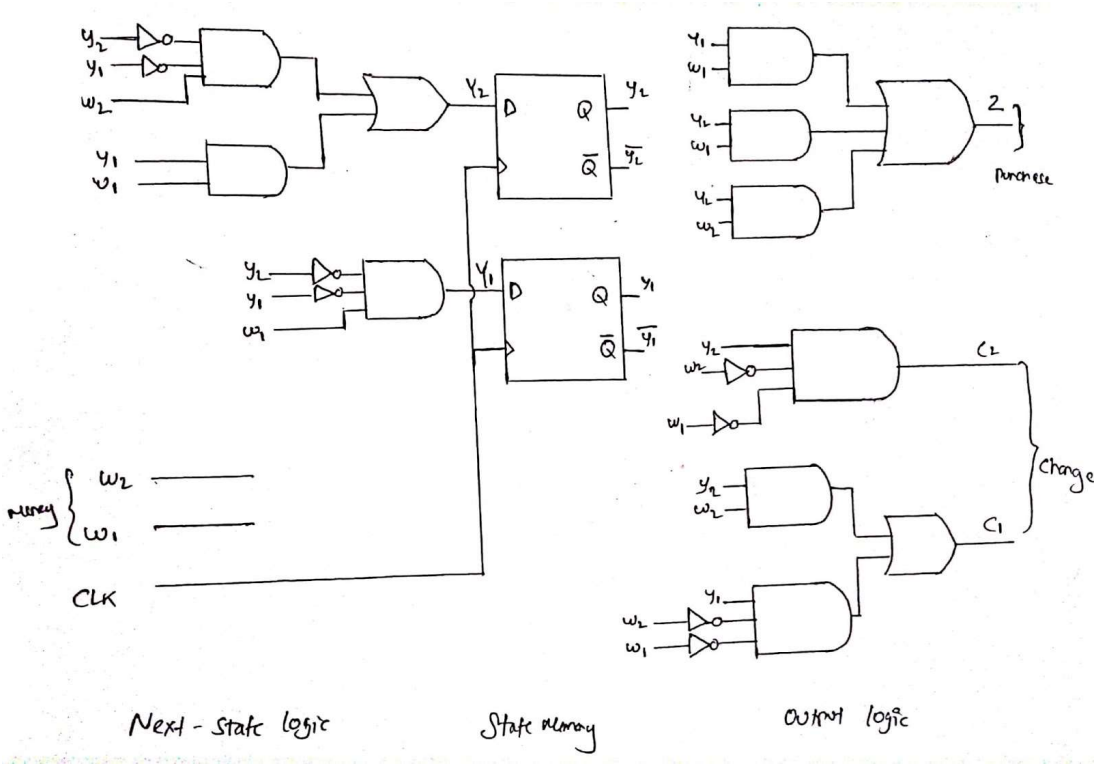
5tk price point



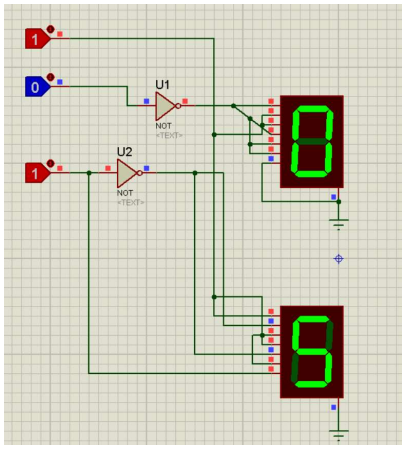
10tk price point



15tk price point



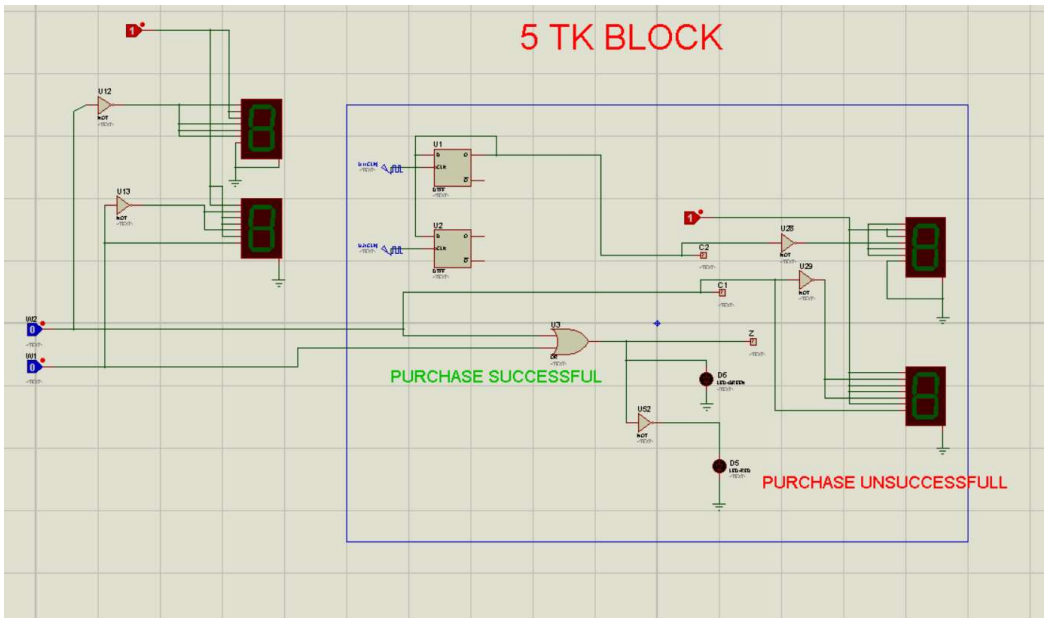
