A rapid diagnosis tool based on LASER for fighting COVID-19

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A Rapid Diagnosis Tool Based on LASER for Fighting COVID-19

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***Abstract*-This paper explains in detail how different technological fields can help to fight against the COVID-19 pandemic disease by means of innovative applications. These technological fields are such as Internet of Things (IoT), Nanotechnology, etc. On the other hand, this paper proposes a new accurate and rapid diagnostic tool that can give more accurate and faster COVID-19 test results than the traditional used RT-PCR test and other new tool called Diffractive Phase Interferometry (DPI). Our approach uses a Raman spectroscopy technique to identify the coronavirus. The sample is taken by blowing the person through a sample chamber that made from carbon nanotubes (CNT). Then, the viruses can be optically characterized by focusing laser light on the collected sample. As known, every virus has its own fingerprint that can distinguish the coronavirus from any other type of viruses such as influenza. This paper introduces a performance comparison between our proposed COVID-19 diagnostic method with the traditional RT-PCR method and the DPI tool. The results showed the great ability of the proposed diagnostic tool to identify the virus easily, quickly, and accurately compared with the existing diagnosis tools.**

***Index Terms*- Carbon-nano Tube (CNT), COVID-19, DPI, Nanotechnology, Raman Spectroscopy, RT-PCR.**

I. INTRODUCTION

In December 2019, a novel coronavirus, nominated as SARS-CoV-2, was detected in Wuhan city of the Peoples Republic of China [1], [2]. This virus caused a respiratory disease called as Coronavirus Disease 2019 (COVID-19). Due to the spread of COVID-19, the World Health Organization (WHO) announced it to be an international Pandemic on 12th March 2020 [3], [4].

As of June 30, 2020, at the time of writing this paper, the total number of COVID-19 confirmed cases reach 5,923,055, with recorded deaths from the disease at 364,836. In Egypt, there are 22,082 confirmed cases with around 900 persons recorded as deaths from the disease [5]. Fig. 1 shows the distribution of infected cases in most infected countries.

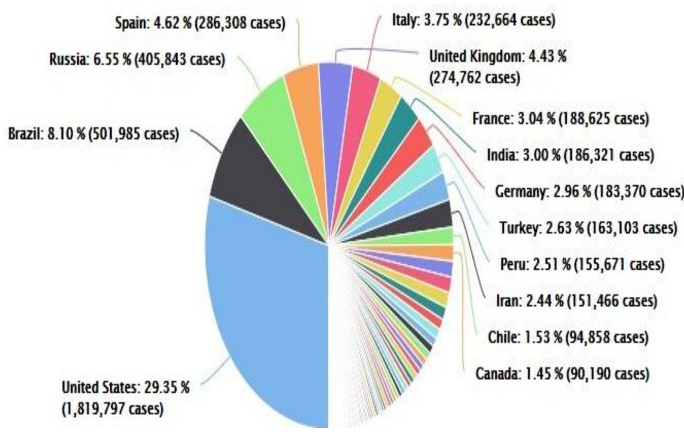

Fig.1. The distribution of infected cases in most infected countries.

The virus growth curve is a classic exponential graph. The experts said that “flattening the spread curve” can help to reduce the current coronavirus outbreak and finally restoring a sense of societal normalcy [6]. If preventative measures have been put seriously (such as self-quarantine, not gathering together, social distancing, wearing masks, avoiding touching the eyes, nose, or mouth with unwashed hands, etc.), this can help to make the daily number of infected cases at a manageable level for medical providers [7]–[9]. As shown in Fig. 2, a higher curve has been resulted due to the steep increase in the number of infected cases per day.

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However, due to a flatter curve, there is a more gradual increase in the number of cases per day. After a long period, the number of people infected might be around the same in two curves, but the difference is the number of infected cases per each day. This is necessary due to the limited numbers of hospitals, doctors, and the capacity of the health system. If many people require healthcare at the same time, it means a high stressed health care system (red curve). The flatter the curve, the more likely it is that hospitals continue to deliver care to the people they serve (blue curve).

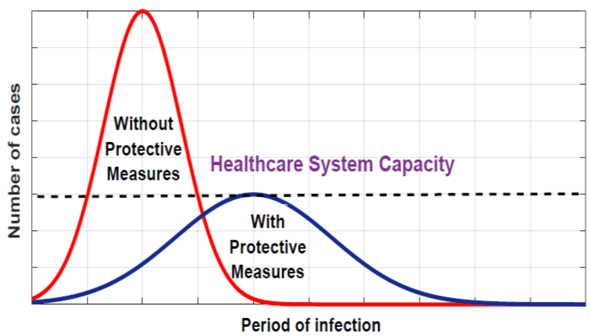

Fig.2. The exponential growth curve of COVID-19.

