**ТЕХНИЧЕСКИ УНИВЕРСИТЕТ - СОФИЯ**

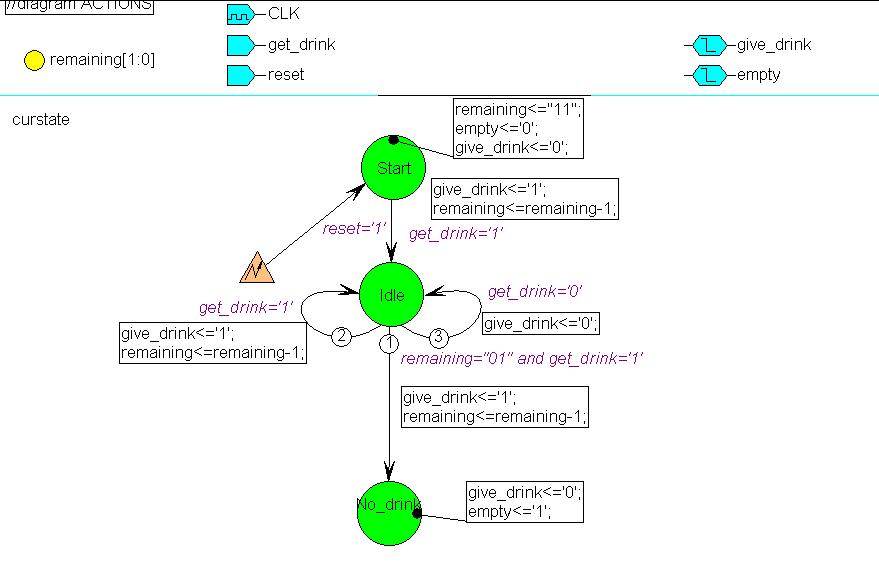
**ФАКУЛТЕТ ПО ТЕЛЕКОМУНИКАЦИИ**

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Група: 46 Дата: 18.03.2015 г.

Преподавател: доц. д-р Галя Маринова Подпис:

1. Проект на автомат за напитки
   * Графичен вид на спецификацията на автомата за сода, реализирана с крайни автомати в ACTIVE-HDL FSM:

 Фиг. 1

* VHDL код, генериран от спецификацията с крайни автомати:

library IEEE;

use IEEE.std\_logic\_1164.all;

package binctr\_pkg is

component binctr

port(reset, get\_drink, clk: in std\_logic;

give\_drink: inout std\_logic;

empty: inout std\_logic);

end component;

end binctr\_pkg;

library IEEE;

use IEEE.std\_logic\_1164.all;

library CYPRESS;

use CYPRESS.std\_arith.all;

use CYPRESS.lpmpkg.all;

entity binctr is

port (CLK: in STD\_LOGIC;

get\_drink: in STD\_LOGIC;

reset: in STD\_LOGIC;

empty: inout STD\_LOGIC;

give\_drink: inout STD\_LOGIC);

end;

architecture binctr\_arch of binctr is

--diagram signal declarations

signal remaining: STD\_LOGIC\_VECTOR (1 downto 0);

-- SYMBOLIC ENCODED state machine: curstate

type curstate\_type is (Idle, No\_drink, Start);

signal curstate: curstate\_type;

begin

--concurrent signal assignments

--diagram ACTIONS;

curstate\_machine: process (CLK, reset)

begin

if reset='1' then

remaining<="11";

empty<='0';

give\_drink<='0';

curstate <= Start;

elsif CLK'event and CLK = '1' then

case curstate is

when Idle =>

if remaining="01" and get\_drink='1' then

curstate <= No\_drink;

give\_drink<='1';

remaining<=remaining-1;

elsif get\_drink='1' then

curstate <= Idle;

give\_drink<='1';

remaining<=remaining-1;

elsif get\_drink='0' then

curstate <= Idle;

give\_drink<='0';

end if;

when No\_drink =>

give\_drink<='0';

empty<='1';

when Start =>

if get\_drink='1' then

curstate <= Idle;

give\_drink<='1';

remaining<=remaining-1;

end if;

when others =>

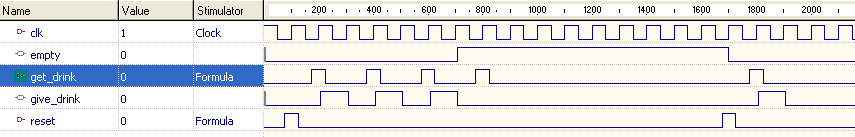
null;

end case;