Circuit for money input and change:



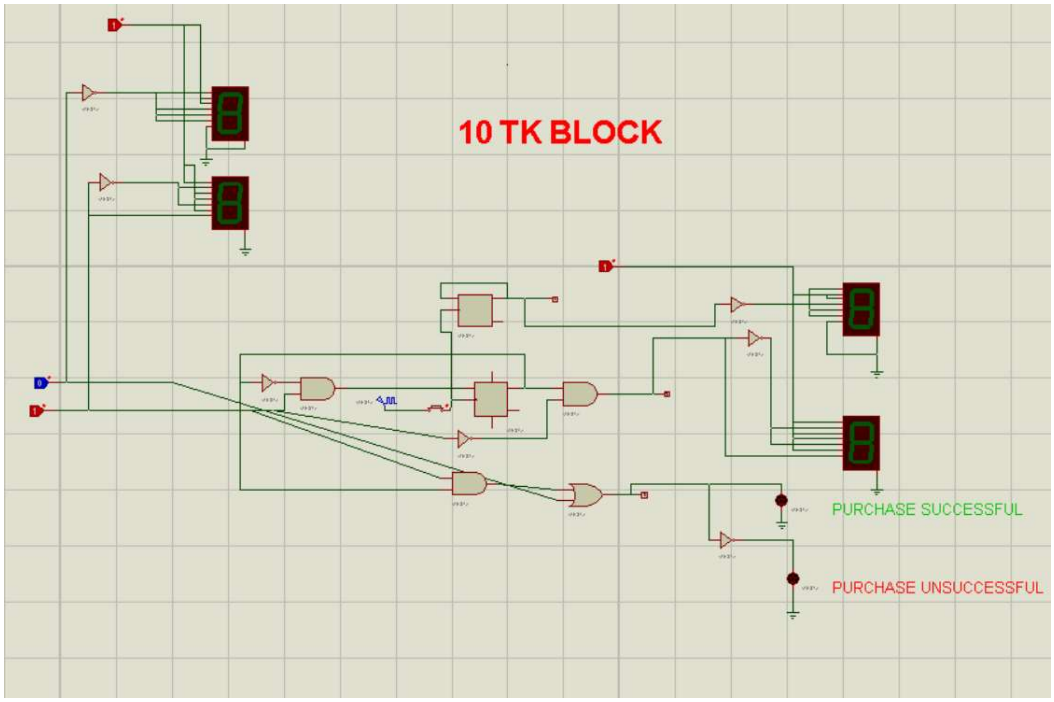
RESULT AND DISCUSSION

The obtained circuits are then implemented in the Proteus Software.

