MCTE 2332 : Digital System and Microprocessor

Semester I, 2020/2021

Digital Logic Design Project

[Dropbox Delivery System]

Section: 1

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1.0 GOAL OF PROJECT

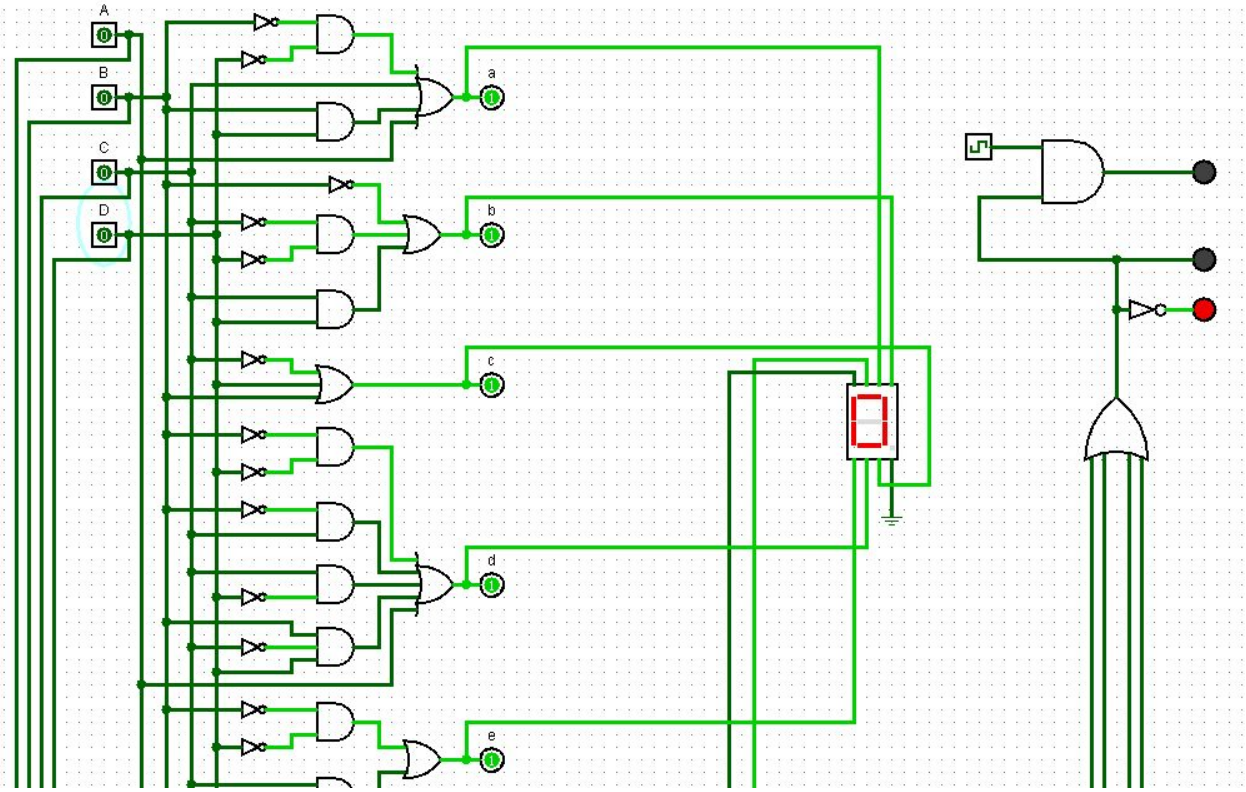
Since the World Health Organization declared the coronavirus outbreak a public health emergency since March 2020, we have taken various steps to ensure the safety of people and create awareness about the importance of social distancing. This to minimize the risk of people from getting infected by Covid-19 and to flatten the curve due to the rising cases happening in Malaysia. As a future engineer, I came up with a contactless dropbox delivery system based on the knowledge of Digital System Design that I learnt. This system can be implemented at everyone's house and also at public places such as restaurants, school, offices etc. For instance, due to this pandemic, people love to shop online and order foods using online platforms such as Foodpanda and Grab Food. Thus, this dropbox delivery system will be placed outside the house and the delivery guy can just easily put the ordered food or parcel inside the box. The main concern here is to make sure there is no contact between the delivery guy and the customer. Thus we can ensure the safety of people involved and get rid of the risk of Covid-19.

