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An Analysis Review, Detection Coronavirus Disease 2019 (COVID-19) based on Biosensor Application

[1]Bakr Ahmed Taha Al-juboori
P103537@siswa.ukm.edu.my
[2]Norhana Arsad
noa@ukm.edu.my
[3]Yousif I. Al Mashhadany
yousif.mohammed@uoanbar.edu.iq
[1,2]UKM – Department of Electrical, Electronic and Systems Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, UKM Bangi 43600, Selangor, Malaysia
[3]Department of Electrical Engineering, College of Engineering, University of Anbar, Anbar, Iraq

Abstract

The global spread of coronavirus disease (COVID -19) worldwide has had a significant effect on social and economic growth. The contamination keeps on advancing quickly and eccentrically, representing a significant test to its recognition and conclusion. Coronaviruses are commonly recognized by seclusion from tests, regardless of whether natural or clinical, utilizing some atomic science procedures, which can take a few days. In this work an analytical review of virus transmission, methods of diagnosing COVID -19 using artificial intelligence techniques to classify images and types of biosensors. At long last, the deformities and points of interest of each kind of sensor are recognized and examined. This exploration gives an explanatory audit of the utilization of crown infection COVID-19 in 2019. Related examinations were led utilizing five dependable databases, for example, Science Direct, IEEE Xplore, Scopus, Web of Science, and PubMed. An acceptable investigation is remembered for this audit, which can be depended upon as a logical database to put resources into another technique for recognizing COIVD-19.

Keywords: COVID-19 Detection, Biosensor Application, COVID-19 Transmission Styles, Sensors Interaction, Artificial Intelligence.

Contents

List of Abbreviations

Abbreviation	Description
COVID -19	Coronavirus disease
MERS-CoV	Middle East Respiratory Syndrome
SARS-COV 2	Coronavirus Severe Acute Respiratory Syndrome 2
SARS-CoV	Coronavirus Severe Acute Respiratory Syndrome
2019-nCoV	2019 novel coronavirus
RT-PCR	Reverse Transcription Polymerase Chain Reaction
LFR	Low-Frequency Raman
UFOP	U-bent Fiber Optic Probe
P-FAB	Plasmonic Fiber-Optic Absorbance Biosensor
FET	field-effect transistor
Zr QDs	chiral zirconium quantum dots
PPM	parts per million
QCM	quartz crystal microbalance
LFA	Lateral Flow Assays

1. Introduction and overview of coronaviruses

There are (15,033,861) Million cases of Coronavirus disease (COVID-19) included (618,061) Thousand cases deaths cases worldwide. Also, the lockdown has a lot of global activities have been stopped, several businesses reduced operations, and more people expect their jobs to be lost [1]. The following part describes the structure and genome of SARS-COV 2.

1.1. SARS-COVID19 Structure and Genome

Coronaviruses (CoVs) are positive, single-strand RNA viruses, which refer to the Coronavirinae subfamily, Coronavirdiae group, Nidovirales order. Four genotypes of CoVs are classified, that is Alpha-coronavirus (αCoV), Beta-coronavirus (βCoV), Delta-coronavirus (δCoV), and Gamma-coronavirus (ɣCoV). The category of viruses is highly infectious in bats and rats with αCoV and βCoV, while δCoV and ɣCoV are present in birds' animals.

Coronaviridae is a large group of viruses infecting animals and human. The common forms of human coronaviruses are mainly[2], [3] Its Middle East Respiratory Syndrome CoV (MERS-CoV), Severe Acute Respiratory Syndrome CoV (SARS-CoV), and Severe Acute Respiratory

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Syndrome CoV 2 (SARS-CoV 2) or Coronavirus Disease (COVID -19). COVID-19 appears that it is not very different from SARS-CoV in its clinical characteristics. The COVID-19, genome involves four main protein molecules: Spike (S), Membrane (M), Envelope (E), also Nucleocapsid (N) protein [4]. Whereas SARS-COV 2 is spread even more widely the community [5], [6]. Coronaviruses, SARS-COV 2, are a wrapped virus with approximately 60-140 nm in diameter, roughly spherical or mildly pleomorphic [7]. As shown in the (Fig. 1). The following section gives background virus detection.

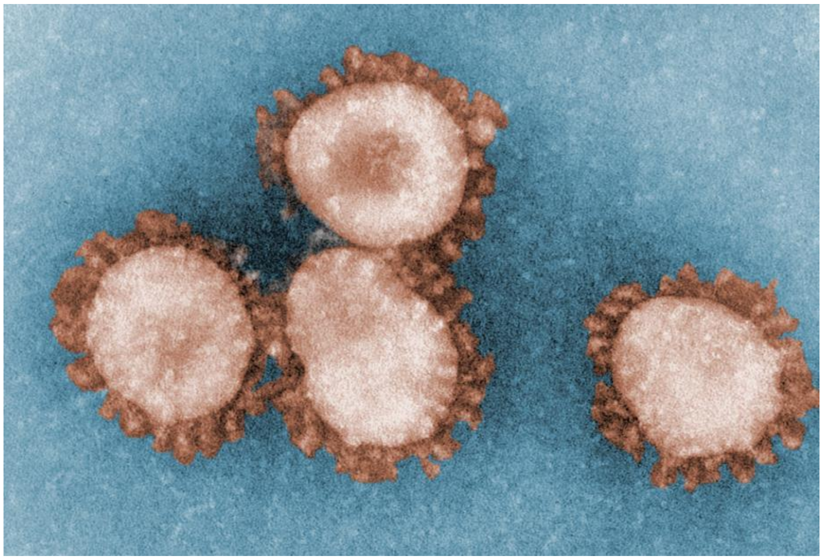

Fig. 1. SARS-CoV electron microscopy image. Fred Murphy's photo credit, this media come from the Public Health Picture Library (PHIL), identifier number 4814 (https:/phil.cdc.gov/Details.aspx?) Pid is 15523).

1.2. Background Virus detection

Nano-optofluidic technique detection of single virus with nanoparticles [8]. It reports a portable microscope based on a fluorescence platform fixed on the smartphone, for imaging viruses and nanoparticles [9].The techniques used in Surface Plasmon Resonance (SPR) processing inside optical sensors for chemical and biochemical applications was discussed in this article. For example, viruses, DNA and bacteria [10]. Showed in this work utilize from Surface Plasmon Resonance Imaging (SPRI) technique to detect individual microparticles and nanoparticles in liquids such as viruses [11]. The researchers presented a review about develop device structures biosensor based on Photonic Crystal Fiber (PCF). Which that used was in the detection of small – size molecules [12]. A method for detection of coronavirus by using an image processing technique with interferometry [13]. Optical biosensor system for detecting influenza viruses has been developed. A Mach-Zehnder waveguide was used to detect the virus exceeding (100 nm) [14]. It presented optical biosensor based on surface Plasmon resonance. Coating layer from nanoparticle gold (40) nm , for detected of the avian influenza virus [15]. A Convolutional Neural Network (CNN) is used for the identification and classification of viruses, using SPR in an optical fiber [16]. Graphene and silver (Ag) were used in the resonance plasma