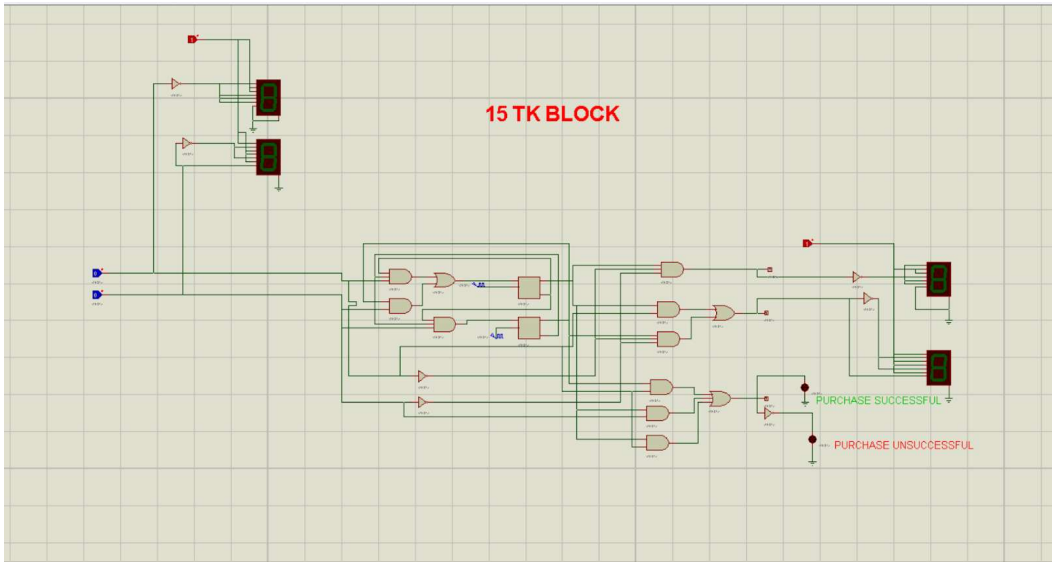
CIRCUIT FOR 5TK PRICE POINT



CIRCUIT FOR 10TK PRICE POINT



CIRCUIT FOR 15TK PRICE POINT



Discussion and Results: In this project we utilized sequential circuit's various utilities. A Sequential circuit comprises of combinational logic and memory element. We used D flip flops as the memory element because it gives the same output as the input in each positive edge clock cycle. This is very useful when dealing with a machine whose primary goal is to juggle money.

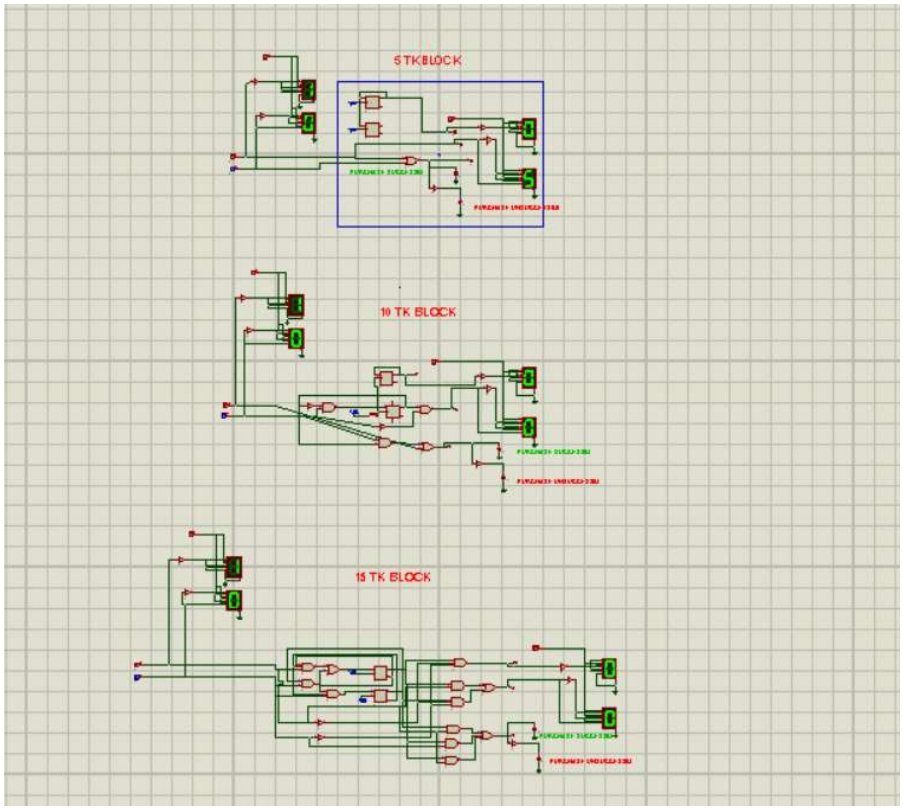
An issue that we ran into whilst simulating is that if the clock frequency is too large then the Circuit resets so fast that the displays and LEDs do not show any change.

