Gas Analysis Codivirus Method for Detecting the Threshold of Contagiousness and Therapy Adjustment

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Abstract— *To date, there is no easy-to-use method and device for its implementation for the detection of codivirus-infectious people by exhalation. The main method of covid infection is airborne when droplets of the infected saliva person enter the oral cavity of healthy person. Such method would make it possible to detect infected people and prevent them from entering in public places and send them to quarantine immediately. The method is not traumatic, unlike the PCR test, and along with other methods, it would allow adjusting the patients covid treatment in the hospital. Currently, gas analyzers are accurate research methods with a division value of 1 ppm. The purpose of this work is to identify which gases during the exhalation of infected or sick person are decisive, how to measure them during exhalation, how these gases are associated with entry proteins and enzymes of saliva? How change a gas concentrations depending from the infection and illness time, and what are their values?.*

Keywords— codivirus-infectious people by exhalation, gas analyzers.

I. INTRODUCTION

The main route of covid infection is aerosolized saliva from person's mouth into mouth. Droplets are formed as result of coughing, sneezing or conversation [1,2].

Till three thousand infected small droplets are formed at coughing. Almost the same numbers of droplets are formed during 5-minute conversation [3]. A single sneeze produces up to 40,000 droplets of saliva with different dispersion to some meters [3]. Normal exhalation produces droplets of saliva that can be airborne up to 1 meter. Larger and heavier droplets of saliva tend to fall to the ground by ballistic trajectory. Small cloud droplets are formed and then with air currents are transported over longer distances [2,3]. Aerosols are solid particles suspended liquid in the air with ranging in size from 0.001 to 100 microns [3]. The time the droplets remain in the air travel depend from their size [3]. Large droplets (diameter > 60 µm) tend to settle quickly. Transmission via small droplets (diameter ≤ 60 µm) can occur over short distances (distance between people less than 1 m). There is possibility also that small droplets under favorable conditions will turn into airborne suspension of infectious particles (diameter <10 µm) and carried over longer distances [4].

In other words, oral cavity this is initial place of covid infection.

On the other hand, in the study of human venous blood was found that the concentrations of carbon dioxide and bicarbonates increase significantly, by 83% and 8.8%, respectively [5].

Besides, during covid infection observe for more half of sick persons a dry mouth and amblygestia (a dulling of the sense of taste). These symptoms arise from impaired tongue function from ACE2 expressing and furin and also ACE2 expression in the salivary glands [6].

Currently, there are gas analyzers for determining the concentration of gases with division value of 1 ppm or 0.000001 fractions in air. That's why it is technically possible to detect changing of the carbon dioxide and hydrocarbonate suspension concentrations in the air at covid contagiousness people at exhale for distance till 1 meter.

II. PROBLEM FORMULATION

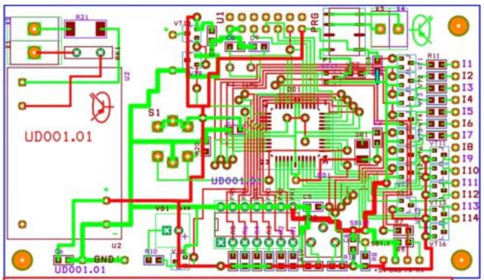
The technical task of this work was to create a gas analyzer with calibration for carbon dioxide and for suspended saliva hydrocarbons in the air based on the Arduino microcontroller with digital signal processing and comparing the results with calibration curves by this gases, with follow visualization of these changes on the screen, sensor buzzer and telegram channel messenger with a division value of 1 ppm. Research tasks are:

1. Is there an increasing of carbon dioxide and suspended saliva bicarbonates concentrations during human exhalation of infected covid patients and what is their percentage ratio?
2. How change the concentrations of carbon dioxide and saliva bicarbonates suspension at exhales person from day time illness?
3. How are change the carbon dioxide and saliva bicarbonate suspension concentrations related with two key input proteins known as the ACE2 receptor and the TMPRSS2 enzyme?