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film, which coated both the optical fiber and the outside for DNA sensing and environmental monitoring [17]. This revealed that a test was implemented as an optical biosensor for the Multi-Channel Smartphone Spectrometer (MSS), which approaches the size of the nanoparticle [18]. Used the LSPR based on a gold nanoparticle (AuNP) modified to detect the influenza virus [19]. Enhancement the Plasm Assisted Nano-Object Microscopy (PAMONO) sensor, using Deep Neural Networks (DNN) technique, for the detection of low Signal Noise Ratio (SNR) nanoparticles [20]. It was utilizing PAMONO sensor technique, with attached the SPR platform to detect without supervised viruses [21]. Improved LSPR device coupling SPR using grapheme oxide / silver-coated silica optical polymer coating, biological identification [22]. A study showed a Nano-laser methods important in the sensing optical for biological [23]. Photonic crystal fiber biosensor based on porous silicon structure was introduced. To detect small chemical molecules [24]. Mentioned of Surface-Enhanced Raman Scattering (SERS), multiplex dependent on LSPR for the detection of the MERS-CoV [25]. Produced a biosensor SERS based on LFIA to detection influenza virus [26]. Using AI techniques to collect, segment, and diagnose images for COVID-19 [27]. He used the hybrid method, deep learning & machine learning for the development of an artificial intelligence program to classify coronaviral disease COVID -19 and normal [28]. Investigators have used the method of identification of coronavirus disease based on a classification CNN technique [29]. Single-virus tracking by image techniques and fluorescent [30]. A research analysis accuracy of Computerized Tomography (CT) technique, for recognizing COVID-19 [31]. It used Artificial Intelligence (AI) research; image Chest X-Ray (CXR) for diagnosis of coronavirus disease, it was used CNN Tools [32]. CNN algorithms used as a decision-making aid to radiologists to accelerate the diagnosis of COVID – 19 [33]. AI techniques for SERS [34]. A study has been developed using the biosensor based on a Field-Effect Transistor (FET) method of detecting SARS-CoV 2 virus [35]. A hybrid Generative Adversarial Network (GAN) with in-depth coronavirus detection learning by using x-ray chest images [36]. Analysis of COVID-19 from Chest X-ray photographs using the CNN method [37]. The use of microfluidic chips to the detection of viruses and how to employ a couple with artificial intelligence [38]. It demonstrated optical biosensor LSPR for possible detection of coronavirus disease [39]. The researchers presented an overview of optical biosensors to detect the COVID-19 virus [40]. It was a compact device built on gold nanoparticles based on the SPR with fiber-optic absorbance biosensor. For SARS-CoV 2 virus identification [41]. Used artificial intelligence to fight COVID -19 through; tracking, diagnosis and social control [42]. They presumed AI profound learning techniques COVID-19 to be derived from individual image features [43]. The diagnostic method COVID-19 is used as Low-Frequency Raman (LFR) spectroscopy [44]. A new approach is the dual- functional SPR, that combines the Photo-Thermal effect in bio-sensor LSPR for SARS-CoV 2 Virus Detection [45]. Deep neural networks with multi-class x-ray COVID -19 images to diagnose (normal, pneumonia and COVID-19) [46]. Proposed profound learning algorithms CNN to classify the SARS-CoV 2 by use Images for chest image CT scan [47]. Used a deep learning method to help radiologists automatically diagnosed positive or negative coronavirus disease [48]. Immunosensor dependent on LPFG for the detection of viruses [49].The next segment discusses the COVID-19 styles of transmission.

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2. COVID-19 Transmission Styles

The standard mode of transmission of coronavirus disease, we can make classification to four parts: environment to human, human exchange, animals to human, and human to others. The next section discusses the process of coronavirus transmission.

2.1. Environment to Human

Built Environment (BE) is a collection of places people have made, including houses, vehicles, highways, public transport, and other building spaces. Most citizens spend 90% of their daily lives in the BE [50]. Preliminary studies indicate SARS-COV 2 can probably continue on surface ranging from a pair of hours to 5 days. Where was estimated the virus survives the most extended period at a rate of humidity 40%, on plastic surfaces 72 h approximately, stainless 48 h, cardboard 8 h, copper 4 h, and aerosols 3 h [51]. Built environment serve as possible vectors for COVID-19 spread by causing near interactions between people. A density of people in buildings raises the degree of indoor activity due to interaction and communication via direct contact between individuals, enabling the accrual of microorganisms associated with humans and environmentally mediated contact with surfaces abiotic. Air and surface pollution detection by SARS-CoV-2 in hospital [52], [53]. Research has shown pandemic transmission of coronaviruses, such as extreme SARS- CoV and MERS-CoV can live on surfaces for long periods, sometimes until months [54]. Ordered this exploration microbiology in the BE and essential data about the SARS-CoV 2 to give noteworthy and attainable direction to BE leaders, building administrators, and every indoor administrator who they attempt to decrease transmission of irresistible ailments through natural interceded pathways [55],[56]. It presented a depth study of detection SARS-CoV 2 in the environment water [57]. It Showed this study a proven detection of SARS-COV 2 virus in hospital toilets and room [58],[59]. As shown in (Fig. 2).

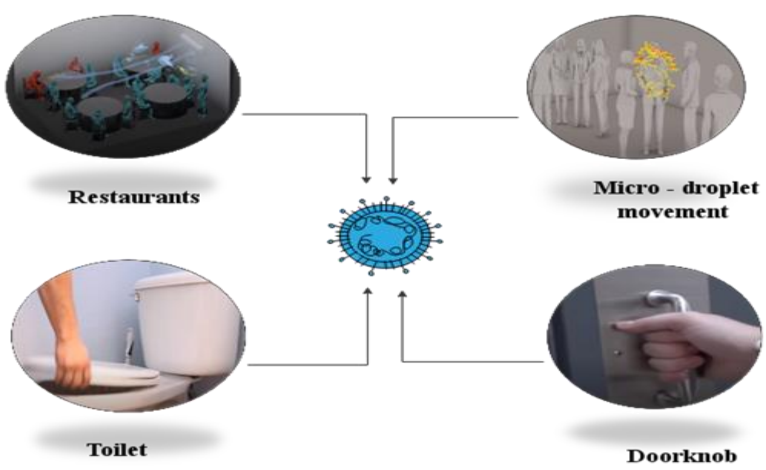

Fig .2. Transmission concepts for COVID-19 virus from Environment to Human

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2.2. Human's Exchange

Human coronaviruses are divided into alpha and beta. They represent families of enveloped, single-stranded RNA viruses with surface spike projections. The rapid appearance and transmission of a novel virus called β-coronavirus that resulted in the 2019 global coronavirus pandemic COVID-19 associated with colossal death [60], [61] Some research issued up until here to explain the pathophysiological aspects of the COVID-19 and propagation mechanism. The current privileges mostly obtained from the related COVID-19 transmissibility behaviors, which based on the human's exchange transmission strategy [62]. Willcox .M .et .al did a study coronavirus disease, and affected with the eye surface corneal, conjunctival. It showed as infection could lead to mild signs and symptoms of pneumonia, has so far only found rarely [63], [64]. Respiratory viruses are typically most symptomatic and most contagious. There is growing evidence; however, that human's exchange transmission during the asymptomatic incubation period COVID-19 is estimated to be between (2 – 10) days [65]. The normal SARS-CoV 2 transmission systems include oral, nasal, and eye mucus transmission and direct transmission as cough, sneeze [66], [67]. As shown below in (Fig. 3).