Hence we used 0.25Hz as the clock cycle.This will give the user of the vending 4 seconds to i insert his money in the second slot before the vending machine resets and returns back the money which he inserted in the first slot.

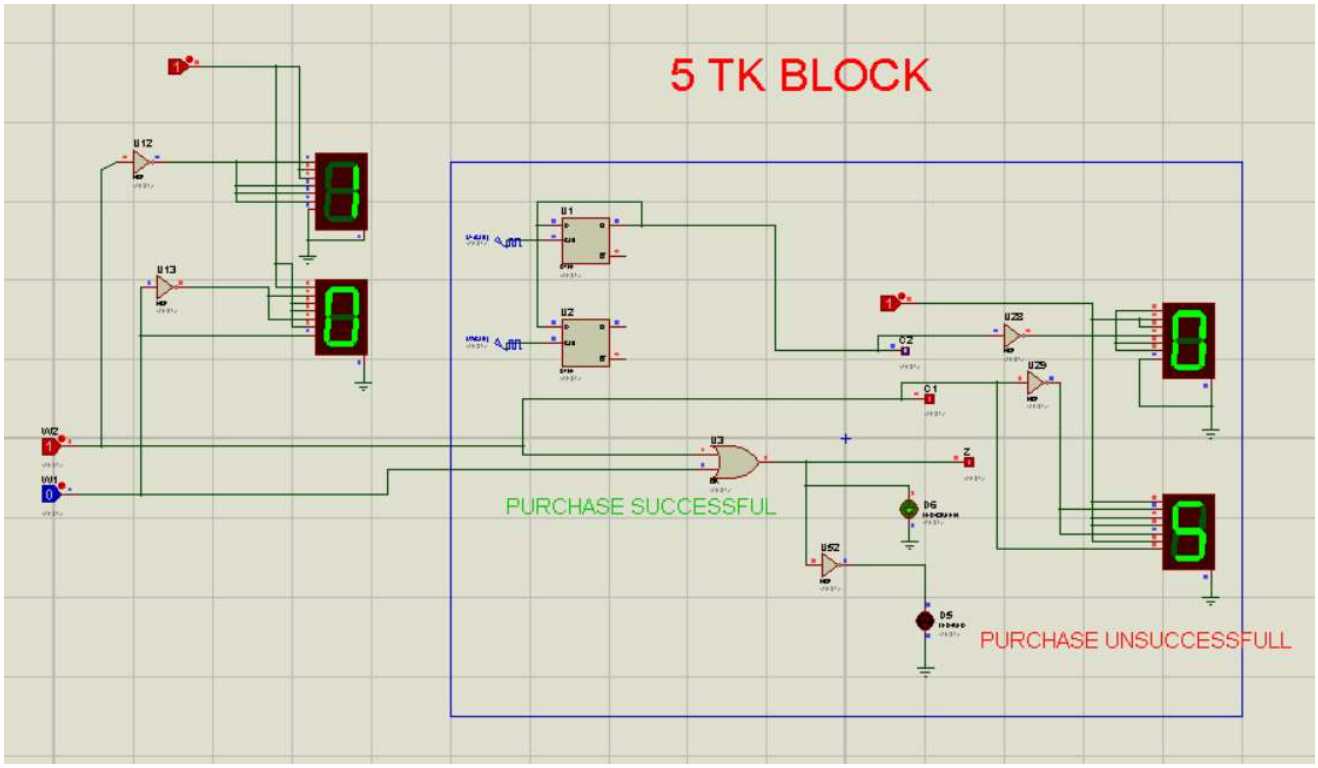
Other than that, our circuit behaves in exactly the way we want it to. Vending products at Expected conditions and returning apt changes. Also returning money if sufficient has not Inserted in 4 secs.

