**Project Title:**

Drink Station (Drink distribution machine for Brac University Permanent Campus).

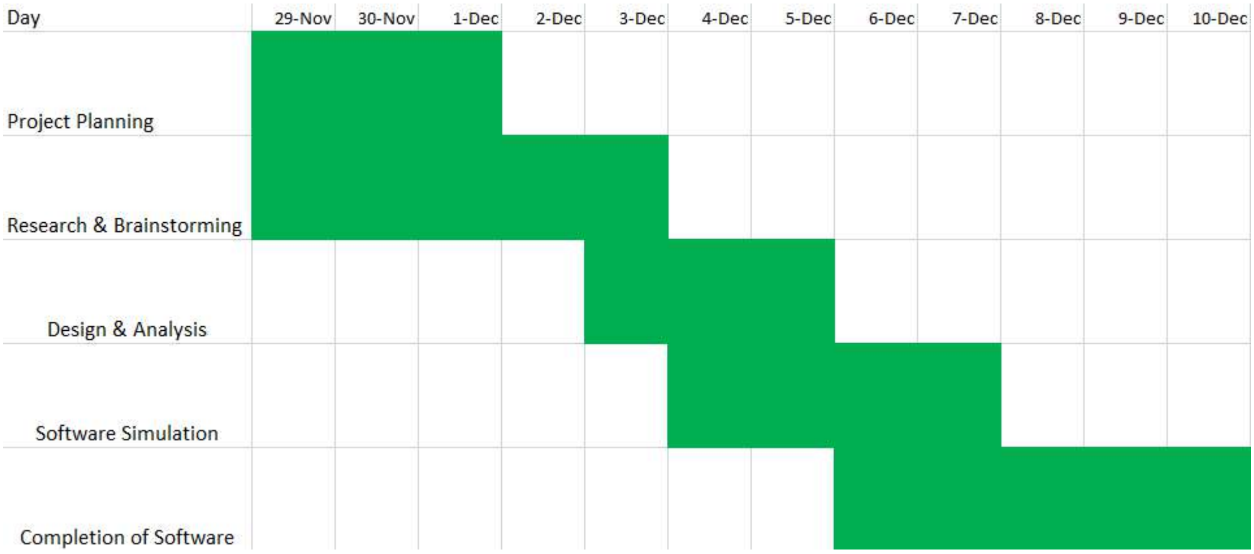
**Problem Statement:**

University life can be draining, with students enduring long study sessions. Tea and coffee are great for refreshment, but getting them at any hour can be a challenge. Some places on campus don't even have cafeterias, making it hard for students to grab drinks when they need a boost. That's where a drink vending machine can come in handy, solving the accessibility issue. Therefore, we aim to design a drink vending machine to tackle these problems.

**Objective**

The goal of our project is to make a drink machine that is easy to use and quickly accessible to students to make their study sessions effective. Our engineering objective is to develop a low-cost, efficient, and low-maintenance drinking machine that would be easy to use, and easy to build. There will be a drink machine on every floor. It will be convenient for students who do not have time to go to a cafe between classes. Our drink machine allows students to choose their preferred drink (between tea & coffee). Students will be able to provide multiple notes as payment options and there will be certain feedback from our drink machine. If students give more than the required amount of the product they will get a change from the machine.

## Gantt Chart:




## Task division of group members

| ID | Name | Task |
|---|---|---|
| 21321007 | Farrdin Nowshad | Project Planning, Research and brainstorming, Design and Analysis, Software Simulation, Completion of Report. |
| 21310008 | Md Manjur | Project Planning, Research and brainstorming, Design and Analysis, Software Simulation, Completion of Report. |
| 21321047 | Anika Antara | Project Planning, Research and brainstorming, Completion of Report |
| 21221014 | Md Abu Yousuf | Project Planning, Research and brainstorming, Completion of Report |

| | | |
|---|---|---|
| 21221026 | Anurag Saha | Project Planning, Research and brainstorming, Completion of Report |

SPECIFICATIONS & TECHNICAL ASPECTS

**SPECIFICATION:**

This vending machine designed by us basically follows the principle that first we have to select the product and then have to put the money
If the money is more than necessary then it'll give the money back.
And if the money is less than the required amount then it won't provide tea/coffee

**Requirements:**

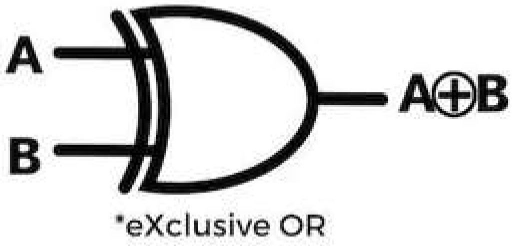
1. Display
2. Money case
3. Buttons to operate

**Specification and Requirements:**

● 3-Input NOR gate
● 4-bit Adder (74283)
● 4-bit Comparator (7485)
● NAND Gate
● NOT Gate
AND Gate
OR Gate

**Component Description**

**XOR Gate**

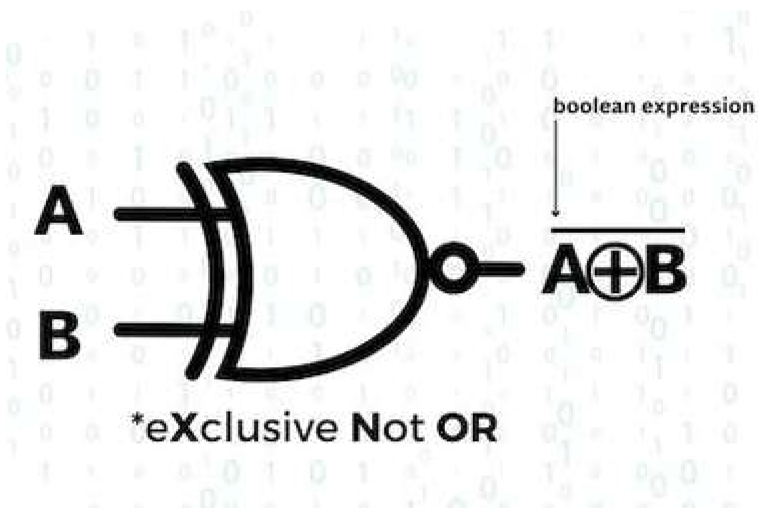



2 input XOR gate

| A | B | A⊕B |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

The XOR gate, short for Exclusive OR gate, is a digital logic gate that produces an output (usually represented as '1' or 'high') only when an odd number of its input signals are '1'. In other words, the output is '1' if the number of true inputs is odd. If the number of true inputs is even, the output is '0' (or 'low'). The XOR gate is symbolized by ⊕ or sometimes by the letters XOR. It is a fundamental building block in digital circuit design and is commonly used in various applications, including arithmetic operations and error detection.

**<u>XNOR Gate</u>**

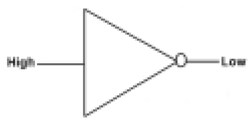


**2 input XNOR gate**

| A | B | $\overline{A \oplus B}$ |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

An XNOR gate, also known as an equivalence gate, is a digital logic gate that outputs true (1) only when an even number of true inputs are present. In other words, it produces a true output when the number of true inputs is an even number and a false (0) output when the number of true inputs is odd. The XNOR gate is often symbolized by ⊕ with a horizontal line above it or by using the traditional symbol of an XOR gate followed by a NOT gate. It is a fundamental building block in digital circuitry and is widely used in various electronic applications, including binary addition and comparator circuits.

**NOT Gate**



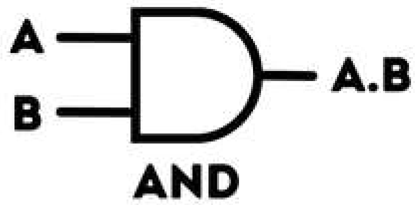

| Input | Output |
|---|---|
| 0 | 1 |
| 1 | 0 |

A NOT gate, also known as an inverter, is a basic digital logic gate that performs the logical NOT operation on its input signal. The NOT operation simply negates or reverses the input signal. If the input is high , the output is low , and vice versa.

**AND Gate**

An AND gate has two or more input terminals. The inputs are binary, meaning they can only have two possible states: 0 (logic low) or 1 (logic high).

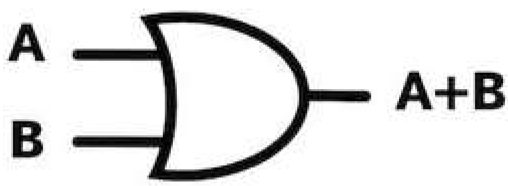
The AND gate has one output terminal. The output is high (1) only when all of its inputs are high (1). If any of the inputs are low (0), the output is low (0).




| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

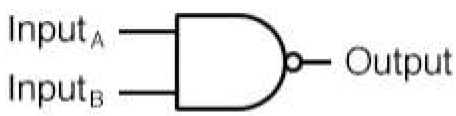
**OR Gate:**

An OR gate has two or more input terminals. Like AND gates, the inputs are binary and can only be in one of two states: 0 (logic low) or 1 (logic high).
The OR gate has one output terminal. The output is high (1) if at least one of its inputs is high (1). The output is low (0) only when all inputs are low (0).



| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

**NAND Gate**




A two-input NAND gate is a fundamental digital logic gate that performs the logical NAND operation on two input signals. The NAND operation (NOT-AND) returns a low output only when both of its inputs are high.

Truth table:
The truth table for a 2-input AND gate is as follows:

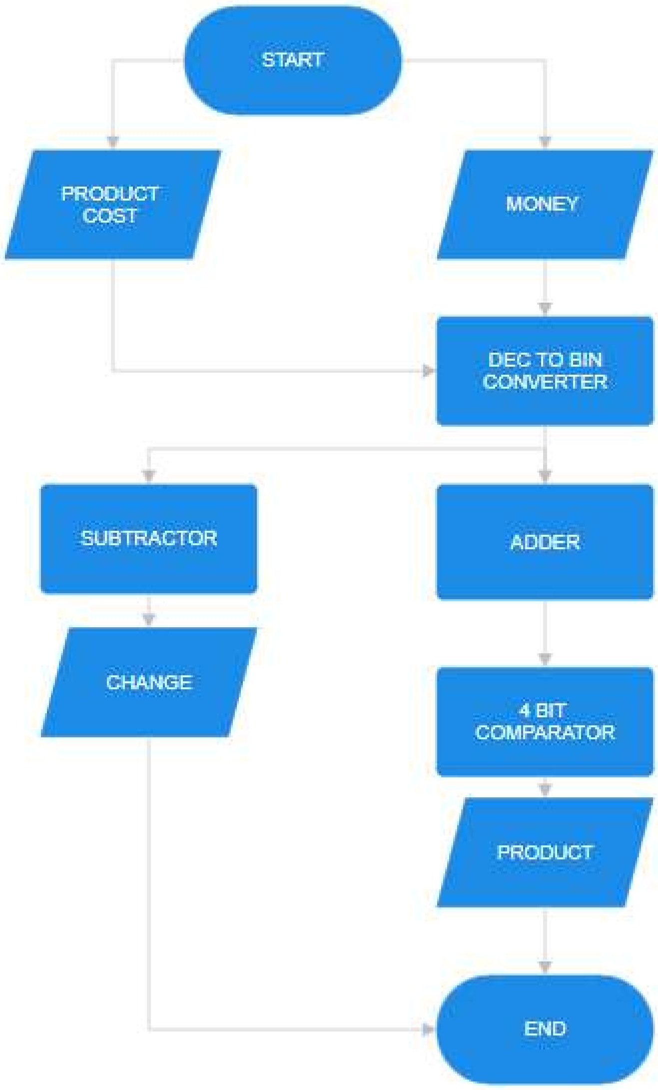
| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

This table shows the output Y for all possible input combinations of A and B

**Methodology:**

The initial task was to select a design concept for a Drink Machine. Numerous options were available, spanning from one constructed with fundamental gates to another utilizing a mix of microcontrollers and microprocessors. The chosen finite state machine would be intricate, incorporating combinational circuits, sequential circuits, and timing elements.

To fulfill user requirements, the user input must adhere to the outlined process below:




Here, product cost and money are input. A binary converter is a decimal to 4-bit binary converter. Adders and Subtractors are 4-bit full adders and 4-bit subtractors respectively.

As we all know all digital logic circuits work based on the Binary logic, we have to convert everything to the Binary from the decimal. According to the flow chart given above firstly the user will input the money note ( in our case Bangladeshi taka note to the machine) and they will choose a product. The machine then converts the value of the note and product cost into a 4-bit binary value.

As our system can take multiple money note inputs and product inputs, to logically perform this task we have added a 4-bit full adder. It will be important to calculate the total amount inserted.

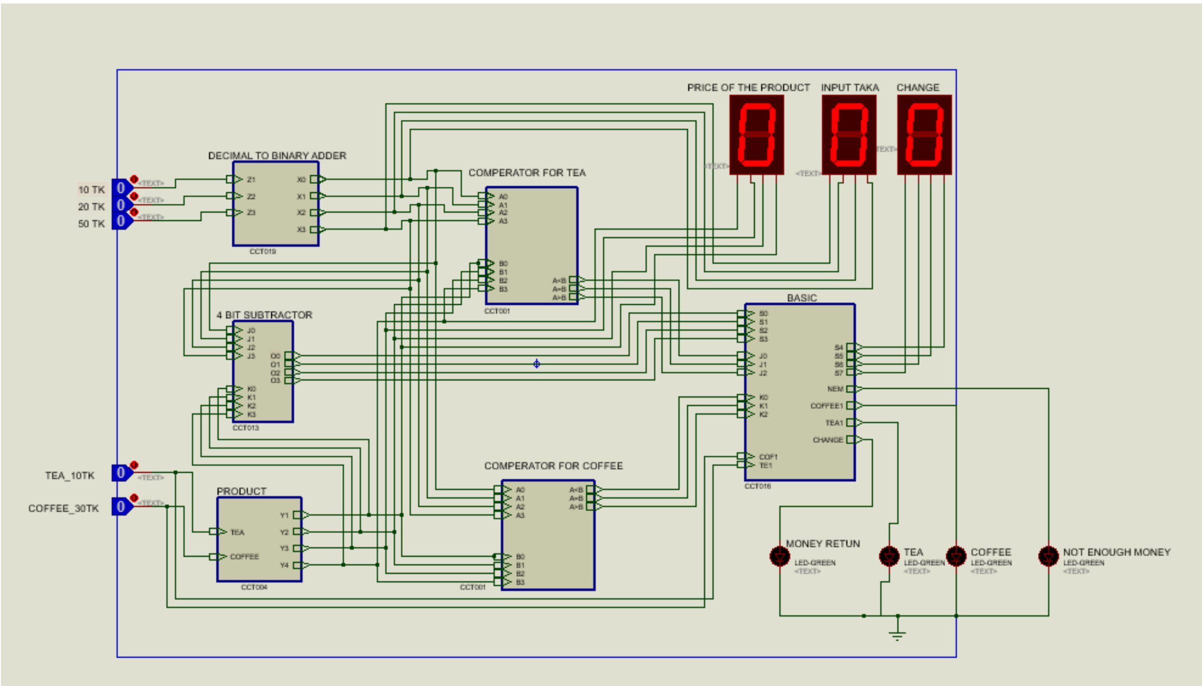
To calculate the money a user of the system will get as a change if he has inserted more money than the cost of the product, we have added a 4-bit subtractor in our system.

One will get a product if a user has inserted an amount similar to or more than the cost of the product. To apply this logically, we have implemented a 4-bit magnitude comparator. 7485 IC is a 4-bit magnitude comparator added to our system. It will compare the cost of the product and the inserted money amount to logically justify if the user is eligible to get the desired product that he wants.

**Results and Discussion:**

Our drink machine is performing perfectly. This machine can take 10, 20, and 50 taka notes. A customer can input a note or a maximum of 3 notes at a time. When a customer deposits money and orders his/her desired item as input, first of all, our machine will add the money given by the customer then it will start to compare with our product price. At the same time, the customer is allowed to see how much money he deposited, the product price and how much money he/she will get back as a change in the 7-segment display as x/10 ( here x=total amount of money the customer gives). If our product price is more than the amount of money the customer deposited, our machine will return the money and the customer will not be entertained with any sort of drink. On the other hand, if the price of our product is equal to or less than the amount of money the customer provided, he/she will get the product he/she wants and will get his/her due money back at the same time.

Our main Circuit:



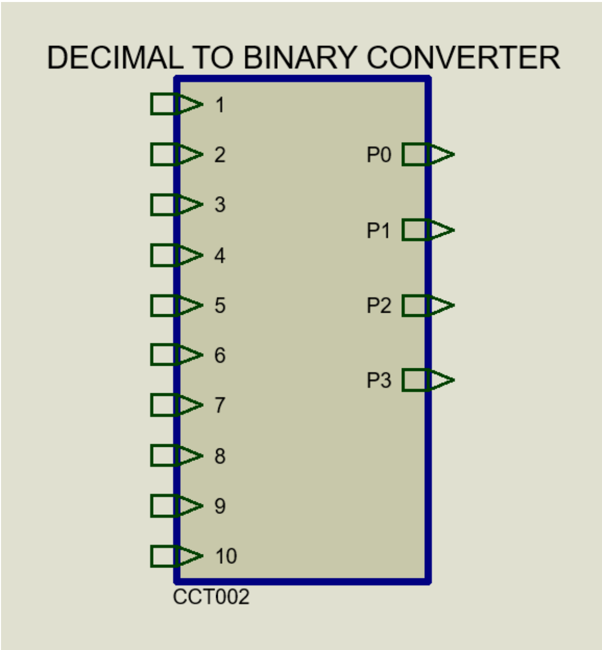
**Truth Table:**

| Input | | | | | Output | | | |
|---|---|---|---|---|---|---|---|---|
| 50tk | 20tk | 10tk | coffee | tea | NEM | tea | coffee | change |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |

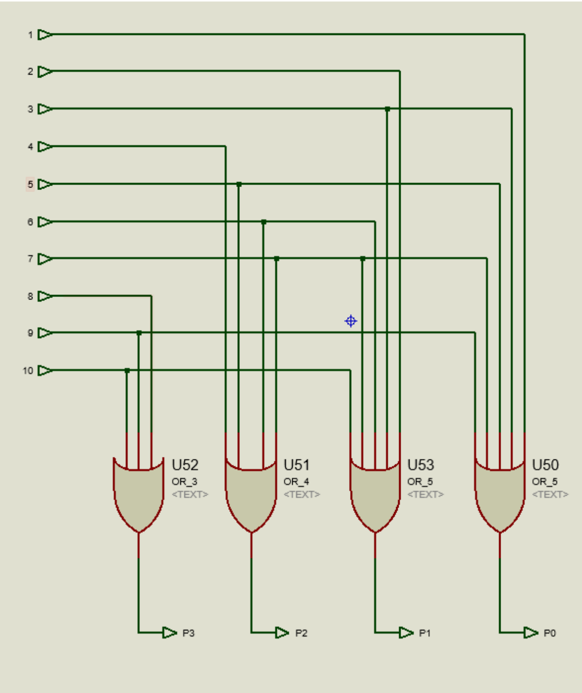
To achieve the desired output we have created a 4-bit full adder, 4-bit full subtractor, 4-bit comparator, decimal to binary converter.

**Decimal to Binary Conversion:**

As we all know all digital logic circuits work based on Binary logic, we have to convert everything to Binary from decimal. According to the flow chart given above firstly the user will input the money note, in our case Bangladeshi taka note to the machine. The machine then reads the value of the note and converts it into a 4-bit binary value. Our machine can only read 3 notes. They are 10, 20, and 50 taka notes. For simplicity, in our converter, we will recognize the 10 taka = 1, 20 taka = 2, 50 taka = 5. Our circuit then converts them into a 4-bit binary number. Similarly, it will also convert the product cost into a 4-bit binary value. Our decimal-to-binary decoders block diagram looks like this:



Child sheet:




**Decimal to Binary Conversion Truth table:**

| Decimal | A3 | A2 | A1 | A0 |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 |
| 6 | 0 | 1 | 1 | 0 |
| 7 | 0 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 |
| 9 | 1 | 0 | 0 | 1 |

Our decimal-to-binary converter follows this truth table to get the 4-bit binary number output.

**Binary Subtractor:** A 4-bit binary subtractor is a digital circuit designed to perform the subtraction of one 4-bit binary number from another.It operates by using a combination of XOR, AND, and OR gates. It typically consists of four full subtractor circuits, each capable of subtracting two bits along with a borrow-in from the previous stage. Similar to a binary adder, the subtractor produces a difference bit and a borrow-out bit for each stage. The borrow-out from each stage serves as the borrow-in for the subsequent stage, ensuring accurate subtraction of larger binary numbers. The 4-bit binary subtractor is a crucial component in digital electronics, employed in various applications where binary arithmetic and computation are required. It plays a key role in performing subtraction operations within binary computing systems and microprocessor architectures.

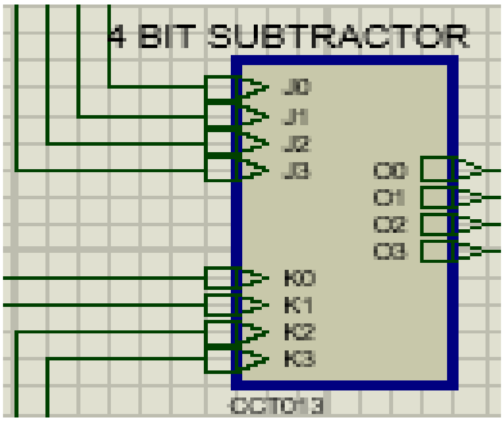
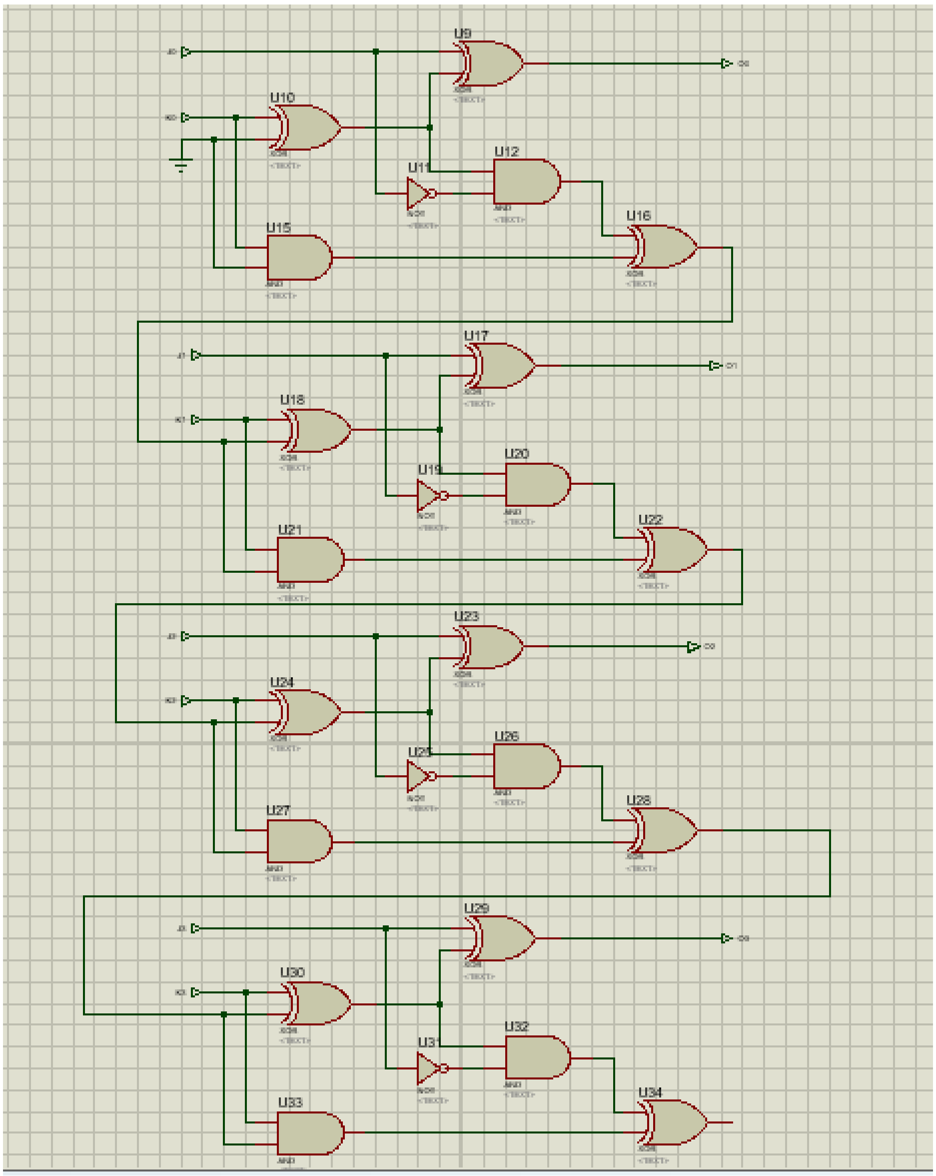



**Fig:** 4-bit subtractor

**Child sheet:**


U9
U10
U11
U12
U15
U16
U17
U18
U19
U20
U21
U22
U23
U24
U25
U26
U27
U28
U29
U30
U31
U32
U33
U34

Truth table of full Subtractors:

| Input | | | Output | |
|---|---|---|---|---|
| A | B | Bin | Value | Borrow |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

Value = A'B'Bin + A'B Bin' + AB'Bin' + AB Bin

= A'(B'Bin + BBin') +A (B'Bin' + B Bin)

= A'(B⊕Bin)+ A(B⊕Bin)'

=A⊕B⊕Bin

Borrow= A'B'Bin + A'B Bin' + A'B Bin + AB Bin

= A'B(Bin + Bin') +Cin(AB + A'B')

=A'B+Bin(A⊕B)

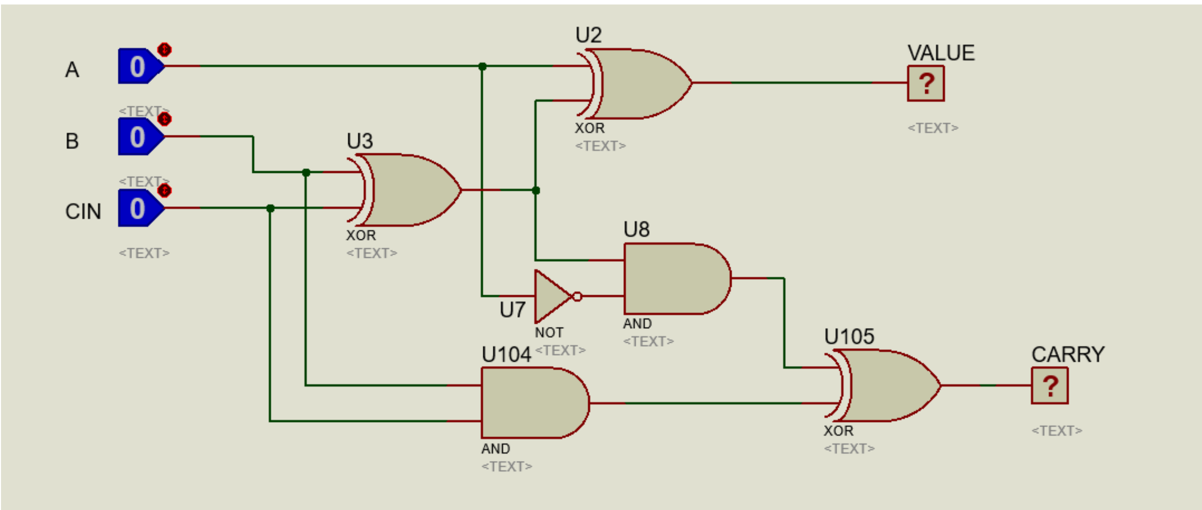



Fig: 1-bit subtractor.

**4-Bit Full Adder:**

A 4-bit binary adder is a digital circuit that performs the addition of two 4-bit binary numbers. It consists of four full adder circuits, each capable of adding two bits along with a carry-in from the previous stage. The adder produces a sum bit and a carry-out bit for each stage, facilitating the addition of binary numbers with multiple bits. The carry-out from each stage serves as the carry-in for the next stage, ensuring the accurate addition of larger binary numbers. The 4-bit binary adder is a fundamental building block in digital electronics and microprocessor design, contributing to various arithmetic operations in binary computing systems. We have made a 4-bit full adder by cascading 4 full adders. Each full adder circuit consists of XOR, OR, and And gates.

Truth table of a 1-bit full Adder:

| Input | | | Output | |
|---|---|---|---|---|
| A | B | Cin | Sum | Carry |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

Sum= A'B'Cin + A'BCin' + AB'Cin' + ABCin

= A'(B'Cin+BCin' ) + A (B'Cin' + BCin)

= A'(B⊕Cin)+ A(B⊕Cin)'

=A⊕B⊕Cin

Carry= A'BCin + AB'Cin + ABCin' + ABCin

=AB +Cin(A⊕B)

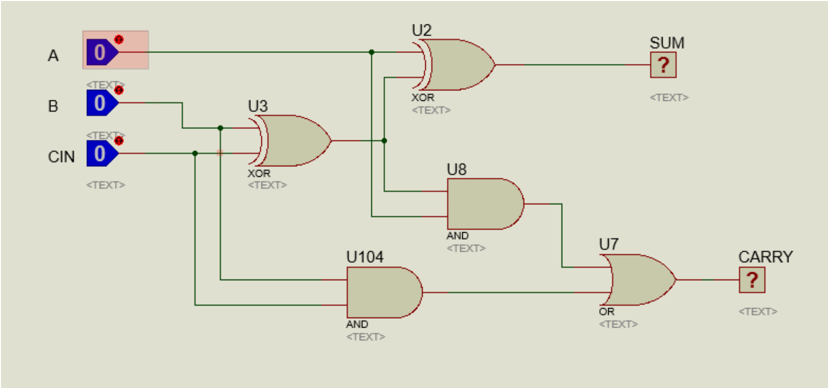



**Fig:** 1-bit full adder.

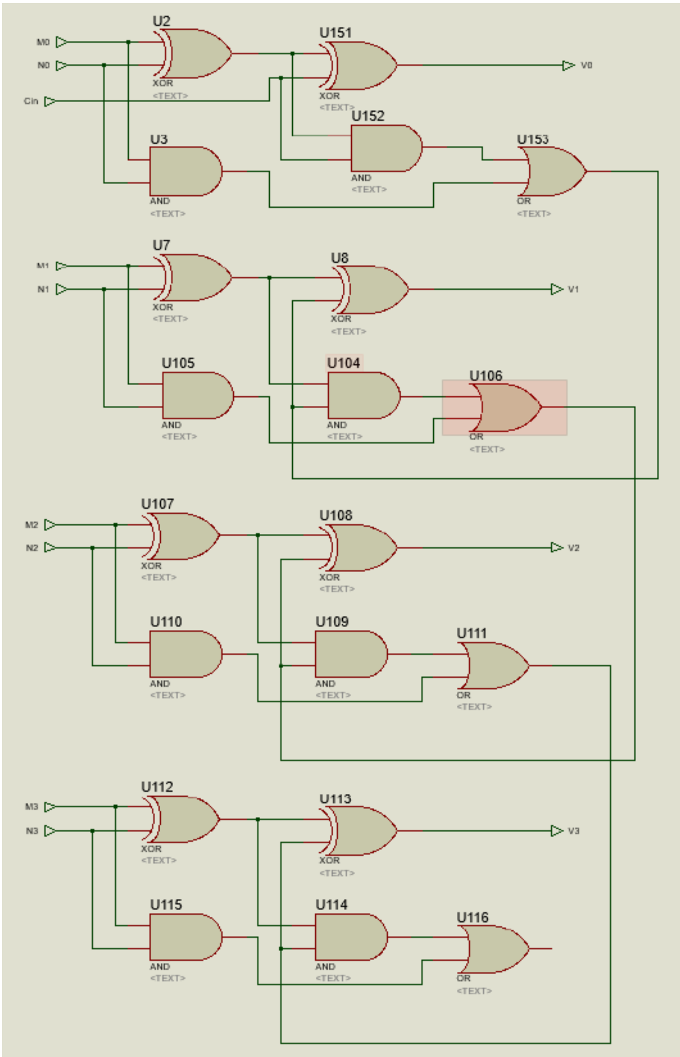



**Fig:** 4-bit binary full adder child sheet.

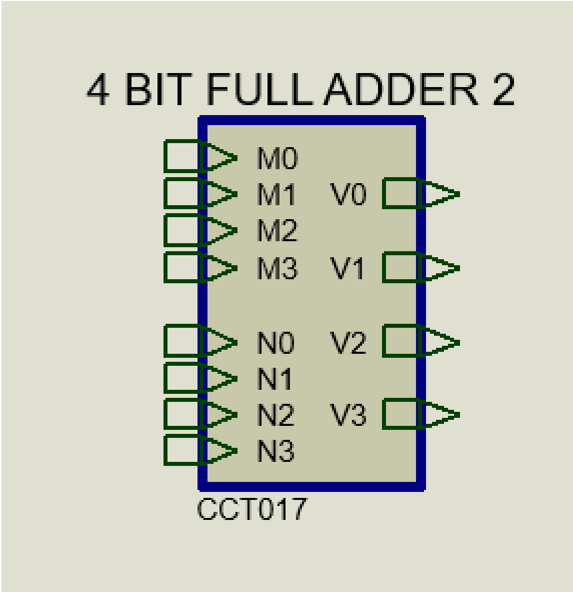



Fig: 4-bit Full adder parent sheet.

**4-Bit comparator:**

A 4-bit binary magnitude comparator is a digital circuit designed to compare the magnitudes of two 4-bit binary numbers. It determines whether one binary number is greater than, equal to, or less than the other based on their numerical values. The comparator examines each bit of the input numbers in parallel, starting from the most significant bit (MSB) and progressing to the least significant bit (LSB). The comparison results in three output signals: A greater than B (A > B), A equal to B (A = B), and A less than B (A < B). The 4-bit binary magnitude comparator is a fundamental building block in digital systems, enabling decision-making processes and facilitating conditional operations in computer architectures and other digital applications. Truth table of a 1-bit comparator is given below:

| A | B | A=B | A>B | A<B |
|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |

From the truth table,

**(A=B)** = $A'B'+AB = (A\oplus B)'$

**A>B**= $AB'$

**A<B**= $A'B$

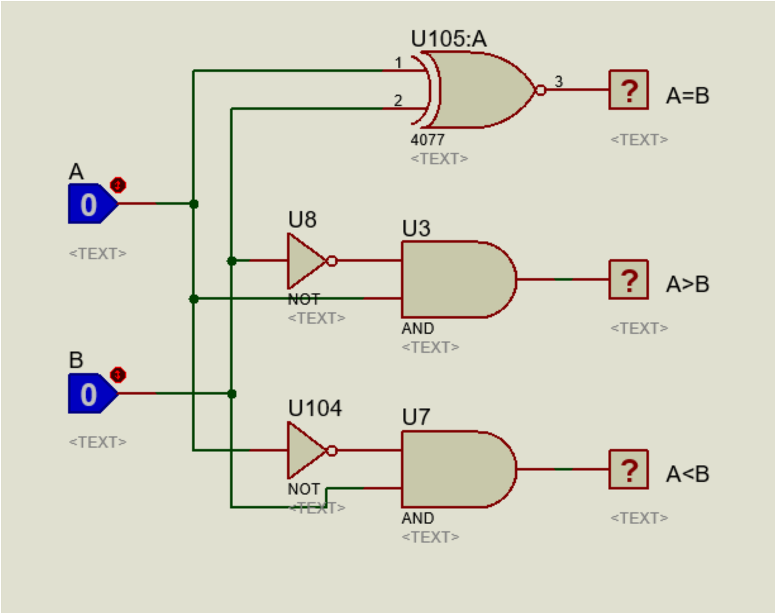



Fig: 1-Bit comparator

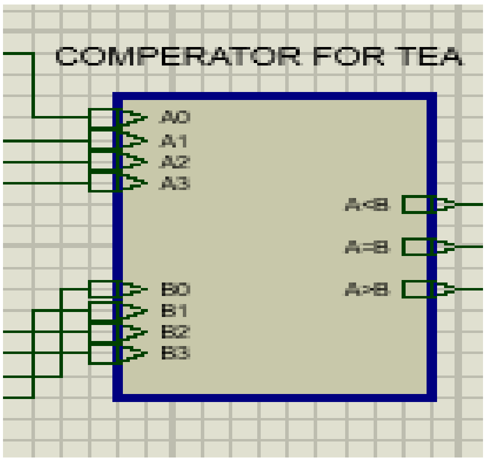



Fig: 4-Bit Comparator

**Child sheet:**

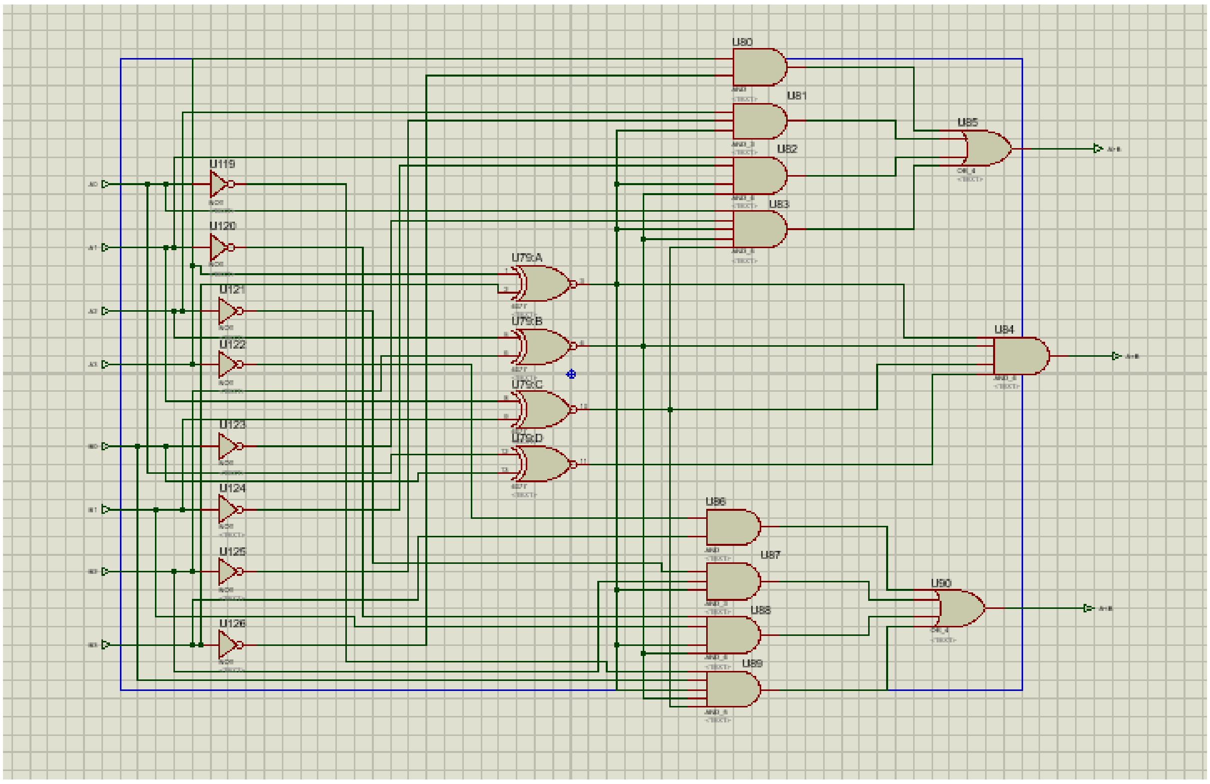


Fig: 4-bit Comparator child sheet

Here we design a 4-bit comparator using the truth table method, as there will be 8 input lines so the truth table will consist of 2^8= 256 different rows or combinations. Our 4-bit comparator compares two 4-bit binary values and determines whether one of them is more than the other or less than it in terms of magnitude.

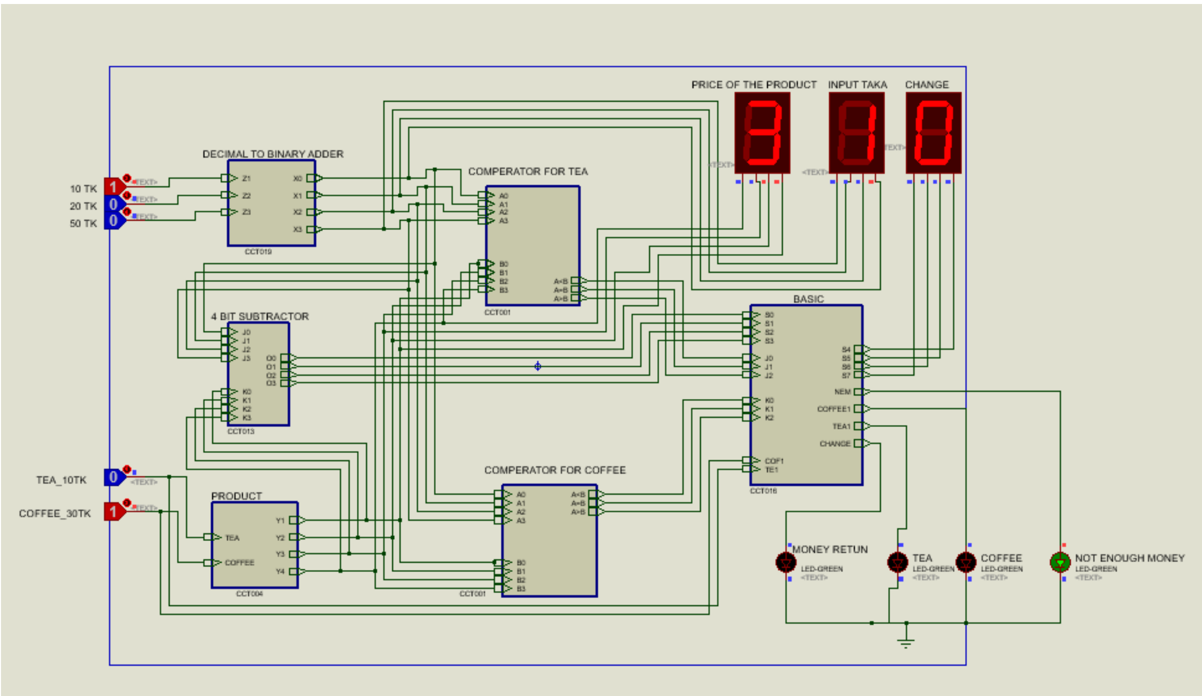
**Project Validation:**

As we stated in our problem statement, we want to build a drink machine/system that can provide drinks to the students all the time. To achieve this we have created our system/machine. Our machine can perform all the tasks efficiently and perfectly. To validate this we are giving some demo cases below.

**Case 1:**

**When the customer gives less money than the product price:**

Let's assume that one customer is buying a coffee from our vending machine. Initially, he entered 10 takas into the machine. And selected coffee from the product section. Point to be noted that the price of a coffee in our system is 30 taka. That is why the system is showing not enough money, by turning on the 'NOT ENOUGH MONEY' LED. At the same time in the price of the product section, the price of the product is shown in the seven-segment display, and inserted taka is also shown in another seven-segment display. As the user inserted less than the product price there is no change.

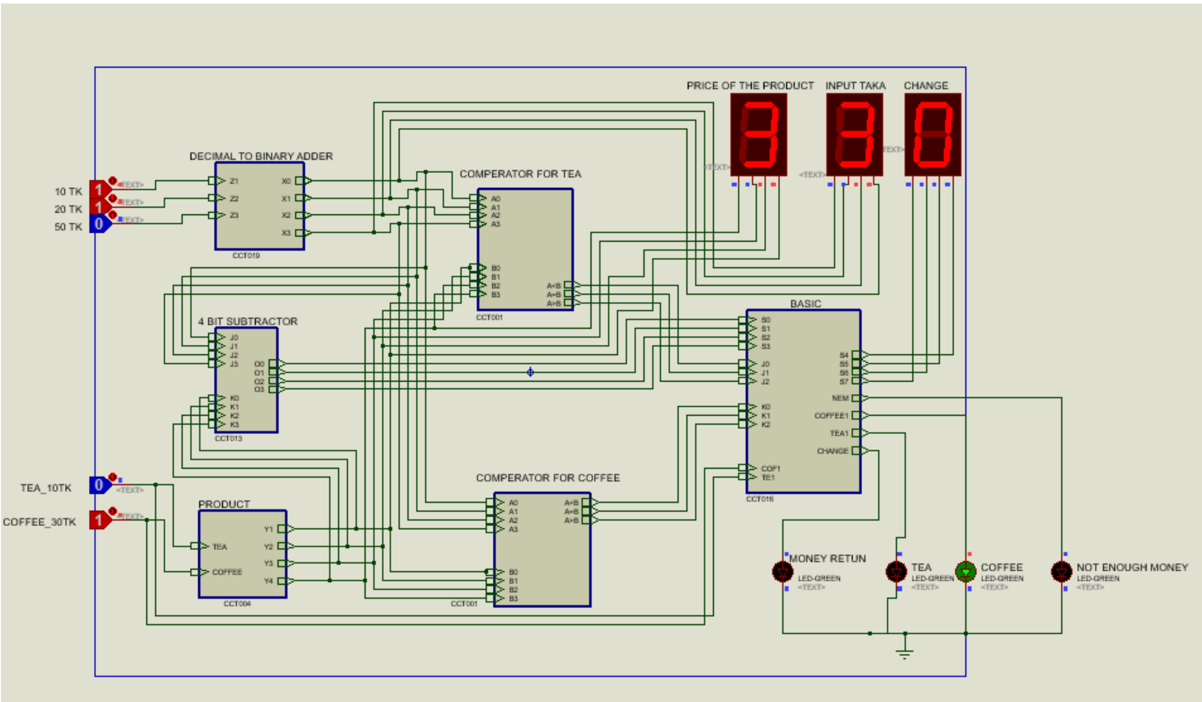


**Case 2:**

**When the customer gives equal money for product price:**

Let's assume that another customer is buying a coffee from our drink machine. Initially, he entered 30 takas into the machine. And selected coffee from the product section. Point to be noted that the price of a coffee in our system is 30 taka.

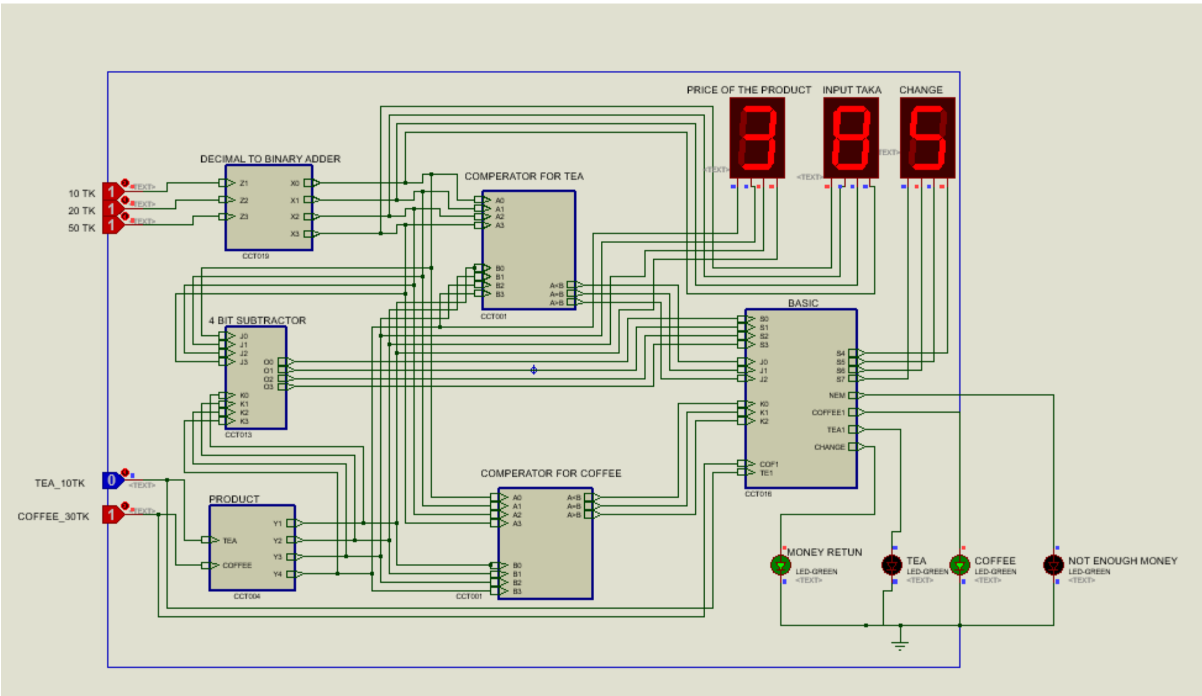
As the price of the product and inserted taka have been matched the customer has got the desired product in this case a coffee. It is showing in our circuit by turning on the LED marked as 'COFFEE'. As the user inserted an equivalent amount to the product price there is no change. His inserted amount, the price of the product, and the change that he will get are shown in the separately labeled 7-segmented display. (As the amount inserted is equal to the price of the product there is no change)



**Case 3:**

**When the customer gives more money than the product price:**

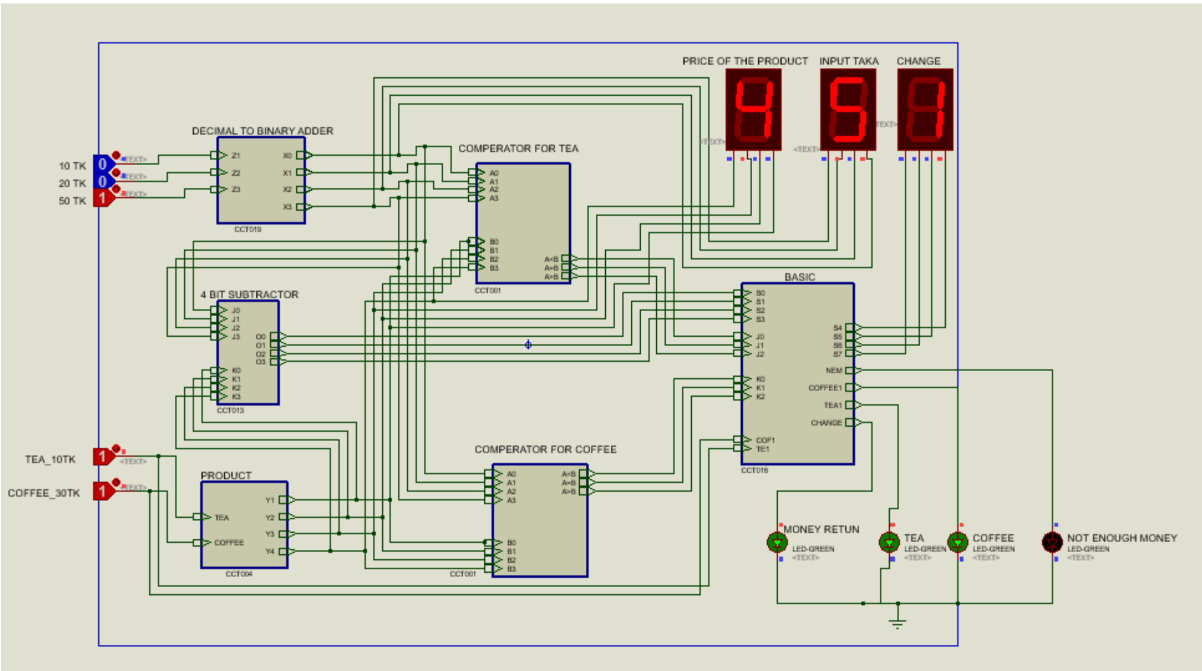
Once again Let us assume that another customer is buying a coffee from our vending machine. Initially, he entered 50 takas into the machine. And selected coffee from the product section. Point to be noted that the price of a coffee in our system is 30 taka. So he has inserted a surplus amount. So, our system is giving him a coffee, (this logic is shown by turning on the LED marked as COFFEE). He will also get a change, which is why A LED marked as change is also glowing in the circuit. His inserted amount, the price of the product, and the change that he will get are shown in the separately labeled 7-segmented display.