Many countries took the concept of flatten the growth curve while facing COVID-19 and found that it is the best way to fight this virus with lowest human losses like china, Spain [7], Korea [8], Ghana and other countries [10]. In order to that, Egypt does its best efforts to minimize the overall COVID-19 attack rate and reduce the peak attack rate by flattening the curve of COVID-19 pandemic as shown in Fig. 3 [11]. Egyptian government must monitor the tested infected cases every day along with respect to the performance of citizens during the month to evaluate the appropriate strategies to flatten the growth curve as much as possible.

At the end of the first three months since the virus was identified, China start to control its initial outbreak and running again, while all other infected countries still struggle in controlling the virus. Since December 2019, many academic papers, WHO reports, and newspaper articles have been published to help governments to control the transmission of the covid-19 pandemic. There are

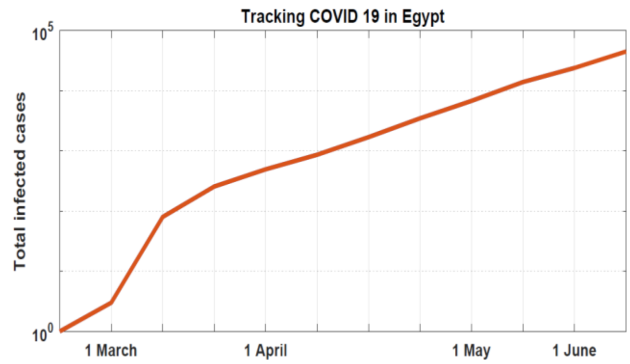

Fig.3. Tracking COVID-19 in Egypt.

many "Scientific technologies" that can be used to fight this virus such as digital information and surveillance technologies, Artificial intelligence (AI), Internet of things (IoT) technology, Open-source technologies, Telehealth technologies, and Nanotechnology [12], [13].

Applications of AI and ML [14]–[16] can be used for screening of the population and assessing infection risks. AI also can help to develop robots and drones to track the disease and enforce restrictive measures [16], [17]. Internet of things (IoT) technology [12] can provide community with real-time tracking and live updates in various online databases. Open-source projects [18] can help in rapid data sharing which allows for a better understanding of the origins and spread of the infection and can serve as a basis for effective prevention, treatment and care. At the same time, telehealth technologies [19]–[21] offer a cost-effective means to slow the spread of the virus and to maintain hospital capacity by operating as a possible filter, keeping those with moderate symptoms at home and routing more severe cases to hospitals. Nanotechnology field [22]–[24] can test and introduce future vaccines, diagnostics, and treatments. This paper analyzes recent researches based on these technologies to help rearranging existing resources and support the research community to introduce solutions that can fight the COVID-19 disease.

In other hand, this paper proposes a new accurate and fast diagnostic tool that can be used to detect the coronavirus which causes COVID-19 disease. The COVID-19 test using the proposed diagnostic tool can be performed easily and in a short time.

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Our approach combines between Nanotechnology and AI to get a most powerful tool. It depends on the laser beam and detector to identify viruses. Firstly, the sample is taken from patients by two ways which are: a nasal swab from the patient, or by a person blowing through the tool. After taking a sample, it is put in a nanocarbon [25], cylindrical shaped tubes and expose it to laser light. As each virus has its own signature vibrations that act as a sort of optical fingerprint, the laser device uses an algorithm to distinguish and detect the SARS-CoV-2. The results showed the great ability of the proposed diagnostic tool to identify the virus easily, quickly, and accurately. Finally, these results were compared with the results of existing COVID-19 diagnosis tools such as RT-PCR and a new diagnosis method called Diffractive Phase Interferometry (DPI). The performance comparison showed the superiority of the proposed model with respect to the other compared models in processing time and accuracy.

II. SCIENTIFIC TECHNOLOGIES TO FIGHT COVID-19

This section tackles the most important scientific technologies that can help humanity against the spread of the coronavirus. It is known that scientific technologies play a critical and necessary role during the disasters and crisis times. While the coronavirus pandemic found, many technological applications and actions are developed in an attempt to control the spread of the virus and extract effective drugs and vaccines to halt COVID-19 disease. These scientific technologies like Internet of Things (IoT) technology, Open-source technologies, Telehealth technologies, Artificial intelligence (AI), and Nanotechnology.

A. Internet of Things (IoT) Technology

Internet of Things (IoT) is considered as one of the most important technologies that can help in fighting COVID-19. This technology can be very helpful in applying remote medicine which can save our medical staff and address the challenge of limited resources with respect to the increasing number of patients. Also, IoT allow real-time data collection at large scale, which could then be used by a software based on AI analysis to execute statistics and forecast how and to what extent the virus will spread, given a set of pre-determined parameters and characteristics.

The IoT can help Natural disaster command centers and officials in Health Ministry by providing a platform that allows access to the collected and updated data for monitoring the COVID-19 pandemic. As instance, the "Worldometer" website which provides us with a real-time update on the actual number of infected people with virus all over the world [26]. This website also introduces the number of daily new infected cases, distribution of disease by countries and seriousness of disease (recovered, critical condition or death). In South Korea, many software engineers and experts developed websites and apps to help in tracking infected people for avoiding the fast spread of the virus. The Korean designs an interactive tracking map [27] which provides community with the patients' information, including their residence, nationality and gender. It also shows where they are hospitalized and how many people they have contacted. The Center for Systems Science and Engineering at John Hopkins University's has also evolved a COVID-19 dashboard as a real-time tracking map for following infected cases Worldwide [5]. Fig. 4 shows a COVID-19 dashboard by the Center for Systems Science and Engineering at John Hopkins University.

