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RESEARCH ARTICLE

COVID-19 Prevention: an IoT - Based Solution for Effective Social Distancing and Contact Tracing

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ABSTRACT

Corona virus has infected millions of individuals throughout the world, and the number of sick persons continues to rise. Humans get the virus through direct, indirect, or close contact with infected individuals. This proposed work introduces a new feature, an intelligent community distance system, that allows people to maintain community distances among others in both indoor and outdoor locations, therefore avoiding COVID-19 exposure and delaying its spread both locally and internationally. The proposed research aims to monitor an IoT-based portable monitoring device that is designed to measure COVID-19 signals. Furthermore, by monitoring real-time GPS data, the device immediately alerts medical authorities concerned about any confinement violations of patients who may be infected. Also, find out what new tool will be beneficial for tracking and predicting COVID-19 collections. To aid in the analysis of COVID-19, the solution incorporates a mobile system coupled with a portable device that is equipped with clever IoT capabilities (complex data analysis and intelligent data detection) incorporated inside the system. A comparison of several machine learning classifier algorithms such as SVM, Random Forest, KNN, and Decision Tree is presented as the best model for making predictions and determining accuracy. We observed that KNN performs better, with a 95 percent accuracy rate. COVID-19 will be utilized to avoid the transmission of illness in future global health concerns using an automatic social distance monitoring and contact tracking system.

Keywords: Corona virus, COVID-19, community distance system, social distance

INTRODUCTION

COVID-19 is an extremely severe infectious virus that causes a highly contagious respiratory disease (SARS-CoV-2). SARS-CoV-2 is a virus that targets the respiratory system and causes symptoms including poisoning, fever, nausea, and shortness of breath. Many nations have used Lockdown to avoid the pandemic, in which the government forces inhabitants to stay at home during this vital period. Community health services, such as the Centers for Disease Control and Prevention (CDC), have to make it clear that avoiding close contact with other individuals is the most efficient strategy to prevent the transmission of Covid-19. To keep the turns to the Covid-19 outbreak flat, the earth's population are used to rigorous activity. During incarceration, community activities, team activities, and congregational activities such as travel, meetings, gatherings, workshops, and prayers were prohibited. People are encouraged to coordinate and conduct events as much as possible via phone and email to avoid personal interaction. In order to keep the virus from spreading, individuals are being advised to practice good hygiene, such as hand washing regularly, wearing a mask, and avoiding close contact with ill persons. There is, however, a distinction between knowing what to do to decrease viral spread and actually doing it [1].Using public broadcasts among persons at least one metre away is one well-known method of preventing the spread of Covid-19. The corona virus is spread from person to person by minute droplets from the nose and mouth, according to WHO. To put it another way, social dispersal is the greatest strategy for minimizing physical contact with probable corona virus carriers by keeping at least a metre between individuals.Covid-19 antiretroviral measures are supported by the planned work. It offers a way to locate individuals in public locations such as retail malls, banks, markets, temples, mosques, public transportation, and government offices [2]. In order to reduce the danger of disease transmission inside congested indoor environments, monitoring and support of social isolation has become more necessary [3].

In public locations, social measures such as contrasting signs on the chairs deter individuals from sitting close to one other (Fig.1). In modern times, the greatest form of prevention is social isolation and wearing a face mask. The World Health Organization (WHO) standards give a full examination of external activities that must be rigorously adhered to: WHO guidelines for follow-up: (1) