

HOMEWORK 1

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The Vending Machine designed by us has **3 states** which are as follows:

1. IDLE
2. BUTTON
3. PRODUCT

IDLE STATE:

- In this state the **SUPPLIER** loads the items in the machine and assigns the cost and count to that corresponding item when the **valid_s** bit is HIGH **and if the cost of the ITEMS doesn't exceed 12.75 USD.**
 - The **cost** variable whenever is all 1's indicates the maximum value to be set by the SUPPLIER.
- **valid_s check:**
 - SUPPLIER Control/USER transaction:
 - Whenever in the IDLE state the SUPPLIER makes the valid_s high the USER only buys the product with the values assigned to cost and count of the corresponding ITEMS in a newer transaction.
 - If the valid_s is LOW then the USER buys the ITEMS with the already assigned previous values.

NOTE [*Transaction cost and count values*]: If the USER does a transition to another state the SUPPLIER values won't take effect until the USER doesn't complete the current transaction. To aid this process flags are set in the design which are made zero once USER presses the button and makes transition.

- **Multiple button checks:** The multiple buttons pressed by the USER is checked and **IF, YES**, the machine remains in the IDLE state.
- **Hard Reset:** If the hard reset is made HIGH then the scenario becomes as if the SUPPLIER machine doesn't have anything and the SUPPLIER feeds in fresh ITEMS in the machine if the valid_s is HIGH.

IDLE TO BUTTON TRANSITION

- The IDLE TO BUTTON transition takes place only when the following conditions are true
 - *If single button is pressed.*
 - *If the SUPPLIER has not pressed valid.*
 - *If the RESET is not applied.*
 - *If the enter key is made high.*

BUTTON STATE:

- In this state the following conditions are checked
 - **COUNT NOT ZERO:** The count of the ITEMS in the vending machine is checked whether it is not reduced to zero.

- **MONEY NOT ENOUGH TO BUY A PRODUCT:** If the coins inserted by the USER are not enough to buy the product. The USER will have two choices
 1. To buy the product.
 2. To invoke soft reset which is explained below.
 - **Soft_reset:** The USER has pressed the BUTTON to select an ITEM but has LESS money to buy an ITEM or has messed up by pressing a different ITEM BUTTON of which the cost is more; the USER has an option to do a SOFT RESET in our design until the USER has not pressed the SELECT BUTTON. To check whether the values have become zero for the USER transaction when the SOFT RESET was made.
- **BUTTON TO PRODUCT TRANSITION:**
 - *Whenever the USER inserts COINS EQUAL TO or MORE than the cost of an ITEM then only then transition occurs.*

PRODUCT STATE:

- In this state the PRODUCT is available to the USER for which the USER has pressed the BUTTON.
- **PRODUCT TO IDLE TRANSITION:**
 - *Once the USER gets the product the machine is transitioned to the IDLE state.*

OUTPUTS:

The info display has values displayed in the following state:

IDLE: the info display is visible only when the button is pressed by the USER

BUTTON: The info display is visible in the state which informs the USER that the money he has inserted is less or more and the USER can know that they must insert more coins if the ITEM costs more.

ITEM-BUTTON-PRODUCT MAPPING

Every row in the following table corresponds to the bit pattern of the bit variables in the corresponding column in that same row:

For example:

If the **item_s** is 3'b001 which is the supplied pattern for an ITEM. When the USER presses the button[0]=6'b100000, for that respective button[0] pressed a product=3'b000 will come out from the Vending machine as an output.

bit [5:0] button	bit [2:0] item_s	bit [2:0] product
button[0]=6'b000001	item_s=3'b000	product=3'b001
button[1]=6'b000010	item_s=3'b001	product=3'b010
button[0]=6'b000100	item_s=3'b010	product=3'b011

button[0]=6'b001000	item_s=3'b011	product=3'b100
button[0]=6'b010000	item_s=3'b100	product=3'b101
button[0]=6'b100000	item_s=3'b101	product=3'b110

NOTE: THE PRODUCT value is considered zzz when there is no transaction operation going on.

STATUS CONFIGURATIONS:

zz	NO PRODUCT	No operation is going on
00	INTERNAL ERROR	When there is no product in the machine even though a button is pressed
01	NO PRODUCT AVAILABLE	Whenever the PRODUCT is not provided by the vending machine whenever the money provided by the USER is not enough to buy a product
10	TRANSACTION PROCESSING	If the transactions happen properly whenever the transitions going on from IDLE TO BUTTON AND BUTTON TO PRODUCT STATES
11	PRODUCT AVAILABLE	In the PRODUCT STATE whenever the product comes out then this is the status

COINS ENCODING:

- Whenever a user buys a product, he inserts COINS:
 - The COINS used are QUARTER, NICKEL AND DIME

COINS	BIT PATTERN	TO ADD to BAL intermediate variable in the operation
NO MONEY	00	NOTHING TO ADD meaning zero to ADD
NICKEL	01	101
DIME	10	1010
QUARTER	11	11001

enter_key [select button]

- 0- enter_key is not pressed by the USER but they have checked the price for the product and
- 1-enter_key is pressed by the USER and they will get the PRODUCT for the corresponding BUTTON pressed.