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2019

ESDM Project

Vending machine

1. Design description

Our finite state machine is described by 7 top-level states:

- ResetStock
- Idle
- InvalidSelection
- Donut
- Chocolate
- Water
- Mentos
- Coke

The **ResetStock** state is the first state where the products stocks are initialized.

After the number of each product is stored, if the *ResetStock* signal is not TRUE, the machine switches to the **IDLE** state. Here the overall status of the machine is cleared and the vending machine is waiting for a product to be selected.

The **InvalidSelection** state becomes valid if the product selected by the user is not one of the available products. In this case the status incorrect product code is displayed and the money are returned to the user. After 5 seconds the machines switches back to the Idle state.

If one of the above mentioned product is selected by the user, the machine switches to its corresponding state. Each product state includes 5 sub-states:

- CheckState
- MoneyNotEnough
- OutOfStock
- Canceled
- MoneyAnd[Product] ([Product] is replaced with the name of the selected product)

CheckState validates the production selection and the vending machine is entering in the operation mode where the input signals are verified. The next step is determined by the inputs.

If the money introduced by the user are not enough for the selected product (if the product is more expensive) the vending machine switches to **MoneyNotEnough** state and returns a money not enough status and it is returning the money to user. This status was not requested, but we considered it

was needed in a normal operation of a vending machine. After 5 seconds the machine returns to Idle state.

The **OutOfStock** state is called if the selected product is out of stock. The out of stock status is displayed to the user, its money are returned and after 5 seconds the machine goes back to Idle state.

While validating the product selection, if the user presses the Cancel button, the **Canceled** state is called. This state stops any ongoing operation, returns the money and switch back immediately to the Idle state.

If all conditions were fulfilled (money are enough the product is on stock) the machine switches to **MoneyAnd[Product]** state and the remaining stock and the money rest are calculated. Then, after 5 seconds, the Idle state is called and a product can be selected again.

2. Testing

- „The machine shall detect if the user requests a product which is currently out of stock, and signal at the Status output.”
- „The number of products available can be reset back to the value of 10 when the input ResetStock is activated.”

For the first test we initialized the Chocolate stock with 1 product and requested 2 chocolates (represented as product 1 on the scope). The first one is successfully dispensed, while on the second try we received the out of stock output status (status 4).

After the out of stock status the ResetStock command is applied and the product is requested again. This time the output status will not return out of stock, but it will finish with a successful dispensed product. The ResetStock command can not be given if the machine is in an ongoing operation or if a product is selected and another product can not be selected if the ResetStock command isn’t finished yet.