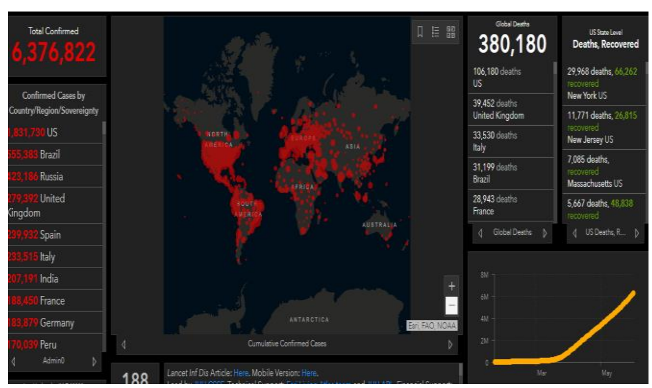

Fig.4. A COVID-19 dashboard by the Center for Systems Science and Engineering at John Hopkins University [5].

B. Open-source Technologies

While virus outbreaks, fast data sharing is very necessary as it enables all for a better understanding of the virus origins and ways of the infection spread. Due to that, all collected data about COVID-19 can

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be considered as a backbone for effective treatment, prevention and care. Most of these data-collection actions are organized by international institutions such as the World Health Organization (WHO) and the European Centre for Disease Prevention and Control [3]. Open-source technology gives us promising signs to fight coronavirus as it allows a large number of software developers, scientists, healthcare experts, and software engineers across many countries to go through searches quickly about ways for fighting virus spread hopefully mitigate the impact of the coronavirus[12] [28].

An open-source coronavirus test methodology has been developed by just One Giant Lab [29] which allows the certified labs to share test design to produce test kits easily. The research community uses many platforms to share data and information about the coronavirus. "PubMed" [30] is a platform that contains a digital archive of peer-reviewed biomedical and life sciences literature maintained by the National Library of Medicine. "bioRxiv" [31] is an open access preprint repository.

C. Telehealth Technologies

After spread of the coronavirus, governments in all infected countries have to close non-necessary services and put out stay-at-home restrictive orders to flatten the growth curve and assist overcrowded hospitals remain functional. In this case, there must be an essential link between patients and doctors or hospitals. Telehealth technologies [21] introduce effective ways to battle the spread of the virus and to reduce from the bid capacity on the hospital by keeping those with moderate symptoms at home and have a remote care by remote contact with doctors but routing more severe cases to hospitals. Several telehealth companies deployed online symptom experts to check remote patients for signs of Covid-19. These companies have recently seen a fifty percent increases in demand in the United States and the United Kingdom [33]. In Israel, the Sheba Medical Centre applied a remote infected patient-monitoring program last month, trying to control the spread of the virus [34].

D. Artificial Intelligence (AI) and Machine Learning (ML)

According to the evidence and superiority of Machine Learning (ML) and Artificial Intelligence (AI) application on the previous epidemic, researchers study how to apply them to fight against the novel Coronavirus outbreak. The spread of coronavirus raises fears in all the infected countries and all over the world, so many international organizations and scientists have already used AI to fight the spread of the coronavirus. Artificial intelligence (AI) and machine learning (ML) are playing a key role in best understanding to address and control the COVID-19 spread [14] [15]. For example, ML technology [35] enables computers to simulate human intelligence and treat with large amount of data to quickly identify patterns and insights. Due to that, organization quickly applies their AI and ML expertise in several fields to fight against COVID-19. These fields include understanding how COVID-19 spreads, where the virus might appear next and develop an effective response, speeding up research for fast treatment, and enhancing from speed and accuracy of diagnosis.

From the starting of this virus, great efforts have been done to develop new accurate diagnostic approaches using ML algorithms. In [36], for large-scale screening of COVID-19 patients, artificial neural network (ANN) classifiers were developed based on the patient's distinct respiratory pattern. Using a CRISPR-based virus detection system in [37], ML-based imaging of SARS-CoV-2 assay designs was demonstrated with high sensitivity and fast. For automated detection and remote monitoring of COVID-19 patients over time, a deep learning-based analysis model of CT-scan images was developed in [38]. Fast development of automated diagnostic systems based on AI and ML can contribute to increased diagnostic accuracy and speed. These systems will also protect healthcare staff by reducing their contacts with COVID-19 patients. Fig. 5 shows the important role of AI and ML to battle COVID-19 disease.

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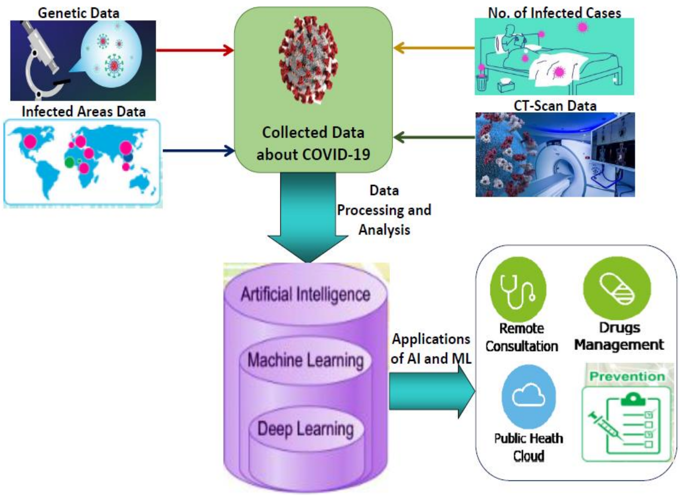

Fig.5. Applications of AI and ML to battle COVID-19 disease.

E. Nanotechnology

With the accelerating spread of COVID-19 pandemic, scientists and researchers are rapidly searching for a suitable vaccine or therapeutic to fight the COVID-19. Nanotechnology is considered as one of the most important approaches that can be used to search about suitable vaccine or therapeutic for this disease [22], [23], [39]. Nanotechnology is known as a multidisciplinary field which enables use of devices and nanoparticles for different applications. These applications include scalable diagnosis methods, targeted drug delivery and the production of new effective therapeutic and medical solutions. For instance, nanoparticles such as gold [40] and silver can help in the detection of viral particles for instance. Also, nano sensors have been showed a great ability to detect bacteria and viruses at very low concentrations which can help clinicians to test patients with very low viral loads even before clear symptoms [41]. Finally, Laser technology can be used in COVID-19 diagnostic tool which may significantly reduce testing time and give accurate results.

A team of scientists from the University of Washington's Institute for Protein Design have been manufacturing nanoparticles to create a more efficient vaccine against Covid-19 via computational models to predict and design self-assembling proteins [42]. There is a lateral flow screening test has been developed by Sona Nanotech to identify the novel Coronavirus, 2019-nCoV, through only 15 minutes, applying its proprietary nanorod technology. Meanwhile, the Spanish Ministry of Science and Innovation and the European Commission recently announced their interest to fund a research project, CONVAT, to develop a rapid COVID-19 test based on nano biosensors [42]. Phonics21 introduces a device Saliva test to detect COVID-19 based on lasers. Once a sample is prepared and has been put in a device, it confirms a positive or negative result of the coronavirus instantaneously. However, allowing for preparation time and analysis, a result — from sample to diagnosis — may take up to 30 minutes [43], [44]. Fig. 6 shows the applications of nanotechnology to tackle COVID-19.

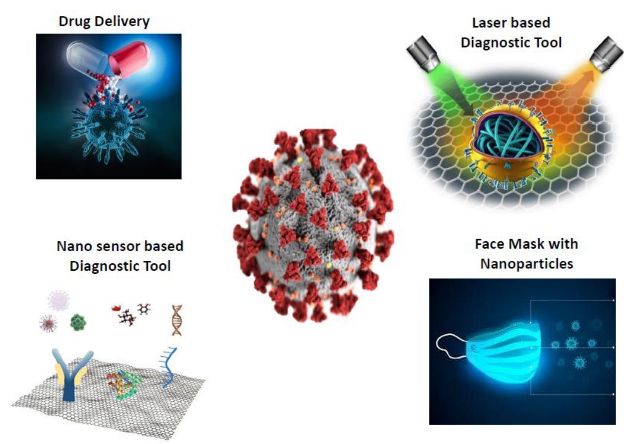

Fig.6. Applications of Nanotechnology to tackle COVID-19 disease.

III. THE PROPOSED MODEL

This section demonstrates a detailed proposed model to design diagnosis tool based on the laser for detection of COVID-19. The most common type of COVID-19 test is done by taking samples which obtained by sliding a swab into the nose or throat. This test method takes several hours and is also inconvenient for patients. Our proposed diagnostic tool is a new comfortable test tool for COVID-19 based on a laser beam technology and detector.

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This tool can help to rapidly enclose and recognize COVID-19 disease caused by the coronavirus. Instead of sliding a swab into the nose to take the patient's sample, the patient can just blow through a medical tube which is much simple and comfortable way. This proposed approach uses a Raman spectroscopy technique to detect the coronavirus. This technique based on emitting a laser light on a sample chamber where patient blowing through. Once a sample is collected, a Raman spectrometer measures the scattered light that result due to spotting the light on the collected viruses. As known that every virus has its own fingerprint that can distinguish the coronavirus from any other types of viruses such as influenza. This diagnostic tool can help to identify the virus quickly, easily, and at the point of contact. So, it can help government to halt COVID-19 disease spread. This suggested system is not useful in detecting coronavirus only, but it can also be used by doctors to detect other viruses. In another hand, this fast tool can be used in places including universities, schools, airports subway and railway stations to avoid the infection between people and control the spread of the virus. Fig. 7 represents our proposed Model.