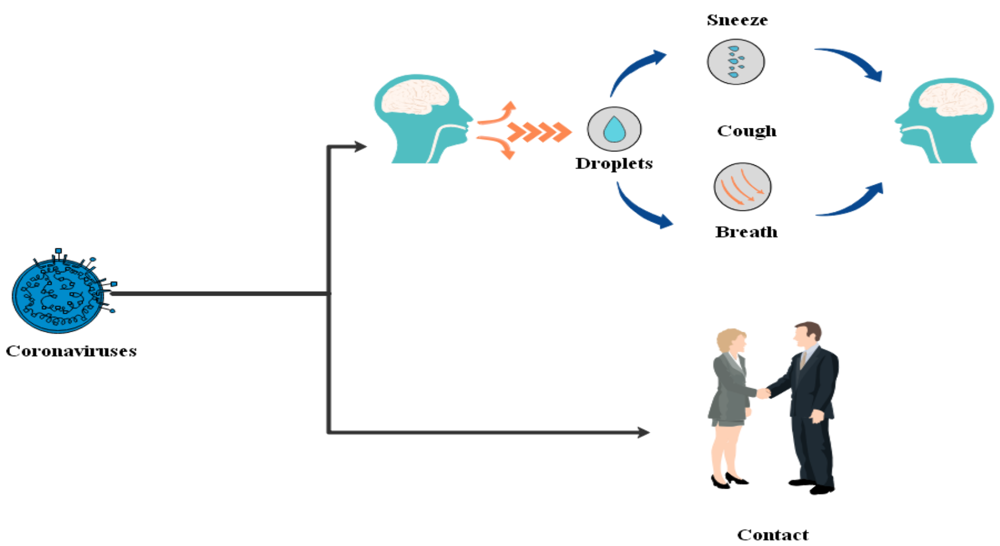

Fig. 3. Transmission concepts for COVID-19 virus from human's exchange

2.3. Animals to human

Many items require a common health strategy in order to address and eliminate outbreaks of a related virus, potentially SARS-COV 2, which is transmitted to humans by spillover from bats or an unknown animal host. The research revealed a bat vector that has transmitted coronavirus to humans [68], [69]. Bio-aerosols microscopic airborne particles pose widespread human and animal threats [70]. The researchers have presented an analysis of the SARS-CoV 2 transmission theory from a list of animals that sold avian, swine, phocine, bovine, canine, seafood, frogs,

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camels, etc. on the market in Wuhan [71]. It collected a data 33 samples of SARS-CoV 2 from out of 585 environmental in the seafood market [72]. Depth study of SARS-CoV, MERS-CoV, and SARS-CoV 2 , related to different bat species [73], [74]. As shown below in (Fig. 4).

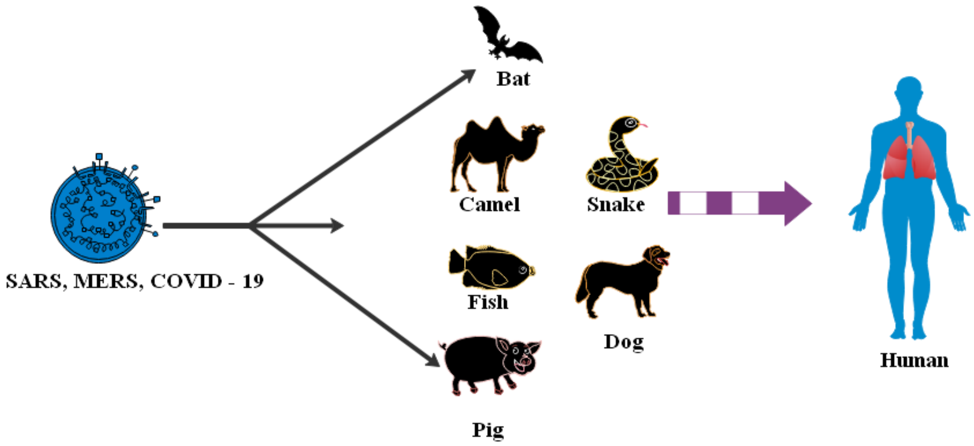

Fig. 4. Transmission concepts for COVID-19 virus from animals to human

2.4. Human to others

An analysis of COVID-19's genetic materials in sewage can alert against an epidemic. SARS-CoV-2 can be dealt with via sewage. The evolution of the SARS-CoV-2 virus in water, soils, and other environmental compartments can be classified through sewage [51], [75] The study presented a literature review on inanimate surfaces concerning the life cycle of human coronaviruses. The transmissions of viruses transmitted via droplets, contaminated hands or surfaces have been identified [76]. First reported SARS-CoV-2 detection in Australia's untreated sewage [77], [78]. Detection of 2019 novel coronavirus (2019-nCoV) in hospital room's patients infected. To understand the virus size distribution in the air and environmental contamination patterns was necessary for infection control policies [30], [79] (Fig. 5). Explain the hypothesized SARS-CoV 2 virus origin, and a common path transmission. In the next section explains of the diagnosis methods of detection COVID-19.

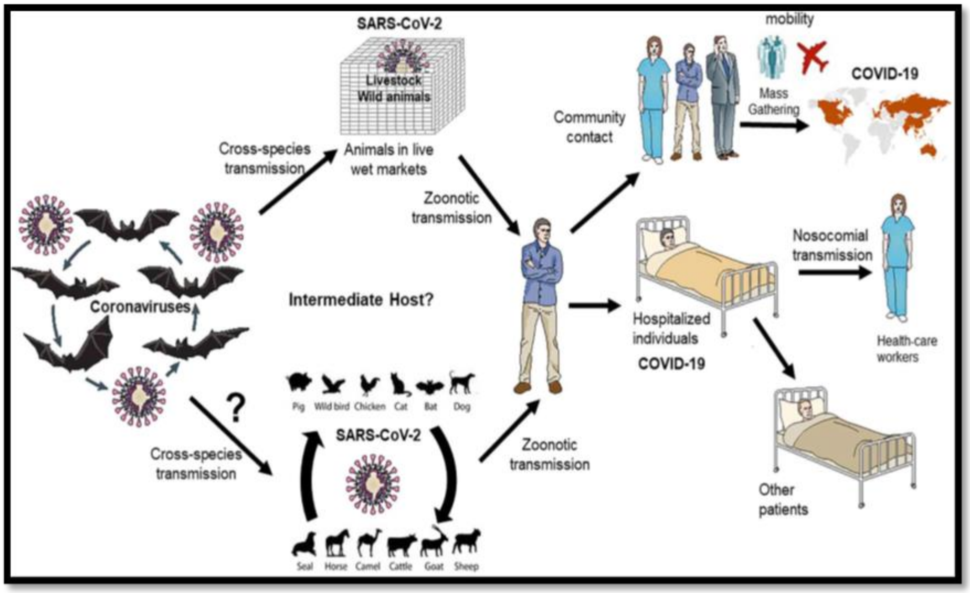

Fig. 5. The hypothesized SARS-COV 2 virus origin. And a common path of outbreak zoonotic coronavirus transmission. [80]

3. Analysis of COVID-19 Transmission

COVID-19 is now a global public health problem, and worldwide mortality is rising rapidly [81]–[83]. It is important to know the potential mechanisms of COVID-19 transmission and human behavior. Besides factors that probably support and decrease the spread of coronaviruses. A density of people in buildings raises the degree of indoor activity due to interaction and communication via direct contact between individuals, enabling the accrual of microorganisms associated with humans and environmentally mediated contact with surfaces abiotic. The spread effect of COVID - 19 has been classified into four categories: extra strong, strong, middle, and low as shown in Table 1. To measurement transmission of airborne droplets to humans, through the equations listed below, which illustrates the calculation of the size and mass of drops during coughing, sneezing, and breathing [84]–[88]. As well as the safe distance, avoid cross-infection. Investigational experiments carried out and quantified exhaled the mass and volume of the droplet due to speaking and coughing. They also fixed the size distribution of the droplet initial point of the expulsion. Eq. 1 displays the probability density law of the Weibull function ***f***. The fitting parameters are defined [89], [90].

$$\boldsymbol{f = \frac{n}{d_p}\left(\frac{d_p}{d_p}\right)^{n-1} e^{-\left(d/d_p\right)^n}, n = 8 \ \ \overline{d_p} = 80\,\mu m,} \qquad \textbf{(1)}$$

The development of the droplet mass m_p in diameter d_p is defined by the following Eq. 2 of conservation.