III. RESULTS AND DISCUSSION

The gas analyzer has the following view

FIGURE 1: Gas analyzer



DRILL CHART				
SYM	DIAM	TOL	QTY	NOTE
○	0.712 mm		50	
⊞	0.786 mm		2	
+	0.862 mm		18	
×	0.964 mm		44	
⊱	1.016 mm		3	
⊠	1.498 mm		6	
▵	1.600 mm		2	
◇	2.158 mm		2	
+	3.500 mm		3	
TOTAL			130	

FIGURE 2: Gas analyzer plata

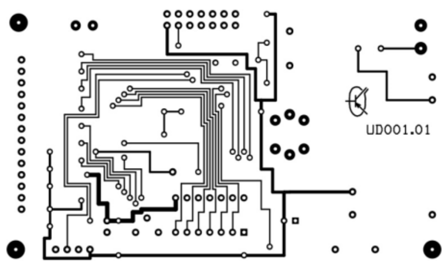


FIGURE 3: Gas analyzer plata-bot

The device was calibrated for carbon dioxide and saliva bicarbonates suspension at 20 degrees Celsius at normal atmospheric pressure and humidity with pre-treatment by bactericidal lamp. Data gas concentrations were measured by 1 or 2 analog gas detectors of the arrays data concentrations carbon dioxide P1 extensional and saliva bicarbonates suspension P2 extensional for nonequilibrium measurement system with follow by comparison arrays data calibration curves functional E1 , sub functional E2 both gases and with subsequent recording of nonlinear equations but already an equilibrium system measurements with interactions of both gases during exhalation in a mixture of atmospheric air and then followed by digitization on Arduino microcontroller [7-9].

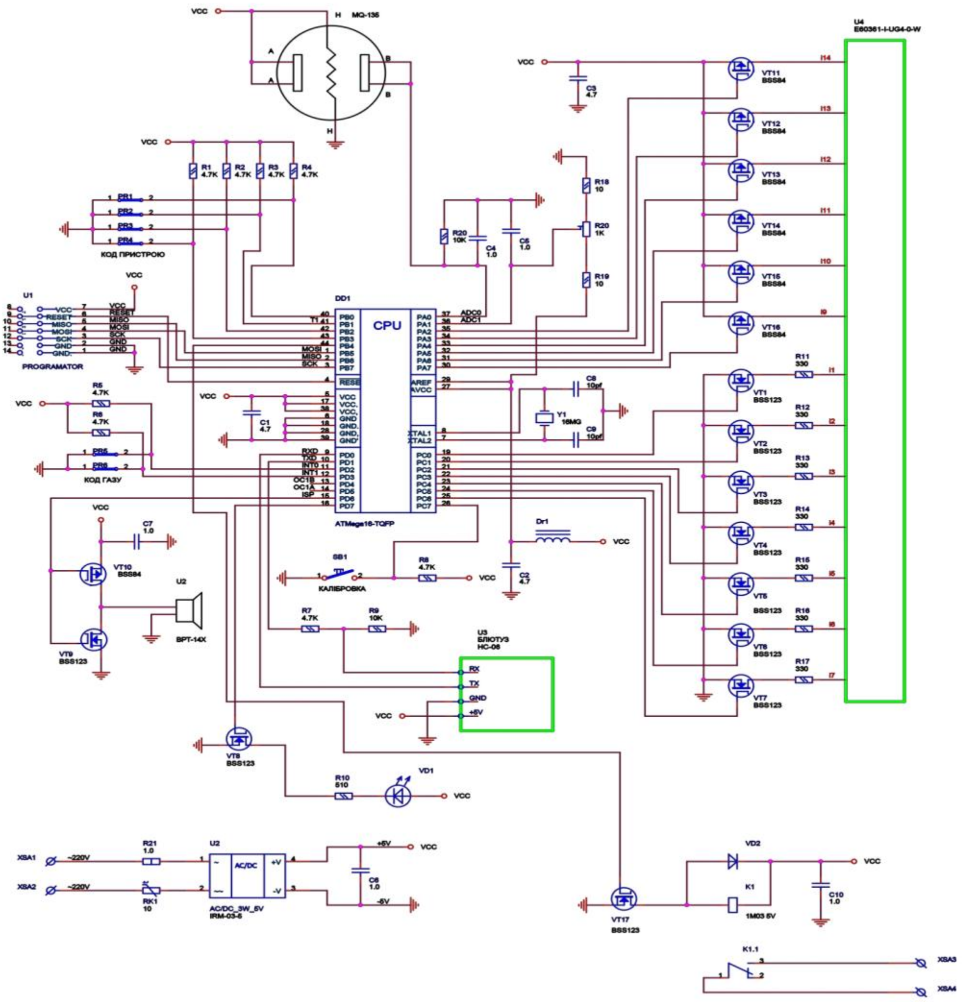


FIGURE 4: Gas analyzer scheme.