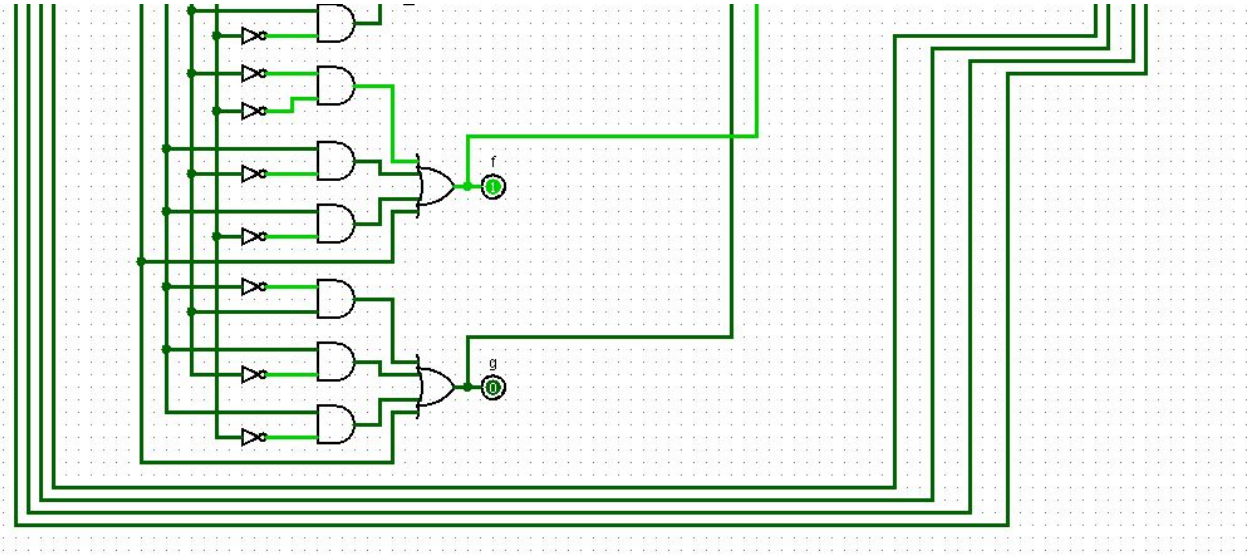
2.0 DESIGN PROCESS

In completing this dropbox delivery system, I implement the system with a button, 7 segment display and three different colours of LEDs. Among the types of logic gates used in the system are AND, OR and NOT gates. The system consists of 4 bit inputs (A, B, C, D) and produce 7 outputs (a, b, c, d, e, f, g) as we can see in the logisim figure below. The 4 inputs function as a button in which it will count up the number of deliveries delivered in the dropbox by the delivery guy everytime when he pushes the button provided at the box. The maximum

capacity that the dropbox can hold is only capable for 9 types of deliveries. When it exceeds 9, the system will automatically reset back to 0. That means here that the user needs to take the delivered stuff before it reaches 9 or else the dropbox will no longer accept the 10th delivery.

On the other hand, there are also three different kinds of LEDs attached with the dropbox system. When the dropbox is empty, the red led will light up meanwhile when there is a parcel or foods available in the box, the green led will light up. Plus, there is also a yellow led that will blink continuously when the number of deliveries are more than 1 to make sure that the user is alert that their dropbox has something in it. To make sure that the yellow led is blinking, I attached the circuit with a AND gate and a clock with tick frequency of 0.5 Hz.