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$$\frac{d_{m_p}}{dt} = -\frac{sh}{3Sc}\frac{m_p}{\tau_p}\xi_M\,, \qquad (2)$$

Wherein t, time. $Sh, Sc, T_p = \rho p d_p^2/(18\,\mu)$, and ξ_M are the number of Sherwood, Schmidt, particle relaxation time and possible evaporative property, in both; ρp is density and μ is a carrier phase dynamic viscosity. The number of Sherwood represents the convective mass ratio move due to diffusion to mass transfer. The number of Schmidt it reflects the ratio of viscous to mass diffusion. The propagation of the droplet speed is determined by application the second law of Newton 's motion as shown in Eq. 3.

$$m_p\frac{du_p}{dt} = \sum F_p\ (u_p\,, u_{f\,,}\, B), \qquad (3)$$

The change in the temperature of the droplet is accomplished by considering the mathematical energy equation dependent on the enthalpy difference H_p .Where the velocity is u_p and F_p (u_p, u_f) the forces are behaving on the droplet, as an upward and even downward velocity function the velocity of the carrier liquid u_f resampled at the droplet. B is the intrinsic gravity force. The change in the temperature of the droplet is achieved solving the following enthalpy-based energy equation H_p differential in Eq. 4, [91].

$$\frac{dH_p}{dt} = A_p\,(q_{conv} + q_{abs\,-}\, q_{emm}), \qquad (4)$$

Where A_p is the surface area of the droplet. H_p gets bigger and is the amount of heat transfer due to convection q_{conv} in the above energy equation, and q_{abs} radiation. Excluding the heat transfer produced by the radiation q_{emm} gathered from the local particle) and loses. The enthalpy Eq. 5, can be formulated in accordance with the particle temperature T_p.

$$\frac{dH_p}{dt} = m_p\,c_p\frac{dT_p}{dt}, \qquad (5)$$

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Table 1
Evaluation of more strong effect for transmission COVID – 19 viruses.

Transmission style	hazard	places	Data published	Country	Finding	Reference
Environment to human	high	plastic, stainless steel, copper, and cardboard	17 March 2020	USA	SARS-CoV-2	51,56
Environment to human	high	hospital rooms	29 May 2020	Singapore	SARS-CoV-2	52,58
Environment to human	high	air and surface	26 June 2020	Italy	SARS-CoV-2	53
Environment to human	high	surface contamination	2016	London	SARS-CoV and MERS-CoV	54
Environment to human	high	Air, Surface	7 May 2020	China	COVID-19	55
Environment to human	high	Water	28 April 2020	Italy	SARS-CoV-2	57
Environment to human	high	Toilet	13 Aug 2020	China	SARS-CoV-2	59
Human exchange	high	contacts	24 January 2020	China	SARS-CoV-2	61
Human exchange	high	ocular surface	22 April 2020	Australia	SARS-CoV-2	63
Human exchange	high	dental clinics	19 February 2020	China	SARS-CoV-2	66
Animal to human	Medium	bats	2020	USA	SARS-CoV-2	73, 74
Animal to human	Medium	sold avian, swine, phocine, bovine, canine, seafood, frogs, camels	2020	China	SARS-CoV-2	71
Human to others	low	wastewater surveillance	18 April 2020	Australia	SARS-CoV-2	77,78

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4. Review and Dep-analysis Diagnosis Methods of Detection COVID-19

This section analysis reviews the Diagnosis Methods of Detection COVID-19. These papers have been divided into various topics and techniques. Selected works were classified into broad categories depending on based on biosensor application for fight COVID- 19.

4.1. based on Artificial Image techniques

Taxonomy of AI research literature used to identify and recognize medical images of COVID-19 based on four techniques: binary classifications, multiple classifications, mixed multiple-class and binary classifications and hybrid multiple –class and hierarchical classifications, as shown in (Fig. 6), [92], [93].

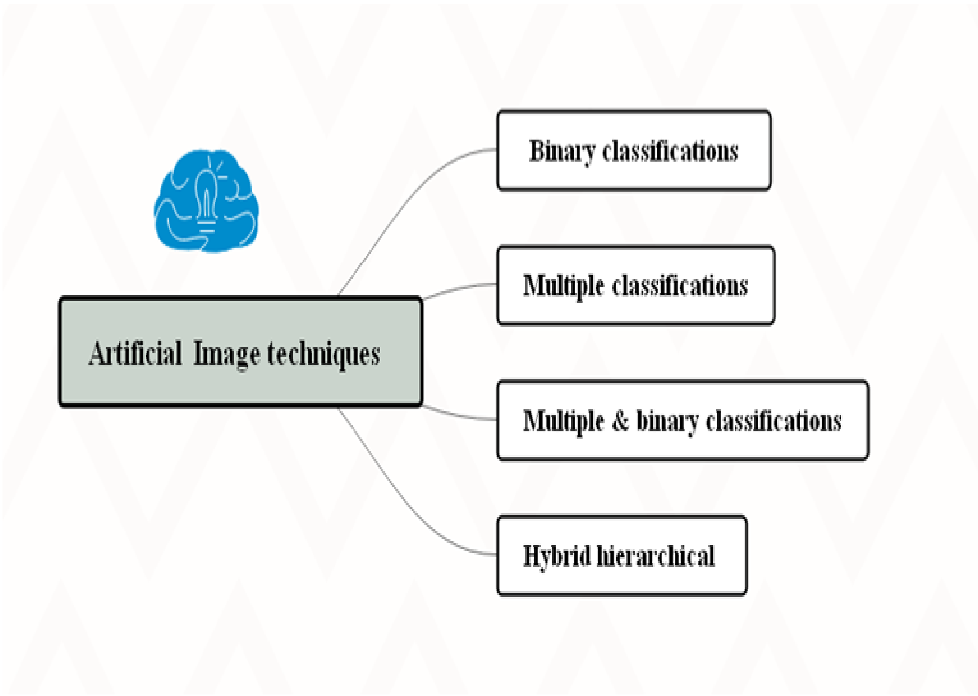

Fig. 6. Categories detection COVID -19 based on artificial images techniques.

4.1.1. Binary classifications

The binary classification problems refer to classify with only different two classes, and one article includes in the study of ref. The capacity of deep learning approaches to COVID-19 diagnosis based on medical images obtained from CT has been demonstrated. Regarding the class labels used to detect the presence of infections, this study was focused on False-Negative (FN) findings that endangered and regulated the epidemic and affected decisions for the monitoring or discharges of health. The data set used consisted of ten patients' details. In the RT-PCR test for COVID-19, two out of 10 negative cases were reported positively. In the previous version, and in RT-PCR was clearly shown and reported [94], [95].

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4.1.2. Multiple classifications

The multiple-class grouping poses various problems and challenges. Creation of a COVID-19 severity scoring method was involved. It presented COVID diagnosis-net, a search for AI method for coronavirus disease based on deep squeeze- net with optimization to detect COVID-19. The rate of detection of 98.3% COVID-19, pneumonia, and normal cases [96]. The study used a system to assign patients to severity-specific categories, which are extreme and moderate/mild according to the World Health Organization (WHO) classifications. Accordingly, 13,500 COVID-19 patients obtained the dataset used. An early review has shown that 93.6% of patients were appropriately established, 0.8% of the patient's condition was underestimated, and 5.7% overestimated [97]. CoVID-19 has been established using a deep learning method, MobileNetV2 module and squeeze-net. The fuzzy color technology was used as a pre-processing step to restructure data classes and to combine organized images with original images. Efficient features with a total classification rate of 99.27 percent were grouped and categorized using Support Vector Machines (SVMs) [98], [99]. Introduced a neural network convolutional technique. A minimal number of parameters are employed in the technique to diagnose coronavirus. Via statistical analysis of the possible chest x-ray imaging biomarkers [32].

