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Detection of COVID-19 by Smart Wearable Devices

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ABSTRACT—

The necessity for quick, accurate diagnostic technologies that may be utilised has been used for mass screening brought to light by the COVID-19 epidemic. Wearable technology, like smartwatches and fitness trackers, has the capacity to be utilised as a continuous and non-invasive COVID-19 monitoring method. These gadgets are capable of gathering a variety of physiological information, including temperature, respiration rate, and heart rate, which can be used to spot possible COVID-19 cases. In this review, we cover the potential applications of wearable technology for COVID-19 detection, as well as their drawbacks, opportunities, and challenges. We also examine the possibilities of wearable technology for public health and disease surveillance while highlighting some of the existing research and development initiatives in this field.

I. INTRODUCTION

Effective and efficient ways of detecting and monitoring the transmission of the virus are urgently needed as a result of the COVID-19 pandemic. Traditional diagnostic methods, including RT-PCR assays, take a lot of time and call for specialised tools and skilled workers. In contrast, wearable technology presents a viable approach for non-invasive, ongoing COVID-19 monitoring.

Wearable technology is already commonly used to track physiological characteristics like heart rate, sleep atterns, and physical activity, such as smart watches and fitness trackers. In order to detect possible COVID-19 instances, these devices can also record information on body temperature, respiration rate, and other pertinent variables. Additionally, some wearable technology can spot changes in skin conductance, which can be a sign of viral infections before they become more serious.

The scientific community has taken a keen interest in wearable technology's potential for identifying and monitoring COVID-19. Globally, researchers and businesses are creating and testing a range of wearable COVID-19 detection devices, from straightforward temperature sensors to complex systems that integrate numerous sensors and machine learning algorithms.

We will talk about the possible application of wearable technology for COVID-19 detection in this review. We will discuss several of the ongoing research and development projects in this field, in addition to the difficulties and advantages of using wearable technology to monitor disease. We will also discuss how wearable technology might affect illness prevention and public health.

II. WORKING

The majority of wearable COVID-19 detection devices use a variety of sensors to gather physiological data that may used by the pinpoint possible COVID-19 instances. There are some typical methods and ideas, however the precise sensors utilised and the algorithms used can differ according to the device and the manufacturer. To develop a WSN-based monitoring system for greenhouse vegetables, you would need to follow these steps:

Body temperature: It is among the physiological variables that wearable technology most frequently measures in the same order to detect COVID-19. Fever or an elevated body temperature is a typical sign of COVID-19 and other viral infections. Temperature sensors in wearable gadgets allow them to continually or periodically check the user's temperature and notify them if it rises above a preset level. The chance of COVID-19 infection can also be predicted by some devices using algorithms based on temperature data and additional parameters including age and gender.

Respiratory rate: It is another physiological variable tracked by wearable technology for COVID-19 detection. The respiratory symptoms and indications of COVID-19 include coughing and shortness of breath. The wearer's breathing patterns can be measured by wearable devices using accelerometers and gyroscopes, which can also spot variations that can point to COVID-19 infection. Some gadgets also have the ability to discriminate between regular breathing and the atypical respiratory patterns linked to COVID-19 using machine learning algorithms**.**

Blood oxygen levels, rate of the heart, and skin conductance: are additional physiological variables that wearable technology can track for COVID-19 detection. A change in these values perhaps a sign of COVID-19 or other viral diseases' early signs. Changes in sleep patterns may be an indication of COVID-19 infection, which some wearable technology can detect.

To be able to find trends and estimate the chance of COVID-19 infection, the data gathered by different technology for COVID-19 detection can be analysed using a number of algorithms and machine learning techniques. The algorithms utilised might range from straightforward threshold-based methods to so many complex model with consideration a variety of physiological characteristics and environmental data.

In general, the operation of wearable technology for the detection of COVID-19 entails the collection of physiological data using sensors, the analysis the data using algorithms and machine learning techniques, and the identification of potential COVID-19 cases according to the patterns and predictions derived from the data.