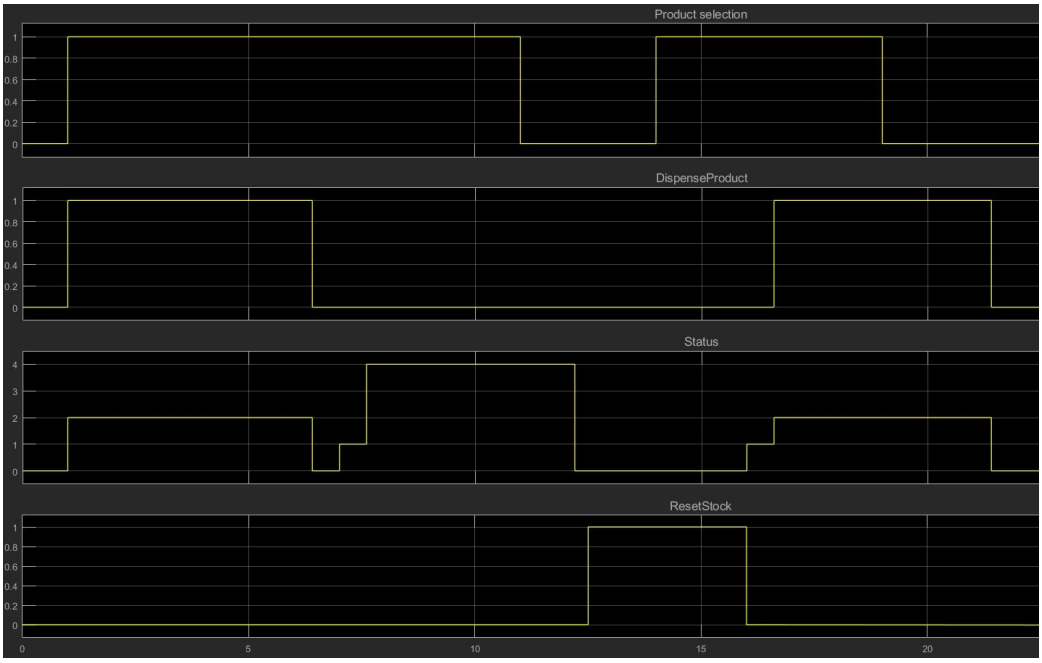

Fig 1. Out and stock and reset stock validation test

- „The machine shall detect if the user requests an invalid product code, and signal this at the Status output.”

For this test we requested a product number (6) which is out of range of the available products numbers. The machine returns the Incorrect product code status (3).

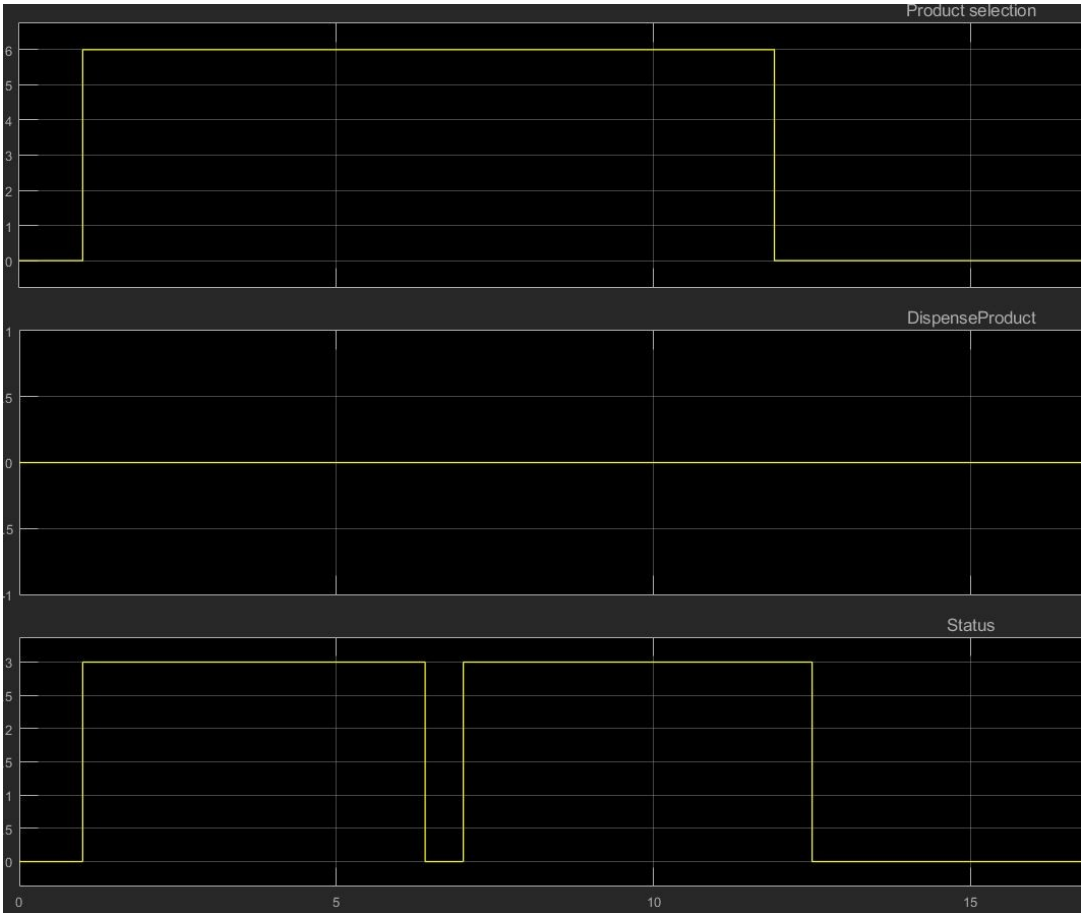

Fig 2. Incorrect product code validation test

- „The machine shall calculate the rest of the money and provide back the change (Note: assume the machine has an infinite supply of coins/notes).”