3.0 DETAILED DESIGN

The inputs involved are A, B, C and D, meanwhile the outputs are a, b, c, d, e, f and g. For this dropbox delivery system, the truth tables are as follows:

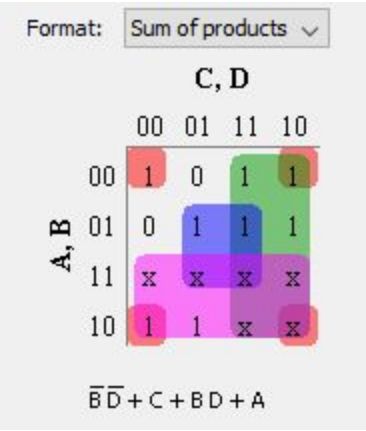
A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1
1	0	1	0	1	1	0	1	1	1	1
1	0	1	1	1	1	1	1	0	1	1
1	1	0	0	1	1	1	1	0	1	1
1	1	0	1	1	0	1	1	0	1	1
1	1	1	0	1	0	1	1	1	1	1
1	1	1	1	1	1	1	1	0	1	1

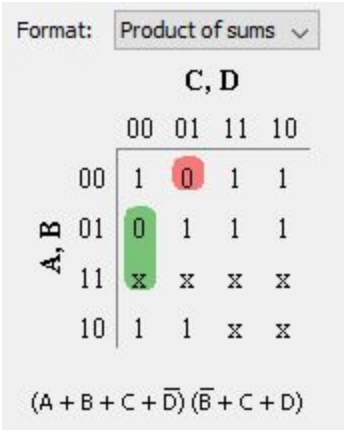
However, to display the output number 0-9 at the 7-segment display, we are only interested to know the truth table that is starting from 0 to 8 only. Hence, the sequence in the truth table after 8 are ignored or labeled as don't care because the 7-segment will not print out the output number of more than 9. The don't cares(x) truth tables are as follows:

A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1
1	0	1	0	x	x	x	x	x	x	x
1	0	1	1	x	x	x	x	x	x	x
1	1	0	0	x	x	x	x	x	x	x
1	1	0	1	x	x	x	x	x	x	x
1	1	1	0	x	x	x	x	x	x	x
1	1	1	1	x	x	x	x	x	x	x

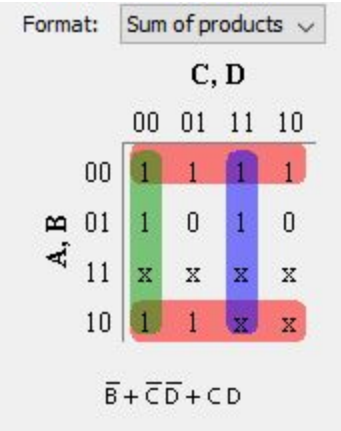
Below are the results of every 7 outputs consist of its K-maps, sum-of-products(SOP) and product-of-sums(POS) expressions :

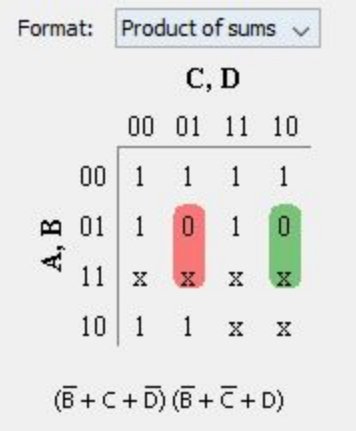
a :



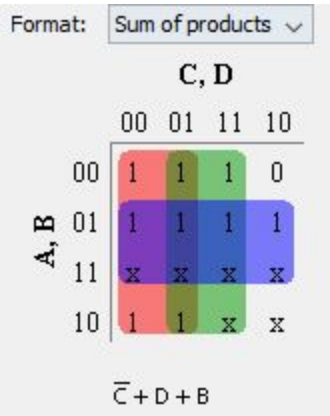


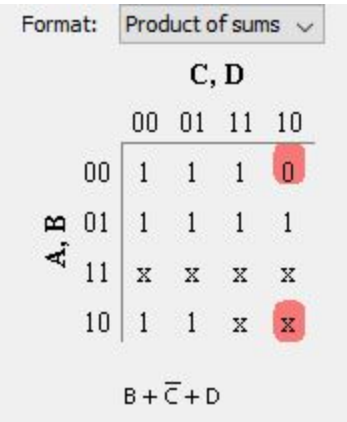
b :