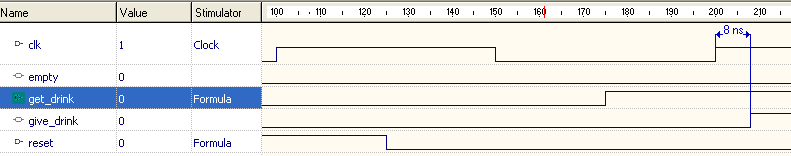
end if;

end process;

end binctr\_arch;

* Резултати от симулацията в ACTIVE-HDL SIM – входни и изходни сигнали:

Фиг. 2

* Закъснение на изходния сигнал **give\_drink** спрямо входния сигнал **get\_drink**:

Фиг. 3

* Данни от репорт файла **.rpt**:
  + Уравнения:

DESIGN EQUATIONS (14:31:43)

/curstateSBV\_0.T = curstateSBV\_0.Q \* get\_drink

curstateSBV\_0.AP = GND

curstateSBV\_0.AR = reset

curstateSBV\_0.C = clk

curstateSBV\_1.T = /curstateSBV\_0.Q \* /curstateSBV\_1.Q \* get\_drink \* remaining\_0.Q \* /remaining\_1.Q

curstateSBV\_1.AP = GND

curstateSBV\_1.AR = reset

curstateSBV\_1.C = clk

empty.T = curstateSBV\_1.Q \* /empty.Q

empty.AP = GND

empty.AR = reset

empty.C = clk

give\_drink.D = curstateSBV\_0.Q \* give\_drink.Q + /curstateSBV\_1.Q \* get\_drink

give\_drink.AP = GND

give\_drink.AR = reset

give\_drink.C = clk

/remaining\_0.T = /curstateSBV\_1.Q \* get\_drink

remaining\_0.AP = GND

remaining\_0.AR = reset

remaining\_0.C = clk

/remaining\_1.T = /curstateSBV\_1.Q \* get\_drink \* /remaining\_0.Q

remaining\_1.AP = GND

remaining\_1.AR = reset

remaining\_1.C = clk

* Съответствие на входните и изходните сигнали с изводите на схемата:

PINOUT INFORMATION (14:31:43)

Device: cy37256p160

Package: cy37256p160-83ac

1 : GND

19 : clk

20 : VCC

21 : GND

22 : reset

23 : give\_drink

24 : Not Used

25 : Not Used

26 : (curstateSBV\_0)

27 : (curstateSBV\_1)

30 : empty

39 : Not Used

40 : VCC

41 : GND

42 : Not Used

59 : get\_drink

60 : VCC

61 : GND

62 : VCC

* Заета площ и ресурси:

RESOURCE UTILIZATION (14:31:43)

Information: Macrocell Utilization.

Description Used Max

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| Dedicated Inputs | 1 | 1 |

| Clock/Inputs | 2 | 4 |

| I/O Macrocells | 4 | 128 |

| Buried Macrocells | 2 | 128 |

| PIM Input Connects | 8 | 624 |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

17 / 885 = 1 %

Required Max (Available)

CLOCK/LATCH ENABLE signals 1 20

Input REG/LATCH signals 0 133

Input PIN signals 3 5

Input PINs using I/O cells 0 0

Output PIN signals 2 128

Total PIN signals 5 133

Macrocells Used 6 256

Unique Product Terms 6 1280

* Закъснения:

TIMING PATH ANALYSIS (14:31:43) using Package: cy37256p160-83ac

Messages:

----------------------------------------------------------------------------

Signal Name | Delay Type | tmax | Path Description

----------------------------------------------------------------------------

reg::give\_drink[23]

inp::get\_drink

tS 8.0 ns 1 pass

inp::curstateSBV\_0.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::give\_drink

tCO 8.0 ns

----------------------------------------------------------------------------

reg::(curstateSBV\_0)[26]

inp::get\_drink

tS 8.0 ns 1 pass

inp::curstateSBV\_0.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::curstateSBV\_0

tCO 8.0 ns

----------------------------------------------------------------------------

reg::(curstateSBV\_1)[27]

inp::get\_drink

tS 8.0 ns 1 pass

inp::curstateSBV\_0.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::curstateSBV\_1

tCO 8.0 ns

----------------------------------------------------------------------------

reg::empty[30]

inp::curstateSBV\_1.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::empty

tCO 8.0 ns

----------------------------------------------------------------------------

reg::(remaining\_0)[957]

inp::get\_drink

tS 8.0 ns 1 pass

inp::curstateSBV\_1.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::remaining\_0

tCO 8.0 ns

----------------------------------------------------------------------------

reg::(remaining\_1)[965]

inp::get\_drink

tS 8.0 ns 1 pass

inp::curstateSBV\_1.Q

tSCS 12.0 ns 1 pass

inp::reset

tRO 21.5 ns 1 pass

out::remaining\_1

tCO 8.0 ns

----------------------------------------------------------------------------

Worst Case Path Summary

-----------------------

tS = 8.0 ns for give\_drink.D

tSCS = 12.0 ns for give\_drink.D using clock signal clk

tCO = 8.0 ns for give\_drink.C

tRO = 21.5 ns for give\_drink.AR

* Зает блок от програмируемата схема и използвани ресурси от него:

LOGIC BLOCK D PLACEMENT (15:08:24)

Messages:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| 0 |give\_drink

XX++++++++++++++................................................................

| 1 |UNUSED

......++++++++++++++++..........................................................

| 2 |UNUSED

..........++++++++++++++++......................................................

| 3 |UNUSED

..............++++++++++++++++..................................................

| 4 |UNUSED

..................++++++++++++++++..............................................

| 5 |UNUSED

......................++++++++++++++++..........................................

| 6 |empty

..........................X+++++++++++++++......................................

| 7 |(curstateSBV\_0)

..............................X+++++++++++++++..................................

| 8 |UNUSED

..................................++++++++++++++++..............................

| 9 |UNUSED

......................................++++++++++++++++..........................

|10 |UNUSED

..........................................++++++++++++++++......................

|11 |UNUSED

..............................................++++++++++++++++..................

|12 |UNUSED

..................................................++++++++++++++++..............

|13 |UNUSED

......................................................++++++++++++++++..........

|14 |UNUSED

..........................................................++++++++++++++++......

|15 |(curstateSBV\_1)

................................................................++X+++++++++++++

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Total count of outputs placed = 4

Total count of unique Product Terms = 5

Total Product Terms to be assigned = 5

Max Product Terms used / available = 5 / 80 = 6.26 %

Control Signals for Logic Block D

---------------------------------

CLK pin19: clk

CLK pin22: <not used>

CLK pin99: <not used>

CLK pin102: <not used>

CLK PT : AH : <not used>

PRESET : AH : GND

RESET : AH : reset

OE 0 : AH : <not used>

OE 1 : AH : <not used>

OE 2 : AH : <not used>

OE 3 : AH : <not used>

Logic Block D

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| |> not used:379 | |

| |= >reset | |

| |= >get\_drink | |

| |> not used:382 | |

| |> not used:383 | 11|= give\_drink

| |> not used:384 | |

| |> not used:385 not used:935 >| |

| |> not used:386 | |

| |> not used:387 | 12|\* not used

| |= >empty.Q | |

| |> not used:389 not used:937 >| |

| |= >curstateSBV.. | |

| |> not used:391 | 13|\* not used

| |> not used:392 | |

| |> not used:393 not used:939 >| |

| |> not used:394 | |

| |> not used:395 | 14|= empty

| |= >curstateSBV.. | |

| |= >give\_drink.Q (curstateSBV\_0) =| |

| |> not used:398 | |

| |> not used:399 | 15|\* not used

| |> not used:400 | |

| |> not used:401 not used:943 >| |

| |> not used:402 | |

| |> not used:403 | 16|\* not used

| |> not used:404 | |

| |> not used:405 not used:945 >| |

| |> not used:406 | |

| |> not used:407 | 17|\* not used

| |> not used:408 | |

| |> not used:409 not used:947 >| |

| |> not used:410 | |

| |> not used:411 | 18|\* not used

| |> not used:412 | |

| |> not used:413 (curstateSBV\_1) =| |

| |> not used:414 | |

| |> not used:415 | |

| |> not used:416 | |

| |> not used:417 | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Information: Macrocell Utilization.

Description Used Max

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| I/O Macrocells | 2 | 8 |

| Buried Macrocells | 2 | 8 |

| PIM Input Connects | 6 | 36 |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10 / 52 = 19 %

* Блокове, в които е реализирано програмиране и програмни връзки в тях:

Нулите в кода съответстват на осъщественото програмиране:

L034168

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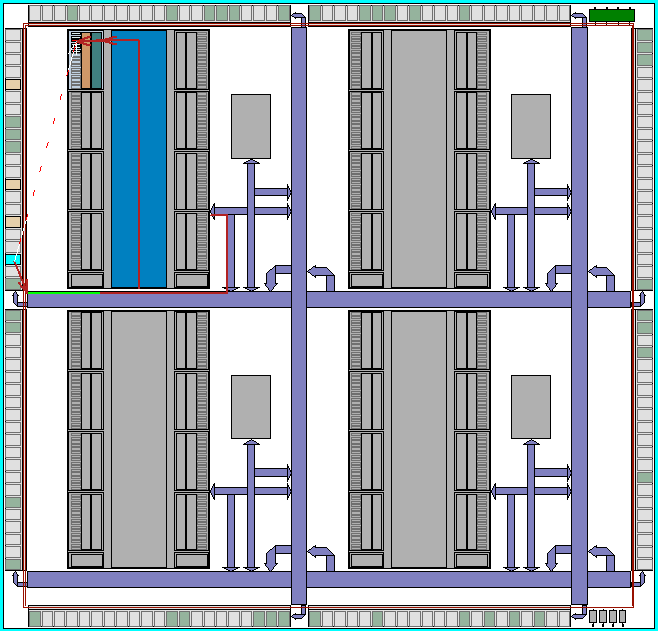
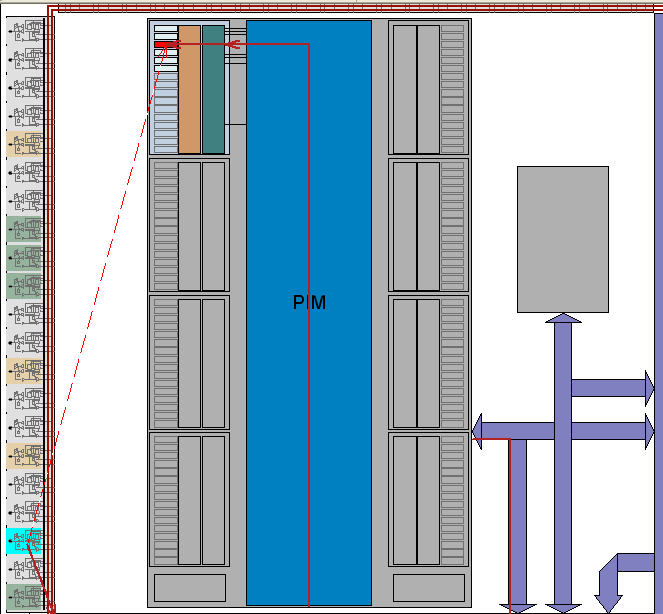
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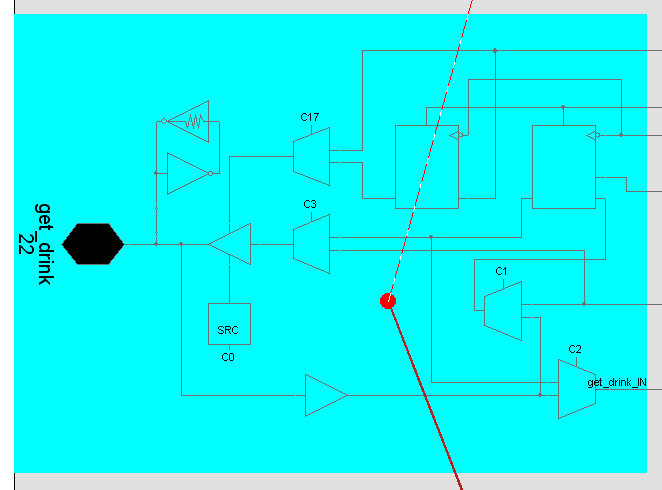
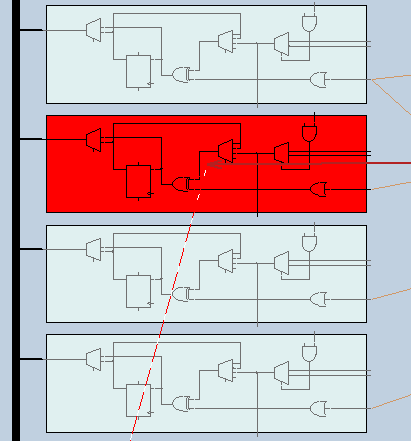
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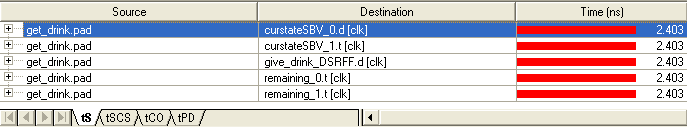
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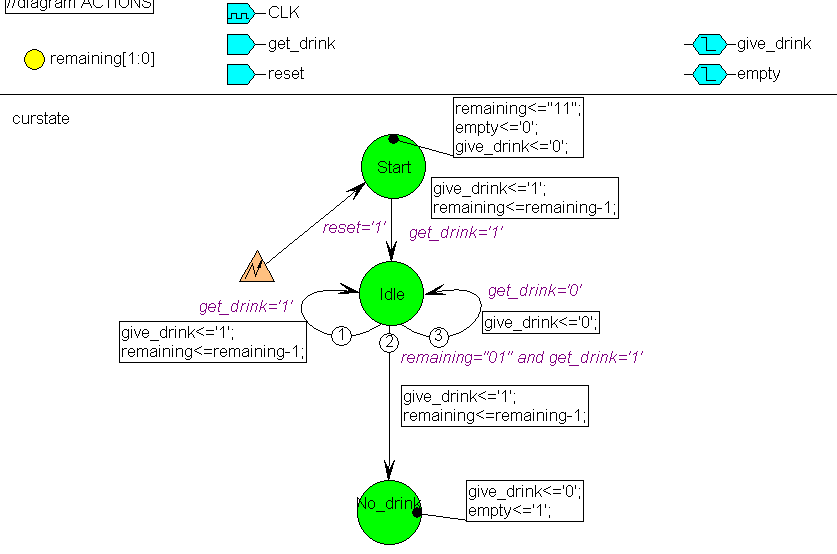
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0010100