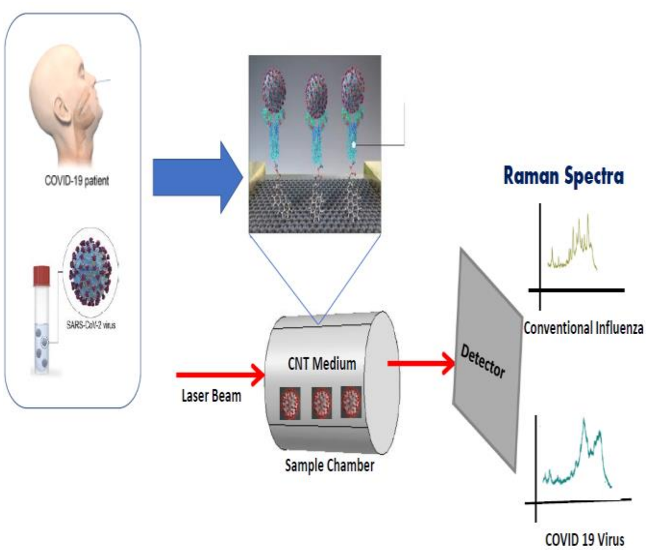

Fig.7. Our proposed Model of COVID 19 diagnosis tool based on laser.

A. Raman Spectroscopy Technique

Raman scattering [45], [46] is a very important technique which can be used to discover information about the material. When monochromatic light like LASER incident on the material, light scattered from these materials has a specific energy shift which results in a unique Raman spectrum called signature of the material (fingerprint of the material) as shown in Fig. 8. The proposed COVID-19 diagnostic model uses Raman spectroscopy technique to identify viruses by emitting a laser light through the collected sample, which is taken by blowing the patient through the a sample chamber. A Raman spectrometer measures the scattered light that result due to spotting the light on the collected viruses and detect the coronavirus fingerprint. There are two types Raman scattering which are Stokes and Anti Stokes scattering [47] [48]. Both types include information about the material. Stokes scattering is a Raman Spectroscopy type that occurred when the emitted photon has a lower energy than the absorbed photon.

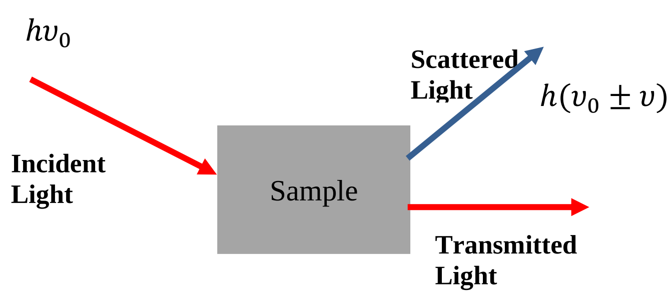

Fig.8. Principle of Raman Spectroscopy Technique.

The Anti Stokes scattering is done when the emitted photon has a higher energy than the absorbed photon. Raman spectrum can provide us with some data such as:

- The **peak intensity** gives the quantity of a specific compound information as shown in Fig. 9-a).
- A **peak shift** can define stress and strain states shown in Fig. 9-b).
- The **peak width** exposes the degree of crystallinity shown in Fig. 9-c).
- The **polarization** state supplies us with information about crystal symmetry and orientation shown in Fig. 9-d).

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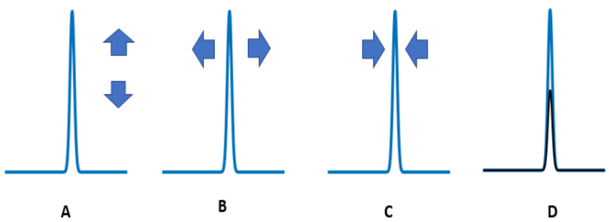

Fig.9. The information obtained by Raman Spectroscopy technique.

Let's explain the Raman using classical interoperation to simplify the principle of operation. To derive the Raman effect, assume a simple case by representing a simple diatomic molecule as a mass on a spring as shown in Fig. 10. Let m represents the atomic mass, X is for the displacement, and K represents the bond strength.

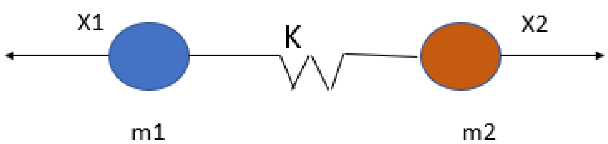

Fig.10. Representation of the molecules as a mass on spring.