Format: Sum of products
C, D
00 01 11 10
A, B
00 1 1 1 1
01 1 0 1 0
11 x x x x
10 1 1 x x
$\overline{B} + \overline{C}\,\overline{D} + C\,D$

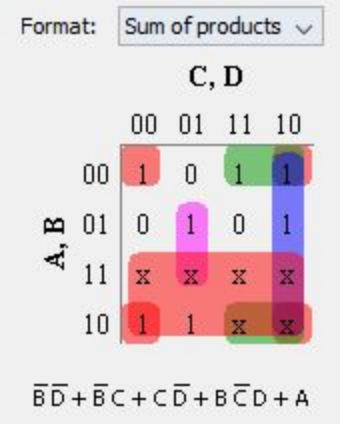

Format: Product of sums
C, D
00 01 11 10
A, B
00 1 1 1 1
01 1 0 1 0
11 x x x x
10 1 1 x x
$(\overline{B} + C + \overline{D})\,(\overline{B} + \overline{C} + D)$

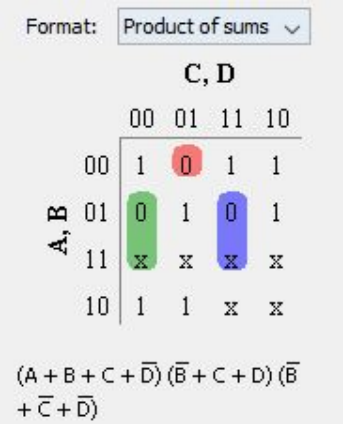
c :


Format: Sum of products
C, D
00 01 11 10
A, B
00 1 1 1 0
01 1 1 1 1
11 x x x x
10 1 1 x x
$\overline{C} + D + B$

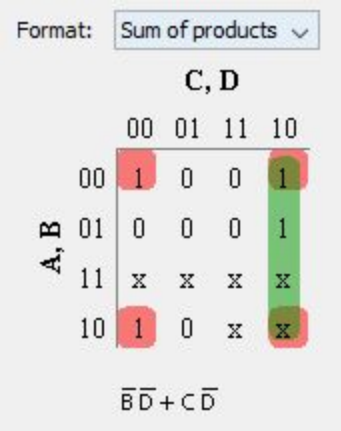

Format: Product of sums
C, D
00 01 11 10
A, B
00 1 1 1 0
01 1 1 1 1
11 x x x x
10 1 1 x x
$B + \overline{C} + D$

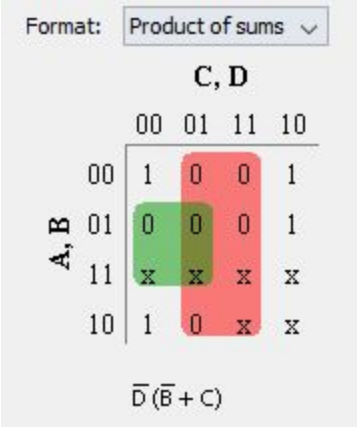
d :


Format: Sum of products
C, D
00 01 11 10
A, B
00 1 0 1 1
01 0 1 0 1
11 x x x x
10 1 1 x x
$\overline{B}\,\overline{D} + \overline{B}\,C + C\,\overline{D} + B\,\overline{C}\,D + A$

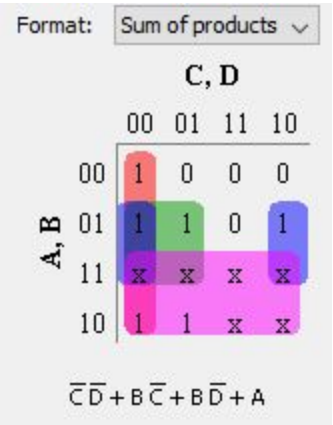

Format: Product of sums
C, D
00 01 11 10
A, B
00 1 0 1 1
01 0 1 0 1
11 x x x x
10 1 1 x x
$(A + B + C + \overline{D})\,(\overline{B} + C + D)\,(\overline{B} + \overline{C} + \overline{D})$