4.1.3. Mixed Multiple & binary classifications

This subclustered includes the articles focused on multiple integrated and binary classification problems. Classifications, the use of AI to help the radiologist's research have been emphasized. We suggested it is possible to control the progress of the disease by applying AI in the COVID-19 infection [100]. In addition to multiclassification (COVID-19 vs. no findings. pneumonia), a model for the identification of COVID-19 has been presented with 125 x-ray images for accurate diagnosis of binary classification (COVID-19 vs. normal). The model's reliability for binary classes was 98.08% and for multiple class cases 87.02% [46]. Intending the distribution of COVID-19 suggested the value of AI [101].

4.1.4. Hybrid hierarchical

Another challenge for classes is the hierarchical grouping, where the learning output is categorized by class taxonomy. The hierarchical classification is defined as follows: every class, which is divided into sub-classes or grouped into super-classes, is to be categorized into one and only one class. The hierarchy is established during classification and cannot be modified [92]. Identified and developed a classification approach for COVID-19 pneumonia from different healthy lung types that takes into account hierarchical and multiclass views [102]. The hybrid platform for COVID-19 detection using an Improves Marine Predator Algorithm (IMPA), and a ranking-based strategy for decreasing diversity in order to obtain particle numbers which cannot seek acceptable solutions for consecutive iterations. For IMPA accuracy testing, nine x-ray chest photos have been used [103] , (Fig. 7). It explained a concept of artificial intelligence techniques to detect and diagnose COVID – 19.

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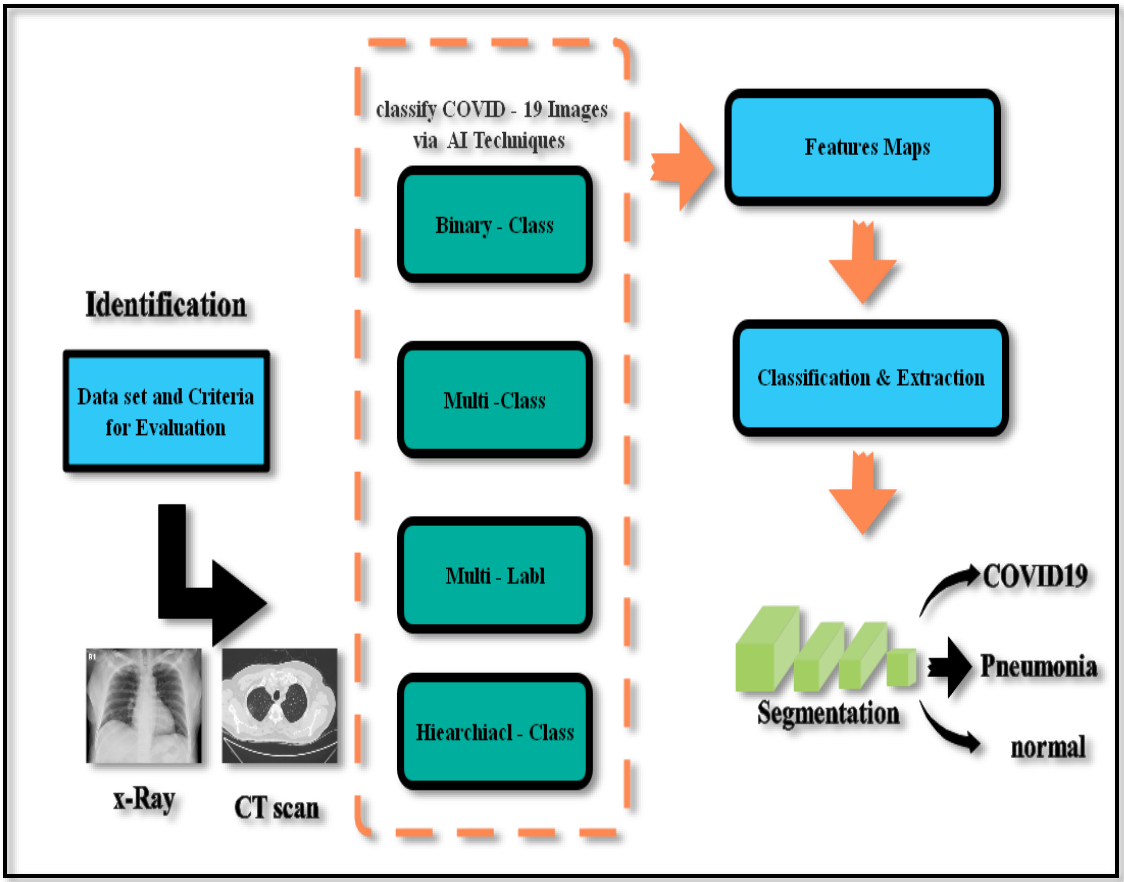

Fig. 7. The concept of artificial intelligence techniques to detect and diagnose

Artificial intelligence techniques have widely used to classification the coronaviruses and healthcare [104]. It is one of the essential points that have been focused on in this review. The implementation of deep learning techniques and algorithms for the identification of new coronaviruses (COVID-19) has many unique challenges. Although deep learning techniques are highly automated, a wide range of data is required for the development of a robust diagnostic system. Because COVID-19 is very new to research, the lack of effective data is a major diagnostic challenge. In some cases, the imagery information available for COVID-19 patients is incomplete, noisy, unclear and inaccurate. Training a profound learning system with such large and varied data sets is very complicated and a number of problems such as data consistency, non - linearity and missing values need to be addressed. Table.2 Presented in-depth study Comprehensive artificial intelligence technology (AI) employed of 2019 coronavirus classification and identification COVID-19 images.

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Table 2

Analysis review for intelligence technology for detection COVID-19.

Type of datasets		AI techniques		Case study	Efficiency of Detection (%)	Installation data	collection dataset size	AI partition			No. of classes
Prime data	Minor data	Traditional Machine Learning Techniques	Deep learning Techniques					Test	Validation	Training	
×	×	×	✓	CT scan	96%	February 19, 2020	2 images	×	×	13.3%	COVID-19, Flu
✓	×	✓	×	CT scan	93.6%	2020	13500 images	×	×	×	COVID-19
✓	✓	✓	✓	CT scan	50%	2020	NA	✓	×	×	COVID-19
✓	✓	✓	✓	CT scan	NA	February 20, 2020	NA	×	×	×	COVID-19
×	✓	×	✓	X-ray	87.02%, 98.08%	26 April 2020	127 images	×	5- fold cross	×	COVID-19 no-finding, and Pneumonia
×	✓	×	✓	X-ray	98.03%	21 April 2020	2839 images	10%	10%	80%,	COVID-19, normal, pneumonia
×	✓	×	✓	X-ray	86.9%	16 June 2020	430 images	0.7	0.1	0.2	Normal, Bacterial Tuberculosis, Viral, and COVID-19
×	✓	✓	×	X-ray	80%	2020	8 images	×	two-fold	×	COVID-19
×	✓	✓	✓	X-ray	99.27%	2 May 2020	845 images	30%	5-fold cross	70%	coronavirus, pneumonia, and normal
✓	✓	✓	✓	X-ray	87 %, 98%	2020	1144 images	30%	×	70%	Normal, COVID-19, MERS SARS, Varicella, Streptococcus Pneumocystis

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Method

The process of study through utilized for the extraction of relevant literature used Academic digital repositories. Such as Science Direct offers various scientific research across all fields, Scopus provides ample coverage of work from all discipline. Web of science which shows large coverage of various subjects and researchers in all areas of literature; IEEE, which is recognized as scientifically accurate and protected by the multidisciplinary and information and PubMed also covers several topics including an interdisciplinary emphasis on research related to medicine and technology.