Due to Hooke's law [49], the displacement of the molecules can be described as in following equation (1):

$$\frac{m_1 m_2}{m_1+m_2}\left(\frac{d^2 x_1}{dt^2}+\frac{d^2 x_2}{dt^2}\right) = -k(X_1+X_2) \quad (1)$$

where $\frac{m_1 m_2}{m_1+m_2}$ can be replaced with μ and the total displacement with q, then the equation will be simplified as:

$$\mu\frac{d^2 q}{dt^2} = -kq \quad (2)$$

By solving equations (1), and (2) for q, we get the following equation (3):

$$q = q_0 \cos\,(2pi\upsilon_m t) \quad (3)$$

Where υ_m is the molecular vibration and can be calculated as:

$$\upsilon_m = \frac{1}{2pi}\sqrt{\frac{K}{\mu}} \quad (4)$$

Due to q & υ_m equations, it is obvious that the molecule vibrates in a cosine pattern which has a frequency that directly proportional to the bond strength and inversely proportional to the reduced mass. According to that, each molecule is seen to have its own unique vibrational signatures (fingerprint) which can be determined not only by the atoms in the molecule, but also by the characteristics of the individual bonds. However, the vibrational frequencies through the Raman effect can be measured as the polarizability of a molecule, α, is a function of displacement, q. Once the incident light interacts with a molecule, it induces a dipole moment, P, equal to that of the product of the polarizability of the molecule and the electric field of the incident light source. This can be expressed as,

$$P = \alpha E_0 \cos\,(2Pi\upsilon_0 t) \quad (5)$$

where E_0 is the intensity and υ_0 is the frequency of the electric field. Then, the polarizability can be presented as a linear function of displacement using the small amplitude approximation:

$$\alpha = \alpha_0 + q\left(\frac{\delta\alpha}{\delta t}\right) + \cdots .. \quad (6)$$

By making combination between equation (3) and equation (5), the result will be the following equation (7):

$$P = \underbrace{\alpha_0 E_0 \cos(2Pi\upsilon_0 t)}_{\text{Rayleigh scattering}} +$$

$$\underbrace{q_0 \cos(2pi\upsilon_m t)\, E_0 \cos(2Pi\upsilon_0 t)\left(\frac{d\alpha}{dt}\right)}_{\text{Raman scattered component}} \quad (7)$$

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Due to the previous equation (7), the interaction of the molecule and the incident light causes two resultant effects. The first effect is called Rayleigh scattering, which is the dominate effect and results in no change in the frequency of the incident light. The second effect is the Raman scattered component which can be reformulated as shown in equation (8):

$$q_0 E_0 \left(\frac{d\alpha}{dt}\right) [\cos(2Pi\{v_0 - v_m\}t) + \cos(2Pi\{v_0 + v_m\}t)] \quad (8)$$

From equation (8), after expanding of Raman scattered component, this causes a shift to the frequency of the incident light by plus or minus the frequency of the molecular vibration. The decrease in frequency is known as a Stokes shift, while the increase in frequency is known as an Anti-Stokes shift as explained above. By measuring the change in frequency from the incident light the Raman effect now give spectroscopists a means of directly measuring the vibrational frequency of a molecular bond.

The Raman effect can be represented as nonflexible scattering of a photon out of a molecular bond. Due to the Jablonski diagram shown in Fig. 11, it describes how the incident photon excites the molecule to other virtual energy state. Due to this operation, there are three various potential outcomes. First case, the molecule can emit a photon of equal energy to that of the incident photon and due to that it will back down to its ground state. This is referred to be a Rayleigh scattering. Second case, the molecule can emit a photon with less energy than the incident photon and then it will return to a real phonon state. This is defined as Stokes shifted Raman scattering. Finally, the third potential outcome is excited to a higher virtual state. This means that the molecule is already in an excited phonon state and after certain time it will relax back down to the ground state emitting a photon with more energy than the incident photon. This case is named as Anti-Stokes Raman scattering.

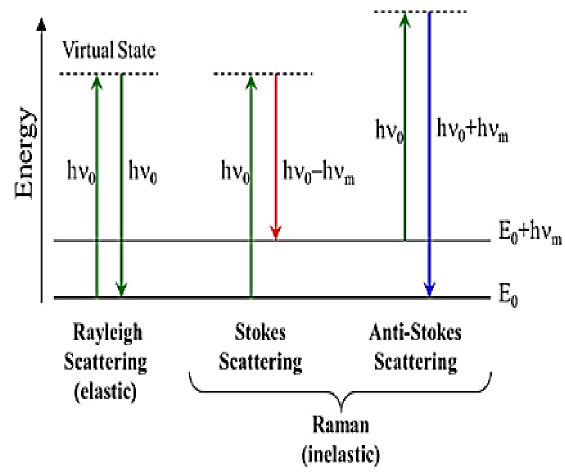

Fig.11. Joblonski diagram representing the quantum energy transitions for Rayleigh and Raman scattering [50].