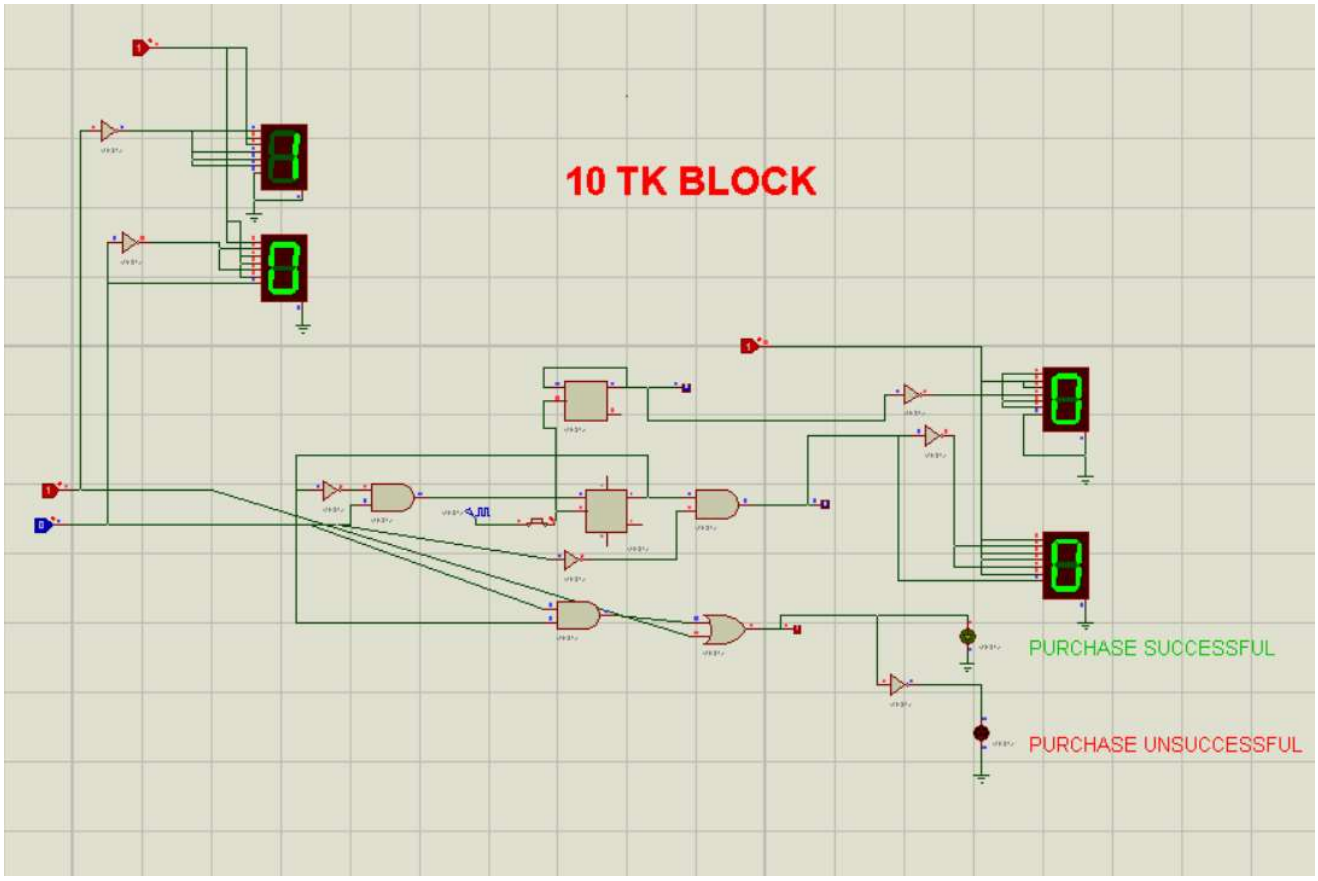
PROJECT VALIDATION

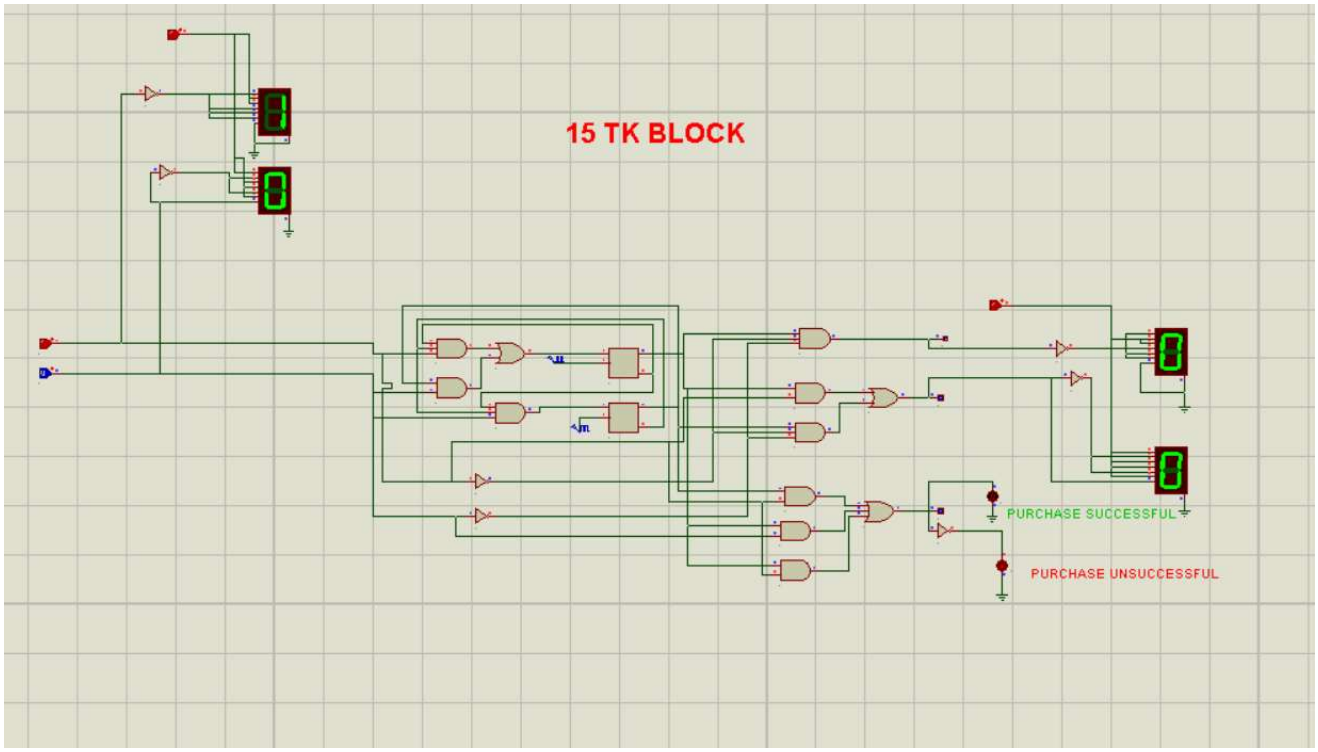
From the vending machine we have designed we have achieved all the objectives of designing it. Our vending machine vends products at 3 different prices. The prices are : 5tk, 10tk and 15tk.