III. LITERATURE SURVEY

Ceren Ates, Ali K. Yetisen, Firat Güder, and Can DincerActivity [1] proposed a trackers and smart watches are examples of wearable technology that can offer special insights into our health and wellbeing. Wearables provide continuous access to real-time physiological data, in contrast to traditional testing in a clinical context, which may take place a few times a year. This makes it possible to identify deviations from a person's "usual" baselines, which is a fundamentally different approach to healthcare than what is currently done, which mostly compares physiological measurements to population statistics. Additionally, as the coronavirus disease 2019 (COVID19) pandemic has progressed, the potential of wearable modern concepts has become advanced clear. To begin with, Xiao Li, Michael Snyder, and colleagues from the Stanford University School of Medicine published a paper in Nature Biomedical Engineering.

M. Yap and J [2] proposes a Weatherill The necessity of using and maximising our digital technology for patient testing and monitoring system has been brought into stark relief by the COVID-19 pandemic. We see a need for more effective disease detection and monitoring of individual and public health, which might be facilitated by wearable sensors, as current viral testing and vaccines are sluggish to appear. Although this Modern technology has utilised to link physiological measures to activities of daily living and human performance, its application to forecasting the occurrence of COVID-19 is still required. Wearable device users may receive notifications when changes in their measurements match those linked to COVID-19 when being combined with predictive platforms.

Shing Hui Reina Cheong, Yu Jie Xavia Ng, Ying Lau, Siew Tiang Lau [3] proposes a wearable is a new technique for the early identification of Coronavirus infection in 2019 (COVID-19). The types, workings, and precision of wearable technologies for the early diagnosis of COVID-19 were examined in this scoping study. Its review was completed using Arksey and O'Malley's five-step methodology. Ten digital databases, such as PubMed, Embase, Cochrane, CINAHL, PsycINFO, Pro Quest, Scopus, science of the web connection, IEEE Xplore, and Taylor & Francis Online, were used to find studies published between December 31, 2019, and December 15, 2021. We also looked through grey literature, reference books, and important periodicals. The several varieties of articles that discussed wearable technologies for COVID-19 infection detection. The publications were independently evaluated by two reviewers who also used a data charting form to extract the data.

IV. Methodology

The framework for our proposed system consists of Iot device, phone apps , and a snow connection. Four sensors are being used here, and they are each coupled to a ATMEGA 328 is a kind of microcontroller. The sensors that are employed include those for measuring rate of the heart, temperature of the body of person, sound, and keeping a minimumdistance.

Fig 1: System Architecture

Wearable IOT Devices: Sensor device deployment has significantly risen. In a similar vein, mathematical ansewers have been made in IoT applications to address the COVID-19 dilemma. The most recent state-of-the-art for forecasting COVID-19 instances concentrates on IoT elements and symptom features using wearable sensors. The working paradigm includes wearable technology, therapeutic care, symptom monitoring, and testing for suspected instances. The user's smartphone and this IoT node team up to collect proximity data via Bluetooth and gives to the server via the cellular data network. It includes a sound sensor, a sound sensor for body temperature, a GSM module for data connection, and a heart rate sensor.

Smartphone App: The patient's condition is displayed on the smartphone app. We must first provide our personal information. A perpuse is able to provide the user with a unique risk factor by compiling this data. Different variety of fields are showed in the every parameter. In this case, four variables heart rate, body temperature, cough frequency, and social distance are of concern. The the first, second, and third fields, and fourth field represent these parameters. The COVID-SAFE mobile app is designed to facilitate simple user interaction. All patient-related data is gathered by this application. The programme requests symptoms in accordance with physiological criteria, offers a risk assessment, and sends some helpful advice.

Arduino Nano Board: A microcontroller board according to the ATmega328 is the Arduino Nano. It contains a 16 MHz ceramic resonator, 6 analogue inputs, 14 digital input/output pins (of which 6 can serve as the PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC-to-DC adapter, or a battery to power it.

USB Plug and External Power Supply Plug: Every board of an Arduino requires a means of connecting to a power supply. A USB connection from your computer or a wall outlet with a barrel jack may both be used to power an Arduino Uno. The source of electricity is selected automatically. Additionally, you can upload code by connecting your Arduino board via USB connection.