4.2. Taxonomy Research Based on types of sensor

The biosensors market has undergone great developments in recent decades, especially regarding healthcare. The key factor that helps motivate the event is an outbreak and propagate in the world country due to weak health care, low responsibility of risk of tracking epidemic, therefore we need to solve this a weakness of points [105]. Typically, the biosensor system consisted of three main modules is a biosensor, which comprises a bioreceptor, a transducer, and a digital output detector [106]. according to studies that have been collected 12 articles in this review paper regarding the type of sensors used in the detection and diagnosis of COVID-19. This final set was divided into four groups, namely, review cluster and research cluster. The taxonomy detection based on classification biosensor is shown in. (Fig. 8).

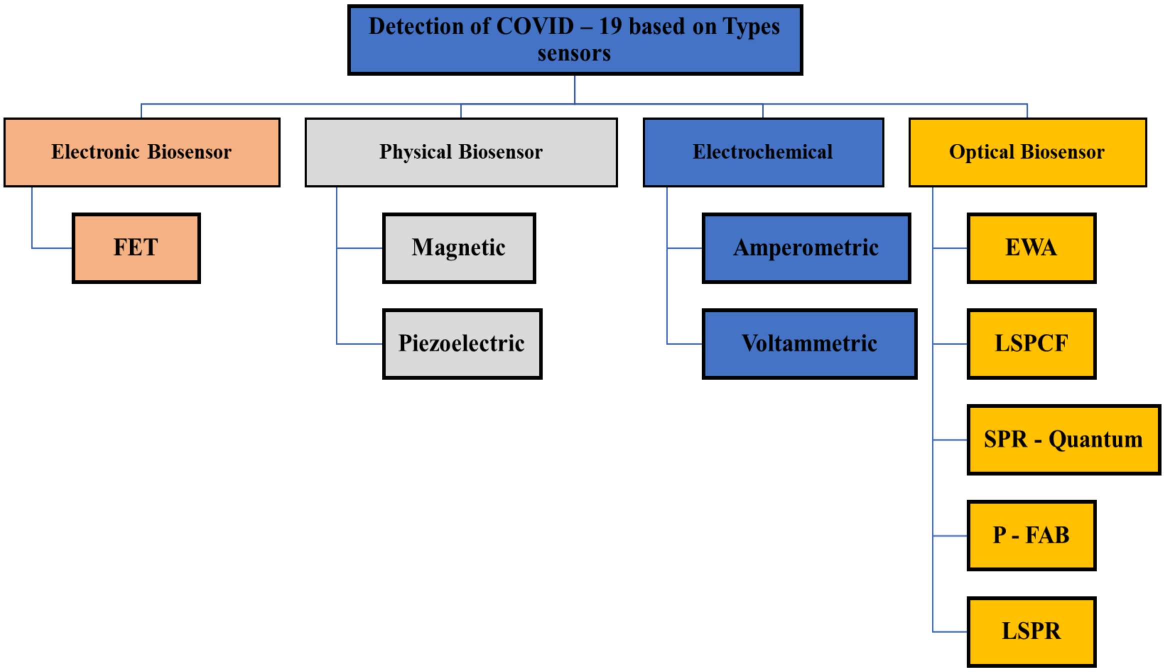

Fig. 8. Taxonomy of research on Detection COVID -19 Based on types Sensors.

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5. Result and discussion

5.1.1. Electrochemical biosensors

There are many problems and challenges joined to electrochemical biosensors. However, the isolation and purification of the sample take time. This group includes two different publication works. Electrochemical biosensor to detect SARS-CoV-2 is reported in a saliva sample. the target used was spike protein, and need to isolation and filtration before detect. [107]. An electrochemical biosensor for the detection MERS-CoV coronavirus has been developed. It is focused on a productive test performed with a range of gold nanoparticles adapted carbon electrodes (DEPs). Antibody spike protein S1 has been used in MERS-CoV as a screening tool. the time of detection was 20 mint after Sample isolation and purification.[108]. a study has been described analysis of multiple manufacturing methods, concepts for detection, and applications of various biosensors.[109]. Electrochemical biosensors have long been used for a broad variety of products in different areas. These biosensors reflect a standard biosensor platform that includes semiconductors and electrodes printed on screen [110], these bio-sensors can be classified into four major groups, including potentiometric, amperometric, cyclic, and impedimetric, to check the changes in dielectron properties, frequency, shape, and load distribution [111], such biosensors have been used to identify various biological targets, such as proteins, cancer biomarkers, nuclear acid, etc. [112], [113]

5.1.2. Electronic biosensors

One category includes analysis studies presented, a report about made biosensor electronic a Field-Effect Transistor (FET) method for determination (SARS-COV 2) virus in clinical units. The limit of detection 2.42 × 102 copies/mL in medical tests [35].The challenges of this techniques take Time for incubation is longer.

5.1.3. Physical Biosensors

These works focus on physical biosensors utilizing for diagnosis of COVID -19. in this section it has been collected two articles from studies, which include a piezoelectric, and magnetic sensors. the challenges of this method are lack of accuracy, sensitivity, or quantitative measurement probability, Sample isolation and purification are time-consuming. For the detection of SARS-associated coronavirus (SARS-CoV) in the gas phase, a piezoelectrical biosensor was developed. the target detection was Antigen (sputum) at 1 h after analysis and filtration of the sample [114]. A new method is proposed and compared with standard ELISA for SARS-CoV-2 detection in specific antibody serum based on magnetic immuno-detection. was time duration 42 min after The isolation and purification of the sample taken [115]. precedent study Popular biosensors systems based on magnetic such as magnetoresistance, magnetic particle spectroscopy sensors, and nuclear magnetic resonance have been reviewed. to prevent the outbreak of the SARS-CoV-2 virus [116].

When a mechanical force applied to a piezoelectric biosensor, an electric signal generated, a Quartz Crystal Microbalance (QCM) sensor for direct detection of aerosol flu influenza has been confirmed to have been developed [117]. The QCM sensor, which calculates material mass changes and viscoelasticity by reporting frequency and vibration changes of the resonator in quartz crystals, is the most popular piezoelectric biosensor [118]. The sensing system requires substantial isolation equipment due to its high environmental sensitivity, which minimizes obstacles such as vibration. These biosensors have been used to detect targets, including hormones, bacteria, cells, etc. in a wide variety of applications [119].

5.1.4. Optical Biosensors

This category deals with articles on optical fiber sensor methods and applications to detect COVID -19 virus. A significant number of optical biosensors based mainly on the plasmonics concept [120], including when optical components like waveguides are used in the modulation principles [121], based on Photon Crystal Fiber (PCF) [24], fiber optics based on wavelength [122], and by using nano laser [23], are categorized into optical sensors. Typically, the optical sensor consists of a light, detector, and optoelectronic transducer, as shown in (Fig. 9).