It accepts 2 kinds of coins or notes. If the amount of money inserted is more than the price of the product, the vending machine will give change back

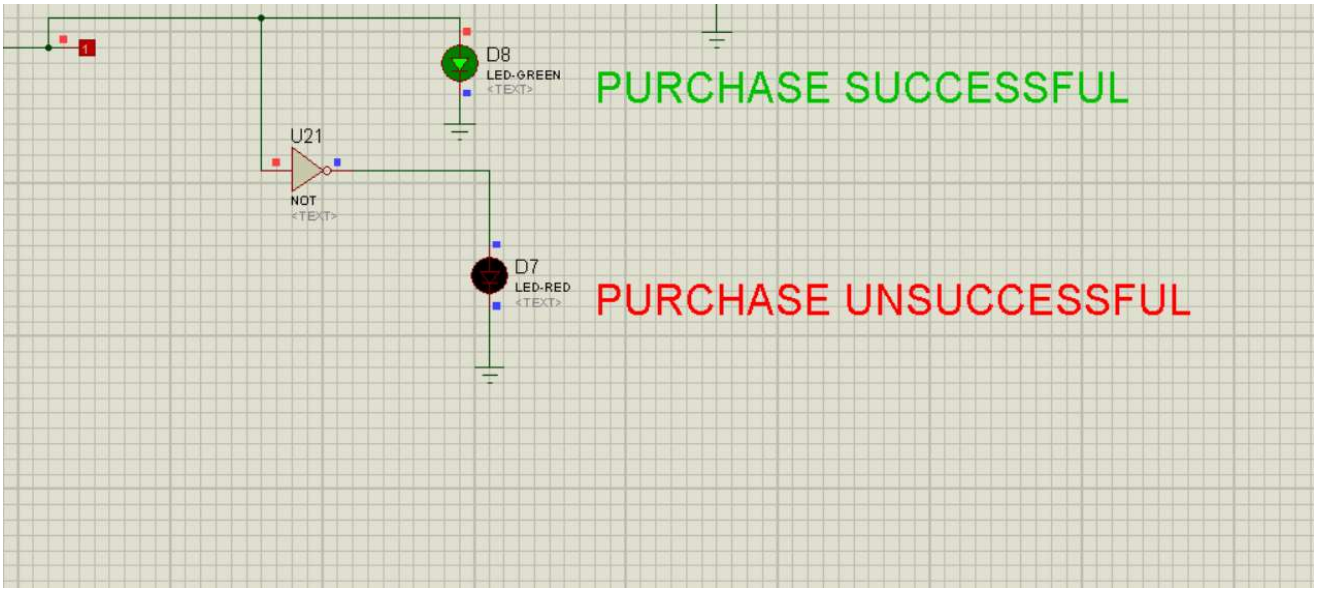






From our circuit diagrams, we can see that for **5 tk** block if we input **5 tk**, the purchase will be **successful** but the amount of change will be **zero.** And if we input **10 tk** one **purchase will**

take place and there will be a change of **5 tk.** For **10 tk** block if we give an input of **10tk** one **purchase will occur** but there will **not be any change.**Similarly for **15tk** block if we give an input of **5tk or 10 tk no purchase will occur**, it will **give the money back** to the consumer. In this case if we give 10 taka input then 5 taka there will be a successful purchase with no change and if we give 10tk input ,then again a 10 tk, there will be a successful purchase with 5 tk change.



In our objectives we wanted to display whether the purchase is successful or not and the amount of change. Here from the circuit diagram given above, we can see that by using GREEN and RED LED we have displayed if the purchase is successful or not.We have also displayed the amount of change.

IMPACT

In this technologically advancing world the vending machine is an important device.It has some huge impacts in terms of societal, health, safety,legal and cultural context.In terms of societal context, vending machines are making people's life easier since purchasing products from vending machines is very easy and it also saves a lot of time.Buying materials from shops can be very time consuming sometimes whereas one can easily purchase anything he needs within a minute by using vending machine.Since, it is one-time installation and one needs no staff to start a vending machine business, it is creating a large market for food vendors. Also, since the installation process is easier and it does nor require a huge space to set up a vending machine, in any places from schools, workplaces to remote areas where shops are hardly available vending machines can be easily used to meet the needs of the customers.

Vending machines make easier access to food in any part of the world.