Voltage Regulator: You shouldn't (or can't) mess around with the voltage regulator on the Arduino. But knowing that it exists and what it is for may be helpful. The voltage regulator controls the amount of voltage that is allowed to enter the Arduino board, doing precisely what it claims it will. Think of it as a kind of gatekeeper; it will turn away an additional voltage that might destroy the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

Power pins: When the Arduino board is powered by an external element (In contrast to the 5 volts provided by n contrast to either the USB connection another n contrast to controlled power source), the input voltage is known as Voltage In Pin. This pin can be used to feed voltage to or access voltage that has been supplied by the power jack. 5V Pin: Through this pin, the board's regulator generates a regulated 5V. The board may be powered by a USB connection (5V), a DC power source, or both port (7–12V), or the board's VIN pin (7–12V). Bypassing the regulator by applying power to 3.3 or 5 volt pins can harm your board. It is not advised. A 3.3 volt supply produced by the onboard regulator is available at the 3.3V pin. The highest current is taken is 50 mA.

Input and Output Pins: All 14 of the digital pins on the Uno may be utilised as inputs or outputs. The operate on 5 volts. Such pins. May be utilised for both digital input (such as determining whether a button has been pushed) and output (such as activating an LED). Each pin includes a 20–5k internal pull-up resistor of ohms that unconnected by default and has a so many current capacity of 40 mA. Additionally, several pins perform specific tasks: Transmitted is TTL serial data and received using the serial out (TX) and serial in (RX) functions. The ATmega8U2 USB-to-TTL Serial chip's relevant pins are connected to these pins.

LED Indicators: LED Power Indicator - Your circuit board contains a is a little LED after the word "ON" and immediately Right after and below the word "UNO." Every time you plug your Arduino into a power source, this LED ought to turn on. It's likely that something is amiss if this light doesn't turn on. Recheck your circuit now! LED On-Board -pin 13 digital is coupled to a built-in LED. When the pin is active, the LED is has a HIGH value; the pin, it is off. has a LOW value. Given that some boards come preloaded with a basic LED blinking programme, this is a useful approach to rapidly determine whether the board is in working order.

SYMPTOM SCREENING AND TRACKING:

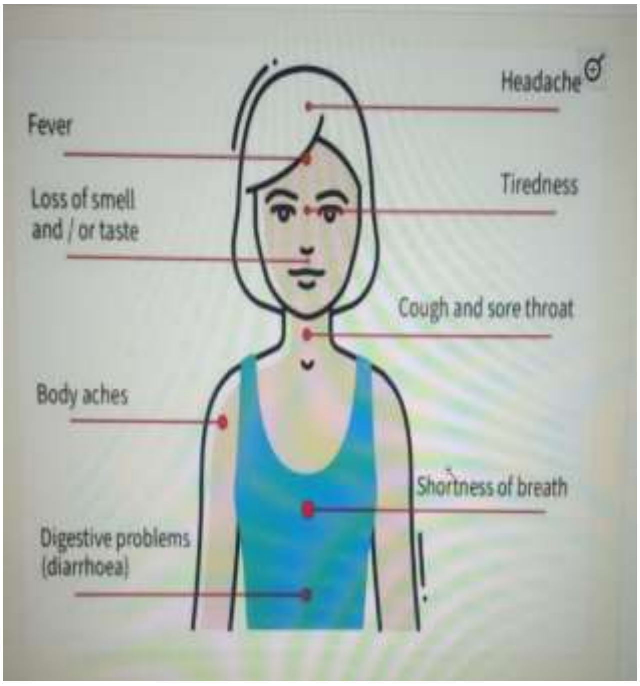

Fig 2: Symptoms of COVID-19

As above fig shown, the most typical COVID-19 symptoms are a fever, a dry cough, and muscular pain, exhaustion, and shortness of breath. Along with these, less common symptoms include hemoptysis, diarrhoea, and headaches. The person with the COVID-19 viral infection is the subject who meets all of these requirements.

The virus ultimately impairs lung function over time, and its effects can last up to 14 days. According to study, among the symptoms, body temperature and a dry cough are crucial indicators of COVID-19.

V. APPLICATIONS

Applications at the individual and population levels can be broadly categorised as two types of wearable device applications for the detection of COVID-19.