## Case 4:

**When a customer buys 2 products at a time:**

When a customer buys both coffee and tea at the same time and inserts 50 taka, our system will give him a tea and a coffee and a change of 10 taka. The change amount is shown in the 7-segment display. And the completion of the process is shown by Turning on the respective LEDs. His inserted amount, the price of the product, and the change that he will get are shown in the separately labeled 7-segmented display.




**NB:** Similar types of scenarios/cases will occur if a customer selects TEA instead of COFFEE.

**Complex Engineering Activities:**

**Range of diverse resources:**

People: Since our group consists of students from our class, we all know each other and we are very good friends.

Money: As our project was software-based we didn't need to spend any kind of money. Just we had to buy our internet package.

Equipment: For the project, we used a software called Proteus, which we used on our PC. Additionally, we used some other software/browsers and all of them were available on our PC.

Information: For the information on the project we took help from our class lecture, Google, and YouTube.

Technology: As it's an engineering project , it depends on technology. We made our circuit simulation in software, we gathered information from different websites, took some ideas from youtube videos, and all of them we used on our PC. All of them are parts of technology.

**Level of interaction :**

As we all are friends we could contact each other any time we need. Every member of our group was highly active and very helpful. We arranged meetings almost every night and all of our group members joined. We discussed, planned, and finally finished the project successfully together.

**Consequences to society and the environment**

Our vending machine has consequences for society and the environment. It will contribute to increased energy consumption, straining power grids and elevating carbon emissions.

Single-use packaging like cups and stirrers exacerbates plastic waste issues, harming ecosystems and wildlife. The resource-intensive manufacturing process depletes raw materials, leading to habitat destruction. Transportation and supply chains further raise their carbon footprint, worsening climate concerns. Waste generation, including used grounds and maintenance materials, can lead to improper disposal. Health effects from caffeine consumption must also be considered. Moreover, the proliferation of vending machines may impact local businesses, potentially reducing economic opportunities. Water usage adds to environmental stress, especially in water-scarce regions.

**Familiarity**

We were familiar with all of the components we used. Already we have learned about all the components we need for the project in our class. Our teacher described them very clearly.

**Complex Engineer Problem:**

To complete our project we first had to acquire in-depth knowledge about the components we have used. Our project had some requirements like building an efficient and effective drink machine. So we had to fill up these complex requirements. All the members of this project participated in the project work. And to solve this project we had to go through a lot of complex analysis. So we have fulfilled 4 complex engineering problems.

| Complex Engineering Problem | |
|---|---|
| P1 In-depth knowledge required | ✔ |
| P2 Wide-ranging or conflicting requirements | ✔ |
| P3 Depth of analysis required | ✔ |
| P6 Extent of stakeholder involvement and Needs | ✔ |

**Impact**

- Societal Impact:

Convenience and Accessibility: The presence of coffee and tea drink machines enhances convenience, allowing individuals to access hot beverages easily in various public spaces. This contributes to a more fast-paced and efficient society, accommodating busy lifestyles.

Social Interaction: Drink vending machines may influence social dynamics by providing a common space for people to gather, and fostering informal interactions over a shared coffee or tea break. This can contribute to a sense of community and workplace camaraderie.

Employment Opportunities: The installation and maintenance of drink vending machines create job opportunities, from machine technicians to restocking personnel, thereby contributing to local employment rates.

- Health Impact:

Caffeine Consumption: Increased availability of coffee and tea might lead to higher caffeine consumption, impacting individuals' health. Excessive caffeine intake can lead to sleep disturbances, increased heart rate, and other health issues.

Nutritional Considerations: The types of coffee and tea offered may influence overall nutritional intake. Drink vending machines with options for sugar-free or low-fat variants can positively impact health, whereas those with sugary additives might contribute to health concerns like obesity and diabetes.

- Safety Impact:

Hygiene and Maintenance: Regular maintenance and hygiene practices associated with drink vending machines are crucial to prevent contamination. Failure to uphold safety standards can lead to health risks, such as the spread of bacteria and other contaminants.

Accident Prevention: Proper placement and securing of drink vending machines are essential to prevent accidents. Poorly located machines can pose tripping hazards, and inadequate anchoring may result in the tipping, causing injuries.

- Cultural Impact:

Cultural Habits: Coffee and tea hold cultural significance in many societies. The availability of these beverages through drink machines can either reinforce traditional drinking habits or introduce new cultural practices, depending on the variety of options offered.

Rituals and Customs: The act of sharing a cup of coffee or tea is often embedded in cultural rituals and customs. Drink vending machines may influence these practices by providing a modern, convenient avenue for individuals to participate in cultural traditions.

In summary, the introduction of coffee and tea drink vending machines has multifaceted impacts, ranging from societal and cultural influences to considerations of health, safety, and legal compliance. Balancing these factors is crucial for creating a positive and sustainable impact on individuals and communities

**Future Work:**

In the future, our drink machine is poised for significant enhancements to broaden its capabilities and improve user convenience. One major upgrade involves expanding the product selection to include a diverse range, allowing customers to choose from a variety of items. Additionally, we plan to enhance the machine's currency acceptance by accommodating more denominations and removing restrictions on repetitive notes, providing users with greater flexibility in their payment options. The introduction of a counter will enable us to keep meticulous track of the total products sold, offering valuable insights into consumer preferences and popular choices. These developments aim to make our drink machine a versatile and user-friendly solution that adapts to evolving customer needs and preferences.

**Conclusion**

In conclusion, implementing a drink machine in the BracU Permanent Campus will be a convenient and efficient solution for students and staff. This initiative not only addresses the immediate need for snacks and beverages but also contributes to a more dynamic and accessible campus environment. The positive impact on student satisfaction and the potential for additional revenue makes the introduction of vending machines a worthwhile investment for the university.

**Reference:**


1. https://www.youtube.com/watch?v=wgje9eH3TT0&list=LL&index=1&t=330s
2. https://www.youtube.com/watch?v=lqN8xLTtdaA&list=LL&index=2&t=720s
3. https://youtu.be/5XbRIVWFRIw?si=P5Hnm5njbqY2TwOj
4. https://www.geeksforgeeks.org/magnitude-comparator-in-digital-logic/?fbclid=IwAR0tXnzX78oiMZtl09qmrK-EIQJdm6btNqaVG-4W3Z0FMGzDtbaFpYg6wjk
5. Digital Systems: Principles and Applications (10th Edition), by Ronald Tocci