B. Carbon Nano Tube

Carbon nanotube (CNT) [51] [52] is one form of carbon, with diameter of nanometer size and length of micrometer size (approximately 50,000 times less than the width of a human hair). In CNT, the atoms are coordinated in hexagons which is the same arrangement as in graphite. The structure of CNT composes of an enrolled cylindrical graphite sheet (called graphene) rolled up into a seamless cylinder with diameter of the order of a nanometer. The name of CNTs is due to their size, as these tubes have diameter size of a few nanometers. Also, they can be up to several micrometers in length. The progress of CNT production is very slow, due to that the best quality CNTs need to high production fees. There are many applications for CNT based sensors as shown in Fig. 12.

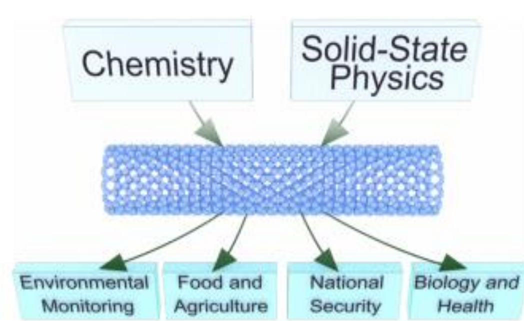

Fig.12. Schematic diagram for the application areas of the CNT based chemical sensors [50].

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Due to the nature of the CNT and its composition as shown in Fig. 13, it is easy to absorb components of the materials when patient blowing into the tube. It is the main reason that make CNT significant in our model. Once the pathogens trapped through the carbon nanotubes, the coronavirus can be optically identified during emitting a laser light through the sample. As shown in Fig. 13, the purple pods represent an example of virus as seen in scanning electron micrograph. As these purple pods are trapped in a mesh of carbon nanotube, it is impossible to infect anyone. Due to that our proposed model is more safety than any other method of testing coronavirus.

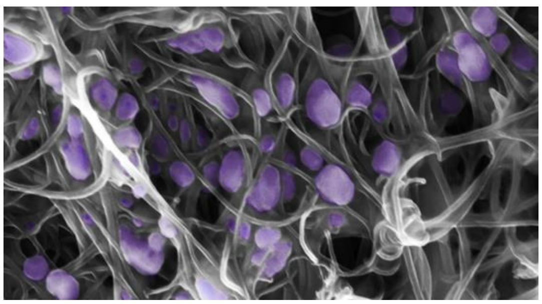

Fig.13. Virus Hunting with Carbon Nanotubes [53].

IV. THEORETICAL ANALYSIS

In this section, the results which obtained due to the proposed diagnosis tool based on laser for fighting covid-19. It's known that laser beam can be represented by gaussian beams which are considered as the most desirable and the simplest type of beam provided by a laser source. The Gaussian beam is a most suitable representation of the field at the output of single mode laser. The complex amplitude U(r) of the Gaussian beam can be represented by the following equation [54]:

$$U(r) = A_0 \frac{W_o}{W(z)} \exp\left[-\frac{X^2+Y^2}{W(z)^2}\right] \exp\left[-jkz - jk\frac{(X^2+Y^2)^2}{2R(z)} + j\emptyset(z)\right] \quad (9)$$

where W(z), R(z) and φ(z) are measures of the beam width, wavefront radius of curvature and phase, respectively. k is the wave number (k=2π/λ with λ the wavelength) and A_0 is a constant. Equations to calculate W(z) and R(z) as functions of z and z_0 can be determined as follows [54]:

$$W(z) = W_0[1 + (\frac{z}{z_0})^2]^{\frac{1}{2}} \quad (10)$$

$$R(z) = z[1 + (\frac{z_0}{z})^2] \quad (11)$$

where z_0 is a parameter known as the Rayleigh range of the Gaussian beam. W_0 is the beam waist. It is known also as waist radius. W_0 is described as a function of z_0 by the following relation:

$$W_0 = (\frac{\lambda z_0}{\pi})^{\frac{1}{2}} \quad (12)$$

As discussed in previous section, each virus has its own properties and different parameters' values such as refractive index, diameter, and weight. Once the sample trapped by blowing the person through the carbon nanotubes, the viruses can be optically characterized. This virus identification process is done quickly due to once the laser beam crashed with the patient's sample, the scattered beam will be influenced by the properties and parameters of the sample. A distinctive optical fingerprint or “Raman peaks” have been created after spotting the laser light on the carbon nanotubes as shown in Fig. 14. Fig. 14 explains that Ramon peak of Coronavirus has different value than influenza virus. As our proposed model is helpful in identifying coronavirus based on **Raman Spectroscopy**, doctors can also use this technique to test for other viruses, such as influenza. This proposed diagnostic method will be quickly, safe, easy to use, and could significantly halt disease spread.