Wearable technology the ability to identify COVID-19 signs early on an individual level, enabling users to seek medical assistance and take the necessary precautions to stop the virus from spreading. The adoption of wearable technology for ongoing COVID-19 symptom monitoring can assist people in managing their health and averting future problems.

Wearable technology can be utilised for population-level COVID-19 mass screening and surveillance, assisting in the detection of prospective outbreaks and halting the virus' further transmission. The health of high-risk groups, like healthcare workers and the senior citizens, who are more vulnerable to COVID-19, also possible monitored via wearable technology.

Here are some particular examples of wearable technology for COVID-19 detection:

1. Screening and keeping an eye on people in high-risk places including jails, nursing homes, and hospitals.
2. Monitoring the health of those in isolation or quarantine, such as visitors or close associates of COVID-19 sufferers.
3. Monitoring people's health conditions in settings like offices and industries to stop outbreaks and guarantee worker safety.
4. Screening and observation of people in public places, including as airports and train stations, in order to spot possible COVID-19 cases and stop the virus's spread.

5. To avoid outbreaks and guarantee the security of participants and spectators, the health status of athletes and other people taking part in gatherings like sporting events and concerts is monitored.

In general, the use of wearable technology to detect COVID-19 has the potential to offer insightful information on the virus's spread and assist individuals and communities in better managing the pandemic. However, necessary steps to safeguard privacy, data security, and ethical concerns should be taken in conjunction with the deployment of wearable technology for COVID-19 detection.

VI. FUTURE SCOPE

As technology and data analysis advance, wearable devices' potential for COVID-19 detection is bright. The use of these technologies is expanding accurate and effective. Here are some prospective wearable technology developments and COVID-19 detection uses for the future:

Integration with other healthcare technologies: To provide a comprehensive and individualised approach to COVID-19 management, wearable devices for COVID-19 detection could be integrated with other healthcare technologies, such as telemedicine platforms and electronic health records.

Use in rural and underserved locations: Wearable COVID-19 detection devices could be utilised to offer Early COVID-19 case identification and monitoring in remote and locations with poor service and little access to healthcare resources.

Real-time symptom monitoring: Wearable COVID-19 detection devices may offer real-time symptom monitoring, such as monitoring fever and cough, to encourage people to seek medical assistance and stop the virus from spreading.

Personalised risk assessment: Based on user health information and COVID-19 exposure history, wearable COVID-19 detection devices may offer a personalised risk assessment that enables users to make health-related decisions and take the necessary precautions.

Contact tracing apps could be linked with wearable COVID-19 detection devices to allow more precise and effective identification of potential COVID-19 exposure and transmission.

Monitoring of vaccine effectiveness: By evaluating immune response and side effects following immunisation, wearable COVID-19 detection devices could be utilised to evaluate the efficiency of COVID-19 vaccinations.

Overall, the future potential of wearable technology for COVID-19 detection is enormous and shows promise for boosting COVID-19 treatment and preventative efficiency. The implementation of wearable technology for COVID-19 detection must be complemented by the right safeguards for data security, privacy, and ethical issues.

VII. CONCLUSION

A promising approach for the Early COVID-19 identification and monitoring symptoms is the use of wearable devices. The constant and non-invasive monitoring of vital signs and other health information that these gadgets offer may aid individuals in managing their health and stop the infection from spreading.

The review of the literature reveals that a variety of wearable gadgets, including smart watches, fitness trackers, and patches, have been created and tested for COVID-19 detection. Many of these gadgets have demonstrated promising accuracy and dependability outcomes.

Wearable technology has a wide range of uses for COVID-19 detection, from individual-level to population-level applications. Some examples include mass COVID-19 screening and surveillance, monitoring of high-risk populations, and tracking of athletes and group members.

With prospective advancements like integration with other healthcare technology, real-time symptom monitoring, individual risk assessment, and tracking of vaccine efficacy, the future potential of wearable devices for COVID-19 detection seems encouraging. The implementation of wearable technology for COVID-19 detection must be complemented by the right protections for data privacy, data security, and ethical issues.

In general, wearable technology for COVID-19 detection has the ability to offer insightful information on the virus's spread and assist individuals and communities in better managing the pandemic.

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