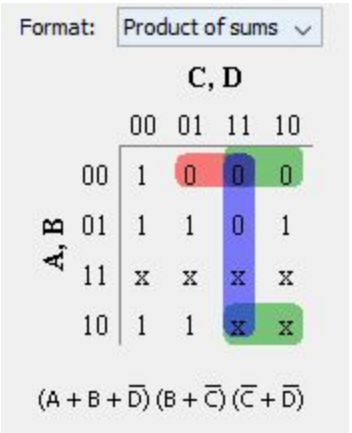
e :


Format: Sum of products
C, D
00 01 11 10
A, B
00 1 0 0 1
01 0 0 0 1
11 x x x x
10 1 0 x x
$\overline{B}\,\overline{D} + C\,\overline{D}$

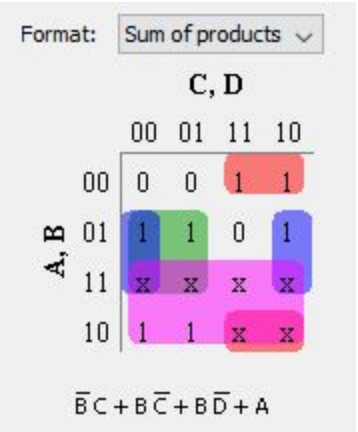

Format: Product of sums
C, D
00 01 11 10
A, B
00 1 0 0 1
01 0 0 0 1
11 x x x x
10 1 0 x x
$\overline{D}\,(\overline{B} + C)$

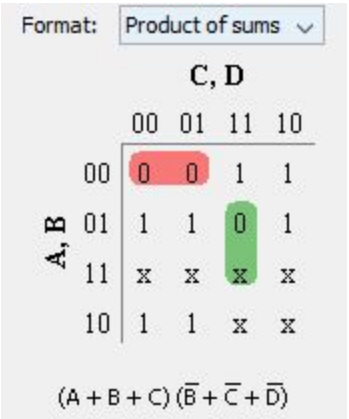
f :


Format: Sum of products
C, D
00 01 11 10
A, B
00 1 0 0 0
01 1 1 0 1
11 x x x x
10 1 1 x x
$\overline{C}\,\overline{D} + B\,\overline{C} + B\,\overline{D} + A$