For this test we fulfilled all conditions to dispense the selected product and we followed the MoneyReturn signal. For 7 input money and a 2 money water (product 4), the machine return the correct amount of money, 5.

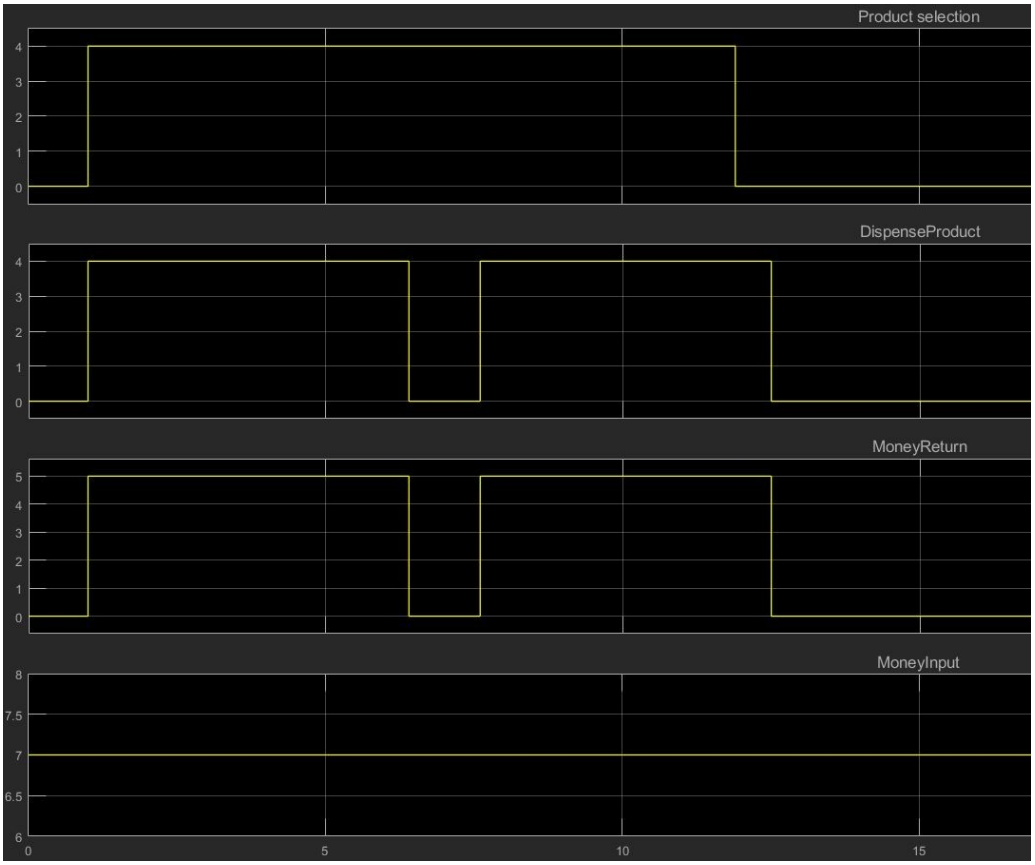

Fig 3. Correct money return validation test

- „After dispensing a product, the machine will wait 5 seconds before accepting any new operation (to wait until the dispensing mechanism finishes).”

This test is visible in previous test. Between the first moment of the product selection and the resetting of the DispenseProduct variable, 5 seconds have passed. Then a new cycle begins because the product is still selected.

- „The machine shall always provide a status code output.”

This test is visible in previous tests where Status signal is displayed on the scope.

- Cancel command check.

The cancel command overwrites every status.