Using vending machines is safer than going to shops specially during Covid since we do not need any human interaction while purchasing products from vending machines and

maintaining a queue is also easier. Also, the payment procedure is very easy and the possibility of mistakes is near to zero.
Before installing a vending machine in any particular area, one needs legal permission and one has to ensure that the products on the machine have no harmful contents.
Vending machines have a great impact on cultural activities too.Vending machines are helping the society to become modern and to keep pace with the prograssive world.In many developed countries, we have seen the use of vending machines in highways, schools, hospitals, workplaces and so on.One can get their desired products like foods, coffee, beverages, medicines etc according to the food habits, needs and culture of the area.

CONCLUSION AND FUTURE WORK

Vending machine is a very useful device in this automated technological world. In developed countries we have often seen the use of vending machines for various purposes. From workplaces to deserted areas a vending machine can be used anywhere. The prime advantage of using a vending machine is that it is functioned to operate automatically without any need of staff. So, in remote areas with less shops, if we use vending machines, people can easily purchase necessary products at any time.

Currently there are also some disadvantages of using vending machines.For example, the administrational cost of vending machines are high. Although vending machines are one-time investment, it is a costly investment.Besides,Some investors have faced a great loss due to destruction of the machine or the faulty programming such as the continuous dispensing of product due to the technical errors.To reduce these problems, in future we can develop the programmings of vending machines to avoid any kind of fault.Moreover, different apps are being created for finding out the closest vending machine in any particular area.People can also comment on these apps mentioning what products the want or if they have faced any problem while purchasing products.

REFERENCE

- https://www.selecta.co.uk/news/benefits-of-vending-machines/?fbclid=IwAR0b9cfsf-UaR1Dxf8nMxZjzmnkAS48NxCSIEBDkWLuUktu6DQos8nBisqQ
- https://www.online-sciences.com/technology/automatic-vending-machines-advantages-and-disadvantages/?fbclid=IwAR2q1srlDrXfyWCqm1RyIvc-jGqqEHByX5tDtomey86GogXnxz6RGMYYrZk

- https://l.facebook.com/l.php?u=https%3A%2F%2Fwww.trendtablet.com%2F9226-the-future-of-vending-machine%2F%3Ffbclid%3DIwAR1vGw-PylTt4RsBZ0lcFcOs1LNreBg9Tt7C81jSvFKAvfTT0L60F5TUrKk&h=AT1VOvSgPa5dXmAHRlJUtmhv_0fSC7GI8mdrlKp_NMSvsoxCGmteLabTxvlZEICfxhOUOxYLyoVCyMMic8i1AkuXam6xxx5RbxbB_OMveB4AOM4AVcF0d3YokdL40GSkoiWTRw
- https://www.youtube.com/watch?v=KHanq9mriJI

Advantages:

There are so many advantages of using vending machine. Vending machines are a one-time investment. They require no staff, which means no extra wages to pay. Besides, Vending machines are easy to manage since a vending machine needs little to no maintenance. Also, the payment procedure is very easy and possibility of mistakes is zero. Using vending machine also saves a lot of time. Buying materials from shops can be very time consuming sometimes whereas one can easily purchase anything he needs within a minute by using vending machine.

Disadvantages :

One of the disadvantages of vending machine is the administrational cost of vending machine can be high. Although vending machine is a one-time investment, it is a costly investment. It requires a good amount of money to set up a vending machine business.

Some investors have faced a great loss due to destruction of the machine or the faulty programming such as the continuous dispensing of product due to the technical errors.

Another disadvantage is the competitive market. Since, nowadays many food vendors are preferring vending machine, there are many competitors in this business. So one need to know which place would be suitable, selling which products would be profitable and who would be the competitors before staring a vending machine business.

Impact :

Vending machine is a very useful device in this automated technological world. In developed countries we have often seen the use of vending machines for various purposes. From workplaces to desert areas a vending machine can be used anywhere. The prime advantage of using vending machine is that it is functioned to operate automatically without any need of staff. So, in remote areas with less shops if we use vending machine, people can easily purchase necessary products at any time.

Besides, during this current pandemic, using vending machine can be very useful to reduce covid-19 from spreading since using vending machine does not need any human interaction.