Version 1

Nov 03, 2020

Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 V.1

Salvatore D Morgera[1], Tiffany Miller[2], Arash Takshi[1], Stephen E Saddow[3], Matthew Palm[4]

[1]Department of Electrical Engineering, University of South Florida, Tampa, FL, United States of America;
[2]Department of Electrical Engineering, University of South Florida, Tampa, FL, United States of America, Inventions International Inc.;
[3]Department of Electrical Engineering, University of South Florida, Tampa, FL, United States of America, Department of Medical Engineering, University of South Florida, Tampa, FL, United States of America,;
[4]Valhall K-9 International, LLC, Hull, GA, United States of America

In Development dx.doi.org/10.17504/protocols.io.bpcqmivw

Front Line Technologies

Tiffany Miller

ABSTRACT

The magnitude of how rapidly the COVID-19 virus could spread and infect others facilitated the need for a rapid COVID-19 test, accessible and affordable for both children and adults worldwide. As a result, an infected patient can quickly quarantine and isolate to slow the spread. Our research group has determined VOCs associated with COVID-19 and has built a prototype gas analysis system similar to a breathalyzer for detecting gasses of COVID-19. Some of the symptoms like headaches, coughing, and diarrhea result in an inflammatory response to create a unique variety of gasses like acetone, hydrogen, and carbon monoxide that can be detected when they are exhaled through a person's breath. A sample of a person's breath is first collected in a chamber when a patient breaths into the valve, the gas sensors then detect a voltage change when they contact a COVID-19 target gas. The concentration in parts-per-million is calculated based on the non-linear resistance ratio of the target gas and clean air. Log-based scale calculations and post-data processing calibrate the sensors to increase the accuracy and selectivity. Finally, the voltages and PPM of the target gas concentration data is stored in a computer database and sensor coding reveals the resulting breath pattern signature of COVID-19. At just under $15.00 United States Dollars (USD), test results are just a breath away, within seconds of taking the test and even before leaving the doctor's office. Although, this system may also be modified to sniff out other pathogens of disease, spoiled meats, and ripened fruit, we are dedicated to build a gas sensor platform for low cost, noninvasive, and rapid detection of the breath pattern signature of COVID-19, in an attempt to slow the spread of the global health threat of infection and in turn to help save lives.

Breath analysis systems serve as a noninvasive means for disease screening. Our objective is to utilize this prototype to obtain a database of H2, CO, NO, Acetone and Alcohol concentrations, whereby, COVID patient breath samples are compared to healthy individual breath samples using our breath analysis system prototype. This system is configured for measuring the aforementioned gas concentrations in ppm and recording the data to a text file in a computer database for subsequent analysis. The data obtained from this study is critical to the development of this system.

ATTACHMENTS

Image_COVID_Breath.jpg

DOI

dx.doi.org/10.17504/protocols.io.bpcqmivw

COLLECTION CITATION

Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm 2020. Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . **protocols.io** https://dx.doi.org/10.17504/protocols.io.bpcqmivw Version created by Tiffany Miller

KEYWORDS

Citation: Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm (11/03/2020). Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . https://dx.doi.org/10.17504/protocols.io.bpcqmivw

XPRIZE, COVID-19 Breath Signature, Gas Sensor, Brain Breath Biochemistry, Volatile Organic Compounds

CREATED

Nov 03, 2020

LAST MODIFIED

Nov 03, 2020

COLLECTION INTEGER ID

44144

ATTACHMENTS

Image_COVID_Breath.jpg

GUIDELINES

A breath collection vessel shown below has a first check valve and a second check valve.

USF Bull Nose

Prototype **NA**

Prototype Breath Collection Device Housing

00:00:05 Take a deep exhale through mouthpiece

Standard Operating Procedure of Electronic Nose System.docx

Citation: Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm (11/03/2020). Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . https://dx.doi.org/10.17504/protocols.io.bpcqmivw

A user wears a specially adapted disposable mask with a one-way valve with filter.

Currently, gas sensors in today's market are not configured for breath analysis of COVID-19. A test bed prototype has been built and has an array of metal-oxide semiconductor gas sensors capable of detecting gas concentrations in parts-per-million (ppm) of hydrogen, CO, acetone, and alcohol and an electrochemical sensor capable of detecting gas concentrations in parts-per-million (ppm) NO. The gas sensors have a novel mucin gel replaceable insert (in conceptual phase and currently seeking patent protection) overlaying the sensing elements and heater element. This mucin gel replaceable insert has a plurality of pores to allow passage of breath to pass through and communicate with the gas sensors. The mucin gel replaceable insert is not static and has cilia-like projections coated in mucin gel located on at least a portion of a wall surface of each pore of the plurality pores of the mucin gel replaceable insert. These cilia-like projections move as the force of an individual's breath passes through the pores of the mucin gel replaceable insert and mimics the moist environment of a nasal cavity for enhanced selectivity and detection of a target gas.