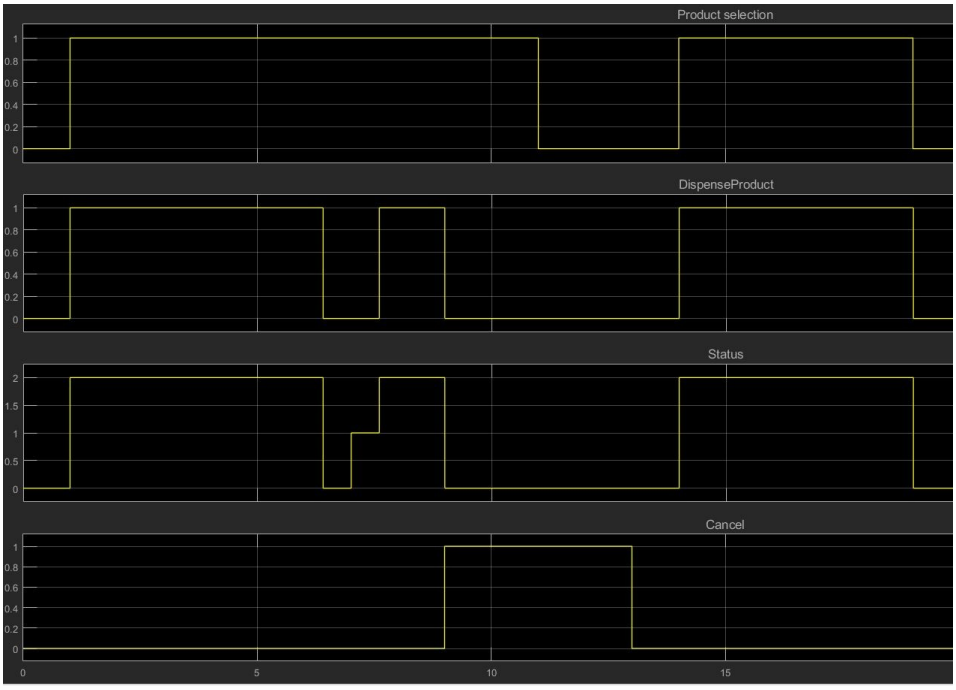

Fig 4. Cancel validation test

- Money not enough check.

If the inserted money are fewer than the product cost, the status 5 is displayed, the money are returned and no product is dispensed. For this test we used 1 money input and requested a Coke (product 2) which costs 2.5.