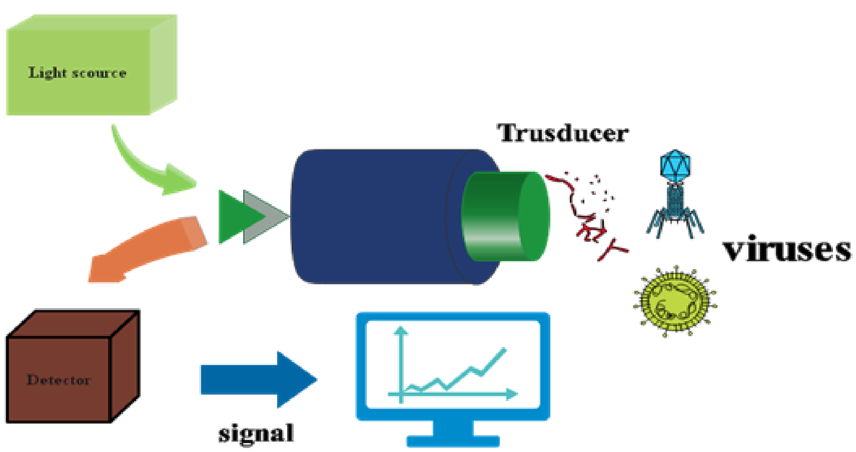

Fig. 9. The essential concept of a fiber optic sensing system

The section discusses and summarizes the challenges and techniques of optical biosensors in clinical for diagnosis diseases coronavirus COVID-19 according to studies publisher. Optical biosensors such as surface plasmon (SPR), as well as LSPR, were also available on the market since the early 1990s and have been used extensively in detecting viral strains like those correlated with them SARS, MERS [123],[124], in lab conditions. Dual-functional plasmonic biosensor integrating LSPR, and plasmonic Photothermal Effect. For medical diagnosis of 2019-nCoV [45].

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A study examines the possibilities of developing an optical fiber sensor for rapid and specific diagnosis of SARS-CoV-2, by utilizing evanescent wave (EWA) absorption [39]. Showed a study Suggested to take advantage of the portable fiber-optic platform (P-FAB) to detect COVID-19. the challenges were that this method needs to refine certain parameters, followed by analytical validation and model scale-up, which can take about nine months [41]. Improved optical biosensor for Localized Surface Plasmon Coupled Fluorescence (LSPCF), detection of SARS-CoV. Was duration time 3h , the challenges The isolation and purification of the sample take time [123]. SARS-CoV detection quantum dot-conjugated biosensor test chip. the duration time for diagnosis was 1h after Sample separation and washing [125]. Model research for developing a technology integrated fluorescence sensor for fast detection coronavirus. the challenge was Incubation time is long [126].Optical biosensor based on interferometer for detection HSV-1 virus [74]. The Raman Surface Enhancement (SERS) and Lateral Flow Assessments (LFAs) platform are being used in multiplexed assays that distinguish between the non-structural Zika and dengue viruses. The detection was down to 0.72 ng / mL [127]. Develop a simple, reduced price, sensitive molybdenum disulfide (MoS_2) biosensor. The biosensor was based on a fluorescent immunosensor, which used the coronavirus detector for Fluorescence Energy Resonance Transfer (FRET). 4.6 / 10^{2} per mL sensitivity [128]. It has been presented in-depth study Comprehensive types of biosensors technology of coronavirus detection. Its included twenty related articles, as shown in the table (3).

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Table .3.
Deep analysis for detection COVID-19 based biosensors.

Sensor type	Application range	Material (nm)	prognosis	diagnosis	Installation date	Target	Duration	Detection limit	Sample size	Detection of COVID -19 virus	
										In clinical	On the surface
Optical LSPR PPT	SARS-CoV-2	Gold	✓	✓	4/8/2020	DNA	800 sec	0.22 pM	0.01 pM - 50 Mm	✓	×
FET sensor	SARS-CoV-2	Graphene	✓	✓	5/29/2020	spike protein	4 h	1.6 × 101 pfu/mL	1 fg/mL	✓	×
Magnetic	SARS-CoV	NA	✓	✓	7/3/2020	anti-spike-protein	42 min	2.96 ng/mL	2 ng·ml^{-1}	✓	×
P-FABU-bent optical fiber	COVID-19	gold	✓	✓	6/1/2020	N- protein	15 min	10–18 M	106 particles/mL	✓	×
Electrochemical	SARS-CoV-2	gold	✓	✓	5/11/2020	spike protein	10-30 s	90 fM	1 μM	✓	×
Electrochemical	MERS-CoV	gold	✓	✓	2/27/2019	spike protein	20 min	1.0 pg. mL^{-1}	10 μg. mL^{-1}	✓	×
Optical Fiber	COVID-19	gold	×	✓	6/11/2020	IgG-type antibodies	1 h	100 units/ml	NA	✓	×
Piezoelectric	SARS-CoV	crystal with quartz wafer	×	✓	2004	Antigen (sputum)	1 h	0.6 μg/mL	0.6-4 μg/mL	✓	×
optical LSPCF	SARS-COV	gold	✓	✓	2009	Nucleocapsid protein	3h	1 pg/mL	~1 pg/mL	✓	×
Optical	SARS-CoV	Quantum dots	✓	✓	7/24/2011	Nucleocapsid protein	1h	0.1 pg/mL	0.1 pg mL^{-1}	✓	×
nanocrystals optical	coronavirus	zirconium quantum dots	×	✓	8/29/2018	antibodies	1h	79.15 EID/50 mL	1000 EID/50 mL	✓	×
LFA	SARS-CoV-2	Gold	×	✓	5/21/2020	IgM antibody	15 min	NA	10−20 μL	✓	×

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6. Mechanism categorize virus detection

The majority of the new sensors in both research and marketing are focused on the methods of electrical or optical receptors [129] These include hand-held portable devices, ingestible sensors, screen-printed electrodes, wearable devices, and ,single-molecule sensors [130]–[134].That could actively detect the virus causing infectious diseases at an early stage of the infection. However, the full potential of biosensors and characterization methods is yet to be explored for on-site usage, such as the outbreak of infectious disease, given their widespread usability and well-known academic benefits. Scientific obstacles and opportunities for biological / chemical sensors definitely remain before they meet the demands of reliable, accurate and early detection in infectious disease. In specific, virus detection can be divided into three major categories:

- Direct Virus Identification: A perfect virus is detected only by biosensors or more generally by cultured cell techniques [135].
- Viral recognition of RNA / DNA: RT-PCR, PCR principles, whether in attributed with fluorescence in regular nuclear acid platforms, or used advanced methods including LSPR, SPR, QCM, and other sensors techniques [45].
- Detection of antibody or antigen: bioassays use absorption coefficient monitors and many optical and electronic biomedical sensors that basically calculate molecular kinetics. high-resolution scanning probe microscopy with a 1000-fold resolution less than the optical wavelength range in the size of a fraction of a nanometer used for the surface properties of viruses [136].
- Tools to enhance surface characterization electromagnetic techniques: the virus surface is imaged with a focused electron beam to identify topographic characteristics [137].
- X-ray crystallography (XRC): Virus features are identified to determine 3D virus structures [138].

7. Critical analysis review of detection COVID-19 on surface

This section discusses and describes the issues and developments laser to detection viruses that can be persistent and accurate Monitoring of healthcare. Display a sensor that combines laser line illumination efficacy with fluidic confinement advantages. can be used to track nano-objects [139]. Showed a study of Laser spectroscopy Techniques, with advanced Femtosecond methods for a Single viral detection are all too apparent [140]. Individually trapped viral particles were studied. Double nanohole (DNH) apertures in a gold film have been used to trap one of the smallest yet reported virus particles, which is 25 nm in diameter [141]. Replacement of fluorescent quantified antibody-based probes with laser detection probes would create a new platform for quantifying biomarkers based on optical instead of enzyme amplification. Virus laser bridges synthetic biology and laser physics. Probes display 10,000 times more signal from only a 50% increase in probe concentration [142]. Surface-enhanced Raman Scatter (SERS) technology was applied to flu virus-detection. SERS has 10 6 − 10 9 times signal amplification, which provides excellent sensitivity have precise influenza virus identification [143]. Reliable viral detection, sizing, and filtering is essential for biosensors, environmental monitoring, and quality control.