Citation: Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm (11/03/2020). Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . https://dx.doi.org/10.17504/protocols.io.bpcqmivw

This test bed prototype is configured for measuring gas concentrations in ppm and recording the data to a text file in a computer database for subsequent analysis to determine a breath pattern signature of COVID-19. A description of our prototype is as follows: a breath collection vessel has a first check valve and a second check valve. The first check valve located at the top of the housing allows exhaled breath to enter the collection chamber. A patient will breath into this valve through a mouthpiece. The second check valve allows exhaled breath to escape the collection chamber, therefore, purging the collection chamber of encased exhaled breath. Thus, the exhaled breath is trapped within the collection chamber and is positioned between the first check valve and the second check valve. The gas sensor is retained within the collection chamber of the housing and a microcontroller is in electrical communication with a computer.

A specialized mouthpiece was built to comprise a mask and a one-way valve having a filter so that an individual could provide a breath sample into the collection vessel without having to remove a mask barrier member from their face due to COVID-19 precautions. Further, sterilization elements such as UVC light emitting diodes have been incorporated into the conceptual design of the breath sample chamber. The exhaust or output valve will be connected to a filtration system to purify the air being purged from the breath collection chamber. Our system provides a database of a plurality of different VOC concentrations from a sample of breath to form a breath pattern signature of COVID-19.

BEFORE START

55 % **20 °C +-2**

MATERIALS TEXT

Mask with one-way valve

Prototype **NA**

Breath Collection Device having housing and sensor array

Prototype **NA**

Compressed Air

NA **NA**

SAFETY WARNINGS

Citation: Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm (11/03/2020). Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . https://dx.doi.org/10.17504/protocols.io.bpcqmivw

Device must be sterilized prior to each use to prevent the spread of COVID-19.

DISCLAIMER:

DISCLAIMER – FOR INFORMATIONAL PURPOSES ONLY; USE AT YOUR OWN RISK

The protocol content here is for informational purposes only and does not constitute legal, medical, clinical, or safety advice, or otherwise; content added to protocols.io is not peer reviewed and may not have undergone a formal approval of any kind. Information presented in this protocol should not substitute for independent professional judgment, advice, diagnosis, or treatment. Any action you take or refrain from taking using or relying upon the information presented here is strictly at your own risk. You agree that neither the Company nor any of the authors, contributors, administrators, or anyone else associated with protocols.io, can be held responsible for your use of the information contained in or linked to this protocol or any of our Sites/Apps and Services.

ABSTRACT

The magnitude of how rapidly the COVID-19 virus could spread and infect others facilitated the need for a rapid COVID-19 test, accessible and affordable for both children and adults worldwide. As a result, an infected patient can quickly quarantine and isolate to slow the spread. Our research group has determined VOCs associated with COVID-19 and has built a prototype gas analysis system similar to a breathalyzer for detecting gasses of COVID-19. Some of the symptoms like headaches, coughing, and diarrhea result in an inflammatory response to create a unique variety of gasses like acetone, hydrogen, and carbon monoxide that can be detected when they are exhaled through a person's breath. A sample of a person's breath is first collected in a chamber when a patient breaths into the valve, the gas sensors then detect a voltage change when they contact a COVID-19 target gas. The concentration in parts-per-million is calculated based on the non-linear resistance ratio of the target gas and clean air. Log-based scale calculations and post-data processing calibrate the sensors to increase the accuracy and selectivity. Finally, the voltages and PPM of the target gas concentration data is stored in a computer database and sensor coding reveals the resulting breath pattern signature of COVID-19. At just under $15.00 United States Dollars (USD), test results are just a breath away, within seconds of taking the test and even before leaving the doctor's office. Although, this system may also be modified to sniff out other pathogens of disease, spoiled meats, and ripened fruit, we are dedicated to build a gas sensor platform for low cost, noninvasive, and rapid detection of the breath pattern signature of COVID-19, in an attempt to slow the spread of the global health threat of infection and in turn to help save lives.

Breath analysis systems serve as a noninvasive means for disease screening. Our objective is to utilize this prototype to obtain a database of H2, CO, NO, Acetone and Alcohol concentrations, whereby, COVID patient breath samples are compared to healthy individual breath samples using our breath analysis system prototype. This system is configured for measuring the aforementioned gas concentrations in ppm and recording the data to a text file in a computer database for subsequent analysis. The data obtained from this study is critical to the development of this system.

FILES

Mask-Based Covid-10 testing system using Exhaled Breath Condensate
Version 1
by John Daniels

Citation: Salvatore D Morgera, Tiffany Miller, Arash Takshi, Stephen E Saddow, Matthew Palm (11/03/2020). Breath Analysis System for Detecting Breath Pattern Signature of COVID-19 . https://dx.doi.org/10.17504/protocols.io.bpcqmivw