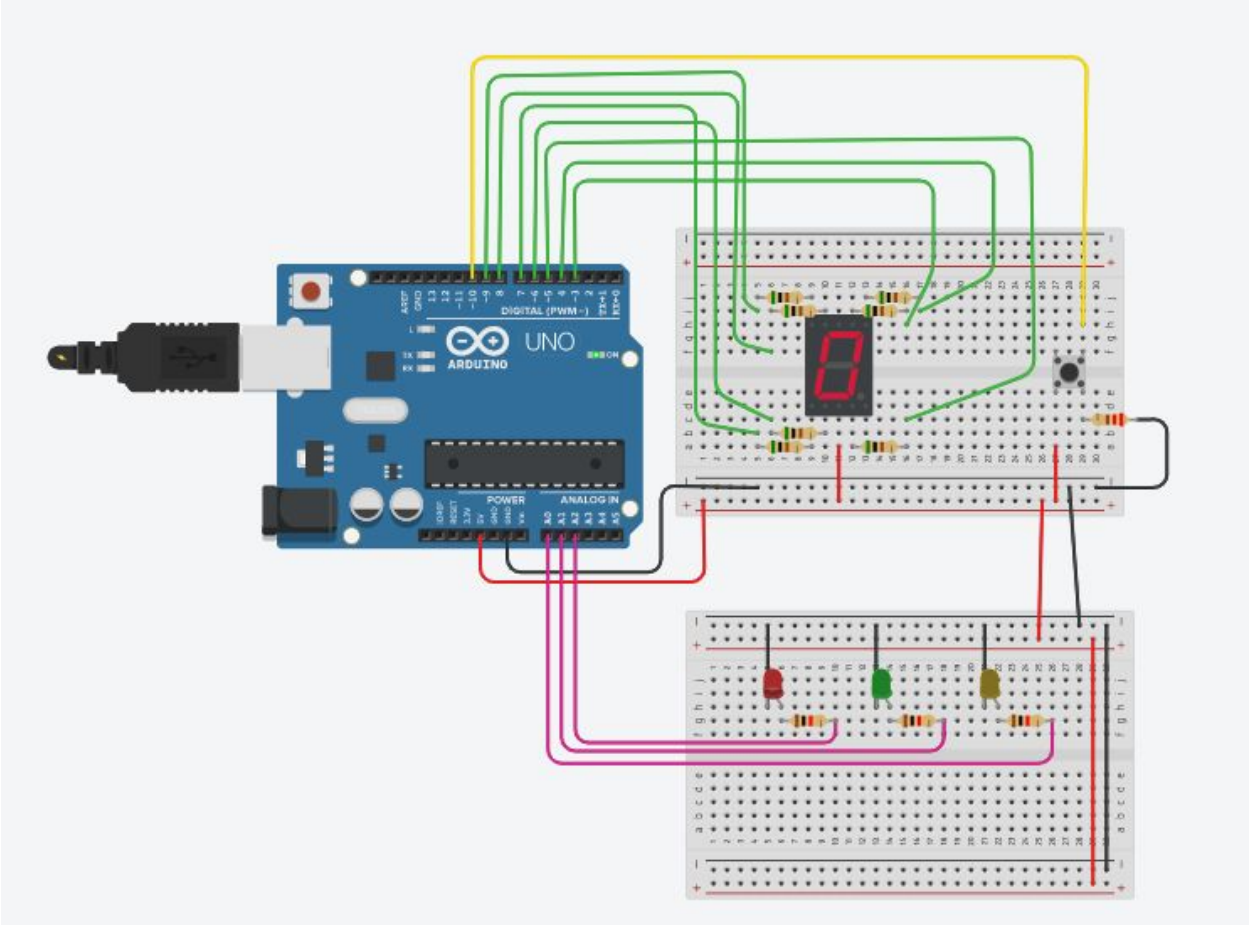

Format: Product of sums
C, D
00 01 11 10
A, B
00 1 0 0 0
01 1 1 0 1
11 x x x x
10 1 1 x x
$(A + B + \overline{D})\,(B + \overline{C})\,(\overline{C} + \overline{D})$

g :


Format: Sum of products
C, D
00 01 11 10
A, B
00 0 0 1 1
01 1 1 0 1
11 x x x x
10 1 1 x x
$\overline{B}\,C + B\,\overline{C} + B\,\overline{D} + A$


Format: Product of sums
C, D
00 01 11 10
A, B
00 0 0 1 1
01 1 1 0 1
11 x x x x
10 1 1 x x
$(A + B + C)\,(\overline{B} + \overline{C} + \overline{D})$

4.0 DESIGN VERIFICATION



To see more clearly how this dropbox delivery system works, I implement the system by using the Tinkercad software. Above is the sample of the system. The button symbolises the 4 inputs of A, B, C and D at which every time it is being pushed, the number of 7-segments will keep on increasing and until 9 before is reset back to 0. Other components like the LEDs and 7-segment display work exactly the same like how I design in the Logisim based on the gates that are involved within the components. Here is the link to the Tinkercad above: https://www.tinkercad.com/things/kRL04G0SNEr-copy-of-counter-using-7-segment-display-and-pushbutton/editel?sharecode=YKokWtZ1_9ul7LwW_2Jh13dDMq3aetQBB6jpKLjo58o

5.0 CONCLUSIONS

To conclude, the existence of this dropbox delivery system is one of the advanced systems alternatives that can help in reducing the risk of Covid-19 transmission among people. Among the advantages of this dropbox could be to avoid contact between people, hence reducing the risk of Covid-19 and also the delivery goods are more secure, plus customers are able to notice that their parcel or food has arrived in front of their house.

Besides, the dropbox system can be installed not only just at home, but also at the restaurants, shopping malls and public places that involve delivering and receiving goods. Thus, with the knowledge that I learnt in the Digital System Design topics, I believe that this working dropbox system will help people in their daily life and together we can break the chain of Covid-19.