We 're introducing an optical biosensor based on artificial intelligence is a potentially strong tool to fight the COVID-19 pandemic, help to detect and analytic viruses at a size nanometer, with high accuracy, as shown in (Fig. 10). The next steps are to simulation the biosensor with an optical fiber network and effected signal-noise ratio (SNR) on the sensitivity efficiency for long-distance.

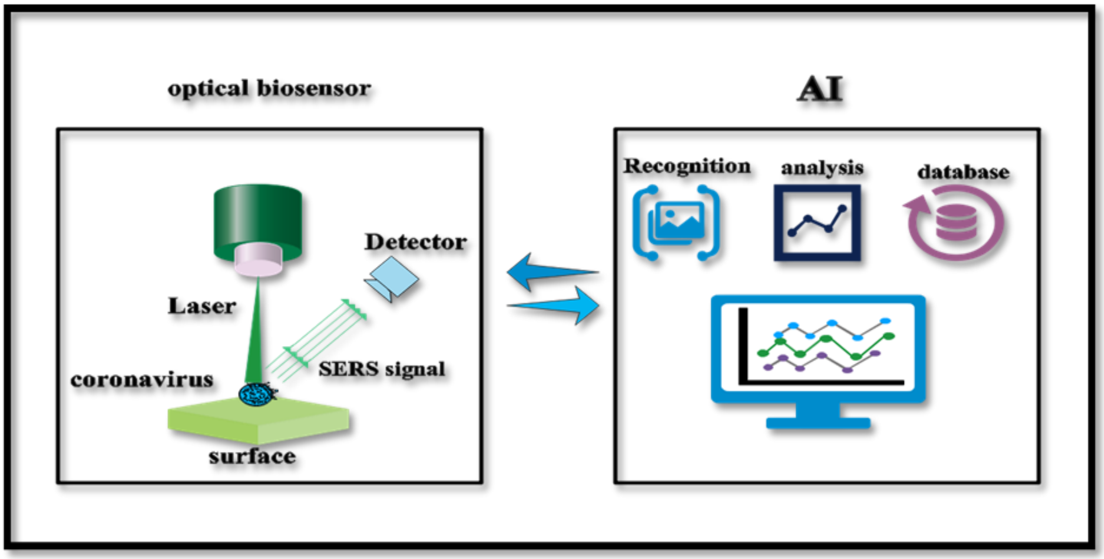

Fig. 10. COIVD-19 detection in environment based optical biosensor.

8. Challenges of techniques detection COVID- 19

This section discusses the limitation of many detection techniques has associated with COVID-19 virus testing and validation, as shown in (Fig. 11).Challenges of detection by molecular model, taking longer to a variety of filters and insulation stages to extract viral RNA are performed for the fluid collected as Reverse Transcriptase Quantitative Polymerase Chain Reaction (RT-qPCR) [144]–[146].Lack of data hampers its use of artificial intelligence to a diagnosis of COVID -19 [147].The computer tomography it used for a CT scan and x-ray the most famous to diagnostic of SARS-COV 2 virus; however, the visibility of the scan decreases as the infection spreads, cases that are often reported as abnormal patterns in the scan [148], [149].The biochemical technique is used to detect viral by protein-protein interactions. One major problem, however, is that while the amount of viral load varies throughout infection, it may be difficult to detect low concentrations of viral protein [150].

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Optical biosensors are categorized mainly as optical sensors based on the concept of the plasmon, such as the SPR, as well as LSPR. Advanced surface chemistry methods developed with Plasmon detect virus strains; provide excellent accuracy and rapid response times. They remain difficult to use in care point applications.

Viral RNA	• Long time result can take 4 hours to 3 days. • Errors in sampling. • Sample preparation, isolation, washing, and analysis.
Antibody	• Low concentration. • Homogeneous protein. • Lacking sensitivity.
Ct scan	• The opacity of ground -glasses. • Irregular linear patterns in the scan. • Lacking in sample dataset.
CXR	• Abnormalities of the radiograph. • Foggy opacity. • A sensitivity 59%. • Lacking in sample dataset.
Electronic Sensors	• Signal transduction process found is not always apparent. • Heterogeneous interface structures.
Magnetic sensors	• These requirements several washing step, well-trained technician is necessary. • Sensitivity medium and time consuming.
Electrochemical sensors	• Immobilization method of the concerned nanomaterial to minimizing the chance of error. • Need long time.
Optical sensors	• Requirement for point of care remaining difficult. • Big size and high cost.

Fig.11. Categories of challenges for detection COVID -19 techniques.

9. Motivations

The benefits of using laser optical biosensors with artificial intelligence to improve accuracy detection and control pandemics outbreak remotely. By design and analysis prototype to diagnose COVID -19 viruses on the surfaces. In order to overcome the challenge to follow patients' crises, and to foresee ailment movement. Just as the utilization of biometric sensors to analyze infections. Along these lines, the location of coronavirus on surfaces by joining an optical natural sensor with picture innovation speaks to the best answer to decrease the pandemic. Unavailable in the existing literature. This section Lists some of advantage.

10. Recommendations

This section summarizes the most relevant literature recommendations for relieving obstacles and promoting the secure and efficient use of a biosensor application on the point of healthcare.

- Enhance diagnostic precision in clinical testing and reduce pressure Tests based on PCR.
- optical fiber sensor device to play a significant role in the detection and treatment of a coronavirus pandemic. can be A wide possible contender for diagnosis COVID-19.
- optical Biosensors could serve as useful COVID-19 pre-screening tests, Specifically.
- Graphene is a two-dimensional layer of hexagonal shapes arranged carbon atoms. Due to its remarkable properties, including high electrical conductivity, high carrier mobility and wide areas, Graphene proved useful for various sensing platforms. Detection of low noise.
- The most or all of the following criteria should be met by the ideal biosensor: high efficiency, excellent stability, fast response time, multiple access capacities, multiple sensor modes, reversible, long life cycle, and simple to use.

11. Conclusion

The worldwide pandemic of COVID-19 majorly affects life. There has been a noteworthy increment in the quantity of individuals worldwide and the quantity of patients influenced. COVID-19 is advancing, and nations, governments and researchers are attempting to adapt to this worldwide emergency. Different analytic tests are utilized to identify COVID-19. In certain tests, a X-beam and CT filter have been utilized to help and recognize COVID-19 inconsistencies. Mechanized tomography outputs and X-beam tests are utilized as essential screening gadgets to decide the degree of COVID-19, to follow patients' crises, and to foresee ailment movement. Just as the utilization of biometric sensors to analyze infections. Along these lines, location of coronavirus on surfaces by joining an optical natural sensor with picture innovation speaks to the best answer for decrease the pandemic. In this investigation, a definite procedure for assessing and looking at the order of man-made brainpower and organic sensor strategies utilized for coronavirus location. The sheer size of information getting every day in regard to COVID-19 is so bountiful and dynamic that even clinical and extravagance staff, exercises and media can't stay aware of this new pandemic. To give an away from of the broad writing accessible, we directed an audit of the COVID-19 examination writing. This survey of examination endeavors to give a decent understanding into the most recent accessible data. This audit is intended to give a decent knowledge into the infection and ailment of the whole clinical network.

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