Analog signals are fed to the microcontroller. Below is a calculation of carbon dioxide concentration in air based on the calibration, experimental sensor resistance values, calculated analog-to-digital converter characteristics and the carbon dioxide value in air of the Global Atmospheric Bulletin for January 2022

$$Res/E_1 \text{ x } E_2 = [(adc_0 \text{ x } 0{,}1875/1000) \text{ x } 4 \text{ x } R_{load}] /E_1 \text{ x } E_2 \quad (1)$$

$$p = (Res/E_1 \text{ x } E_2) /ATM_{0CO2} \quad (2)$$

Res - detector resistance in Om,

E_1 - temperature correction coefficient,

E_2 - humidity correction coefficient,

Res/E_1 x E_2 - calculate concentration carbon dioxide value in resistance detector units,

adc_0 - analog detector value,

U=float (adc_0) x 0,1875/1000, converting an analog detector value in voltage,

Coef V = 0.1875, constant for the accuracy of the analog-to-digital converter,

d = 1000, divisor to get value in volts,

Res = U x 5 - 1, here a resistance detector calculation,

V = 4 V, 4 volt gas analyzer supply,

R_{load} - resistor value in Om,

p - Carbon dioxide concentration in air in ppm,

ATM_{0CO2} = 417,99 ppm, carbon dioxide value in air in ppm at Global Atmosteric Bulletin, January, 2022. http//www.co2.earth/

Exactly the same calculation and for saliva bicarbonates concentration.

$ATM_{bicarbonates}$ = 16, 4 ppm , saliva bicarbonates concentration in air at health human exhalation defined by sampling of spectrophotometer Lambda 365, USA. Controlled also saliva samples of health and covid infected peoples and received a results 8-9,5 % in side of increasing, which is consistent with [5].

Calibration curves were built taking into account the temperature E_1 and humidity E_2 Winter-Summer regime at the Odessa latitudes and climate, Ukraine. To do this arranges a separate unit with temperature and humidity sensors into detector sheme. Other words, calculation coefficients ATM_{0CO2} = 417,99 ppm and $ATM_{bicarbonates}$ = 16, 4 ppm enter 1 time after calibration curves built on experimental values of temperature and humidity detectors.

Their changes show the intensity for each concentration relationship and for 2 functional or their sub functional have the form:

$$P_1 = f_1 (E_1 , E_2)$$

$$P_2 = f_2 (E_1 , E_2) \tag{3}$$

Fig. 5,6.

Differentiating among the equation, absolutely the outcome will be:

$$dP_1 = A_{11}\, dE_1 + A_{11} d\, E_2$$

$$dP_2 = A_{12}\, dE_1 + A_{12} d\, E_2 \tag{4}$$

The state coefficient nonequilibrium measure system A connects the functional and intensials, when changing from one nonequilibrium state to another, coefficients A temperature and humidity changes. Obviously, the coefficient of state is also a show the carbon dioxide and saliva bicarbonates concentrations E_2 of exhaled gases in the structure volumes of atmospheric air.

There are simple and cross-sectional coefficients of connections between singles structures of state and interactions of structures under distribution of exhaled gases in the volume of atmospheric air distributions. Basic and cross coefficients A in the form of corresponding functions of various functional E, as for carbon dioxide can be outdoor wind speed, the presence of cars and air pollution with carbon monoxide; for saliva bicarbonates concentrations this can be also outdoor wind speed and the presence of detergents based on soda or soda drinks :

$$A_{11} = f_{11} (E_1, E_2)$$

$$A_{12} = f_{12} (E_1, E_2)$$

$$A_{21} = f_{21} (E_1, E_2)$$

$$A_{22} = f_{22} (E_1, E_2) \tag{5}$$

We studied about 5,000 people with and without signs of covid in the street, quarantine and hospitals. The subjects exhaled air with open mouth for distance 10 cm. The values of gas concentrations were recorded on the display. Research has identified the following groups of people: 1. Healthy people who haven't any covid external signs and both gas concentrations no increase. 2. Healthy (infected -?) people who haven't any covid external signs of the disease, but have elevated concentrations of either carbon dioxide or both gases, possibly an asymptomatic form. 3. Infected people who have external signs of illness and have elevated concentrations of either carbon dioxide or both gases. 4. Sick people who have external signs of illness and have more elevated concentrations of both gases. 5. Sick people who have external signs of the disease, but recovering and having elevated concentrations of either carbon dioxide or both gases with tendency to decreasing.