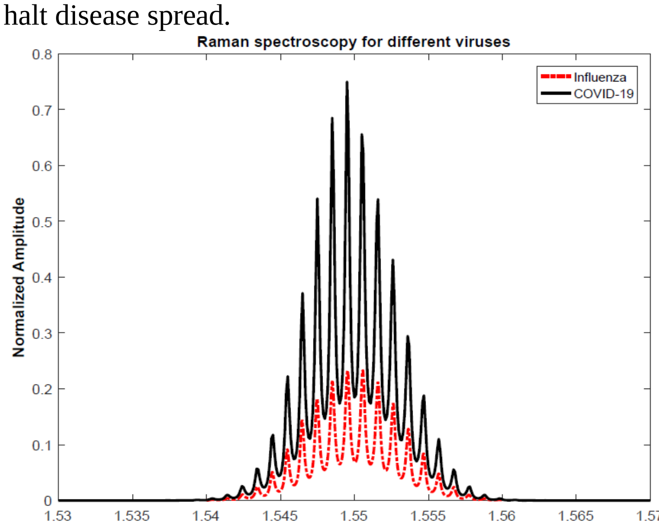

Fig.14. Raman Spectroscopy for different viruses.

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V. COMPARISON OF PERFORMANCE

This section introduces a comparison between our proposed COVID-19 diagnostic method with the traditional used reverse transcription polymerase chain reaction (RT-PCR) method [55] [56] and another new COVID-19 rapid screening tool by authors called Diffractive Phase Interferometry (DPI) in [57]. As mentioned before, RT-PCR is the traditional testing tool which considered as the key indicator of COVID-19 for hospitalization in most of the infected countries. However, PCR has many limitations due to the harm sample collection method, the low sensitivity of results, take much time, the low positive rate of PCR which was reported to be approximately 30%–60%. On the other hand, the DPI method [57] is based on the laser to detect any signs of COVID-19 in the blood sample. QUANTLASE lab [58] used DPI test to conduct more than 6,000 COVID-19 tests. The accuracy of DPI is reached to 85% approximately. The results are produced within five minutes.

Our proposed model depends on the laser in the detection of COVID-19 as the DPI method [57]. The difference between the proposed model and DPI method is that the sample is taken by blowing the person through a sample CNT chamber using our proposed COVID-19 testing tool instead of taking a blood sample as in DPI method. Once the pathogens trapped through the carbon nanotubes, the coronavirus can be optically identified during emitting a laser light through the sample. The results of our proposed method take around 100 seconds only and achieved accuracy of 90% approximately. Table 1 summarizes the comparison between the proposed laser based COVID-19 test, RT-PCR and DPI.

Finally, according to the performance comparison in Table 1, it is shown that the proposed diagnostic tool of COVID-19 is better than the existing methods. Saving more time, high accuracy, painless, and easy to use are the main parameters that distinguish the proposed tool than the other models.

Table 1: Comparison of proposed COVID-19 diagnostic tool with other existing tools.

Parameter	PCR [55]	DPI [57]	This Work
Technology	Based on microbiology	Based on laser	Based on laser
Sample collection method	Nasal or throat swab	Finger stick or blood draw	Just blowing through a device
Processing Time	Same day or up to a week	5 minutes	100 seconds
Accuracy	60%	85%	90%

In Future work, we can apply the AI and ML algorithms to identify the signature spectrum of the virus. After the laser emitted through the trapped sample, AI and ML algorithms can be used to detect the difference between the features of each virus easily. By using ML and AI technologies, the identification of the coronavirus may take less than two minutes with a higher accuracy rate comparable to state-of-the-art microbiology techniques.

VI. CONCLUSION

Coronavirus disease 2019 (COVID-19) is a new disease which is considered as the most dangerous virus attack during the last one hundred years. It causes bad effects to the people's daily life extraordinarily. Due to the spread of COVID-19, the World Health Organization (WHO) announced it to be an international Pandemic on 12th March 2020. While the infected countries depend on the classic public-health measures for fighting of the COVID-19 pandemic, researchers and scientists uses several scientific technologies to develop models that can help in halting this disease. This paper explains some of these technological fields and their applications to control COVID-19, such as Artificial intelligence (AI), Open-source technologies, Telehealth technologies, and Nanotechnology.

This paper proposes a new accurate and rapid diagnostic tool that can give more accurate and faster COVID-19 test results than the traditional used RT-PCR test and a new developed diagnostic named DPI. Our approach uses a Raman spectroscopy technique to identify the coronavirus. In the proposed model, the sample is taken by blowing the person through a sample chamber that made from carbon nanotubes (CNT). Once the sample is trapped in the sample chamber, the viruses

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can be optically characterized by focusing a laser light on the collected sample. As known, every virus has its own fingerprint that can distinguish the coronavirus from any other types of viruses such as influenza. As our proposed model is helpful in identifying the coronavirus based on Raman Spectroscopy, doctors can also use this technique to test for other viruses, such as influenza. This paper presents a performance comparison between this proposed diagnostic method with other existing tools such as RT-PCR and DPI. The results showed that the proposed tool would be quickly, safe, easy to use, and more accurate compared with the other tools. The accuracy of our model reached to 90% approximately. It could significantly halt disease spread as the proposed tool enables much faster screenings and testing on a wider scale. As breakthrough's ability of the proposed tool in 'mass-scale screening' will change the whole dimension of tracing, and the speed with which masses can be approached.

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