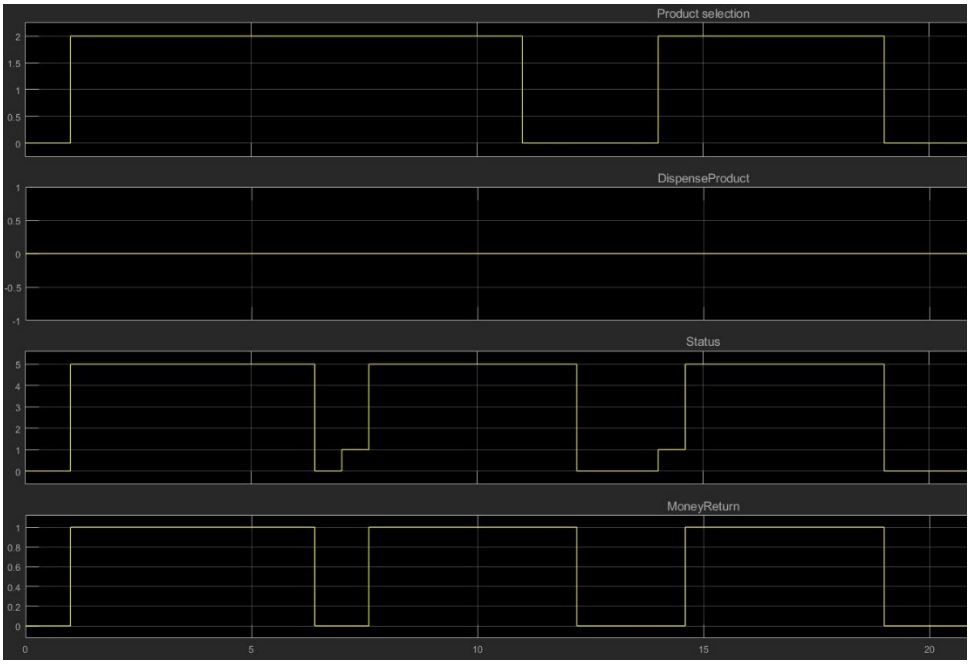

Fig 5. Money not enough validation test

3. Annexes

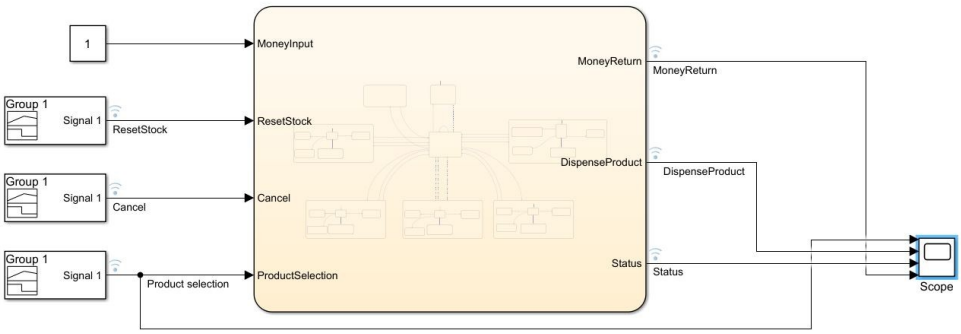

Fig 6. Tests setup

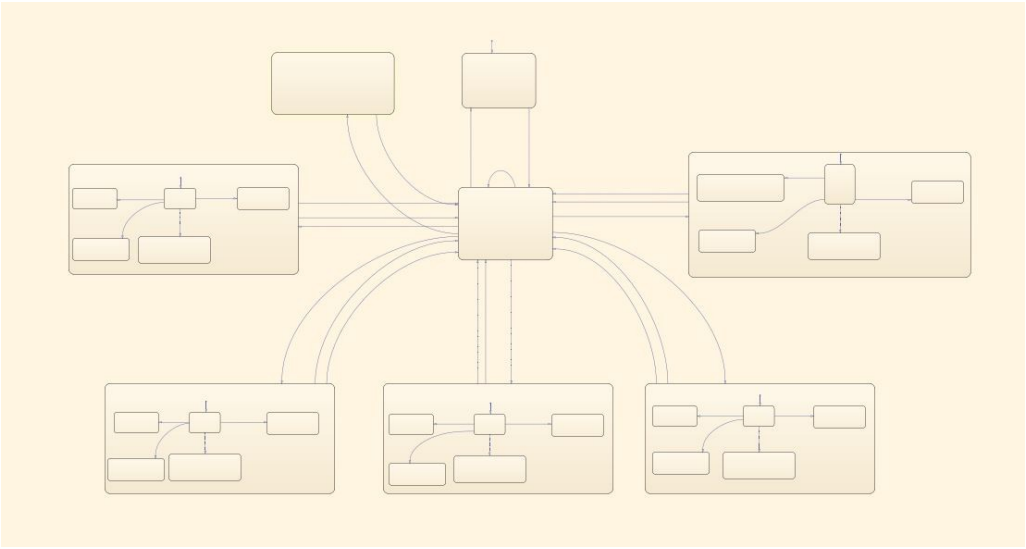

Fig 7. Full state machine view

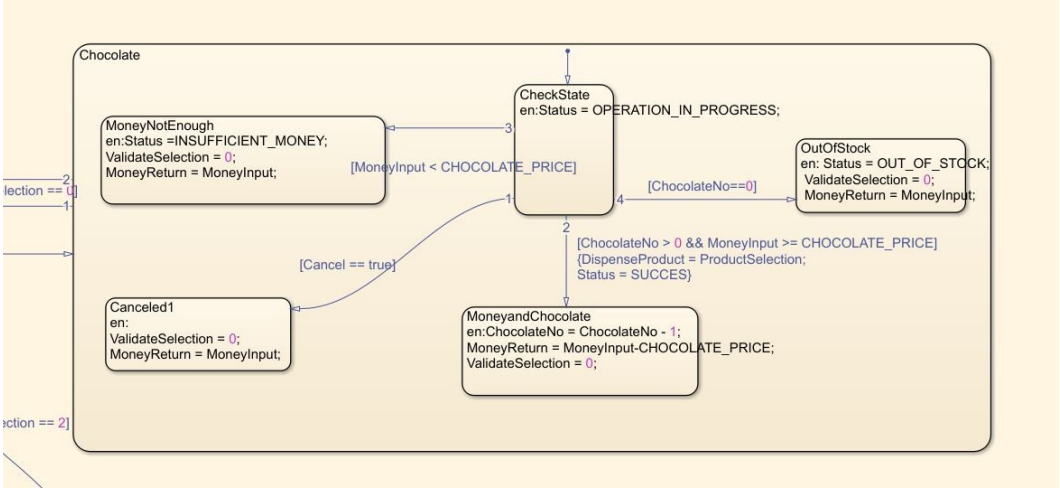

Fig 8. Product super-state with sub-states view