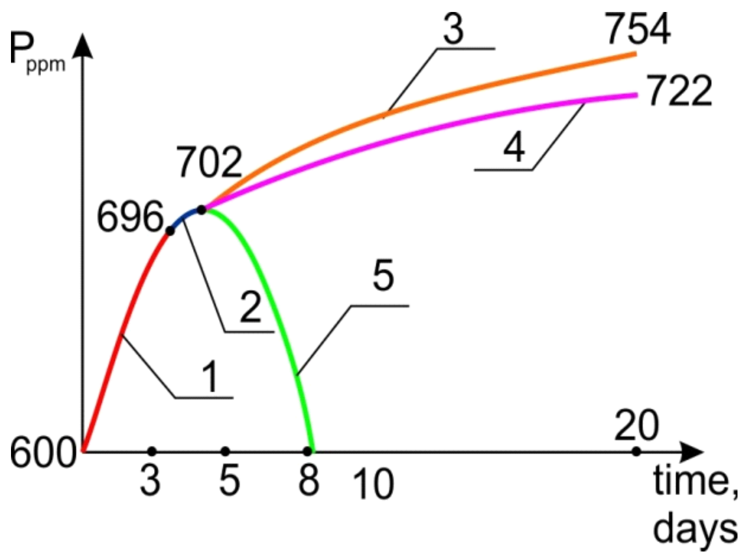


FIGURE 5: Curve of concentrations of carbon dioxide during exhalation of infected and sick people with covid.

The results of the research are presented by graphs of carbon dioxide concentrations (Fig.5) and suspensions of bicarbonates in saliva (Fig. 6) depending from infection day at exhalation. The counting of the curves is considered from start of infection for given room with values 630 and 35 ppm concentrations of carbon dioxide and suspended bicarbonates in saliva respectively. Curve 1 (red colour) is the area of infection with increasing of gas concentrations to 696 and 39 ppm of carbon dioxide and suspended bicarbonates respectively and corresponds to groups 2 and 3 of asymptomatic and infected people. Curve 2 (blue colour) is the area of disease stabilization with slight increases of gas concentrations to 702 and 40 ppm of carbon dioxide and suspended bicarbonates respectively.

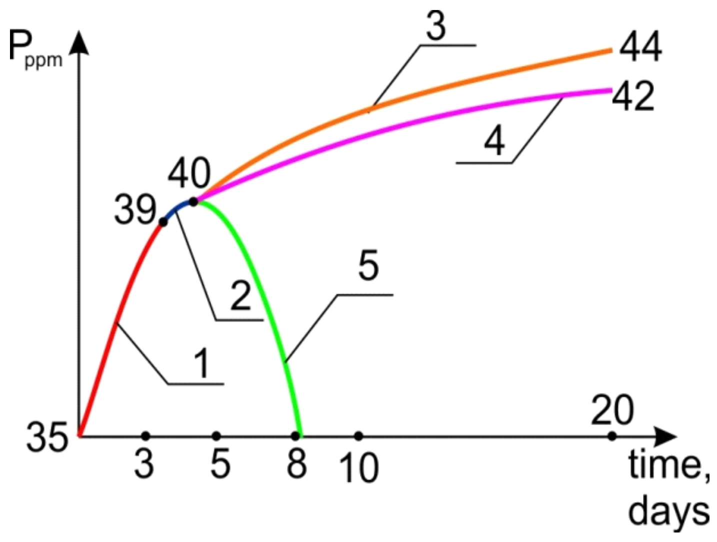


FIGURE 6: Curve of concentrations of suspension of bicarbonates in saliva during exhalation of infected and sick people with covid.

Curve 3 (orange colour) is a further escalation of the disease with increasing of concentrations to 722 and 42 ppm of carbon dioxide and suspended bicarbonates respectively and correspond to medium form of severity of covid illness. Curve 4 (crimson colour) is a further escalation of the disease with increasing of concentrations to 754 and 44 ppm of carbon dioxide and suspended bicarbonates respectively and correspond to heavy form of severity of covid illness. Curve 5 (green colour) show a recovery of human and decreasing a value both gas concentrations. The gas analyzer examines the process of infection through saliva in the oral cavity. If we consider curves 1 and 2 from the side of key entry proteins ACE2 receptor and the TMPRSS2 enzyme we can approve about infection development (Fig.5,6) [5], curve 2 as blocking the infection development in the body host human with codivirus colony. It correspond a results many researchers that 2-3 days after the first disease signs appear dry mouth and decrease the saliva production. Covid disease seems to spread to the bronchi and lungs.

IV. CONCLUSION

It is possible to detect covid illnesses by gas analyzers based on person's exhalation. Carbon dioxide and a suspension of bicarbonates in saliva show a steady increasing to 150 and 20 ppm respectively. Both curves are characterized by the stage of infection, a sharp increasing in the concentrations of both gases from the first hours to 2-3 days of illness depending from different strains. Further, the disease stabilizes within 1-2 days. After that covid illness passes in medium or heavy form or the person recovers.

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