* Разположение на проекта върху програмируемата схема и клетките, от които тръгват сигналите и входно/изходните клетки, където се подават



Закъснения:

1. Проект на автомат за напитки с разменени приоритети.
   * Диаграма на автомат за напитки с разменени приоритети в графичен вид от ACTIVE-HDL FSM:

Фиг. 4

* Генериран VHDL код:

library IEEE;

use IEEE.std\_logic\_1164.all;

package binctr\_pkg is

component binctr

port(reset, get\_drink, clk: in std\_logic;

give\_drink: inout std\_logic;

empty: inout std\_logic);

end component;

end binctr\_pkg;

library IEEE;

use IEEE.std\_logic\_1164.all;

library CYPRESS;

use CYPRESS.std\_arith.all;

use CYPRESS.lpmpkg.all;

entity binctr is

port (CLK: in STD\_LOGIC;

get\_drink: in STD\_LOGIC;

reset: in STD\_LOGIC;

empty: inout STD\_LOGIC;

give\_drink: inout STD\_LOGIC);

end;

architecture binctr\_arch of binctr is

--diagram signal declarations

signal remaining: STD\_LOGIC\_VECTOR (1 downto 0);

-- SYMBOLIC ENCODED state machine: curstate

type curstate\_type is (Idle, No\_drink, Start);

signal curstate: curstate\_type;

begin

--concurrent signal assignments

--diagram ACTIONS;

curstate\_machine: process (CLK, reset)

begin

if reset='1' then

remaining<="11";

empty<='0';

give\_drink<='0';

curstate <= Start;

elsif CLK'event and CLK = '1' then

case curstate is

when Idle =>

if get\_drink='1' then

curstate <= Idle;

give\_drink<='1';

remaining<=remaining-1;

elsif remaining="01" and get\_drink='1' then

curstate <= No\_drink;

give\_drink<='1';

remaining<=remaining-1;

elsif get\_drink='0' then

curstate <= Idle;

give\_drink<='0';

end if;

when No\_drink =>

give\_drink<='0';

empty<='1';

when Start =>

if get\_drink='1' then

curstate <= Idle;

give\_drink<='1';

remaining<=remaining-1;

end if;

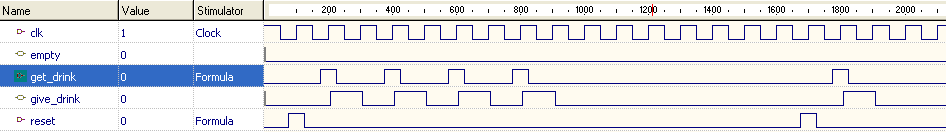
when others =>

null;

end case;

end if; end process; end binctr\_arch;

* Резултати от симулацията:

 Фиг. 5

След размяната на приоритетите се забелязва, че командата за даване на напитка **give\_drink** се изпълнява, въпреки че в автомата няма останали напитки. Изходният сигнал би трябвало да изчака следващо рестартиране, за да се включи.

При неправилно подреждане на приоритетите е възможно да се достигне до безсмислени ситуации и нежелателни резултати. Ако проверката за наличност не се извършва в началото на всяко поискване, автоматът се опитва да даде напитка всеки път, без значение дали има или не.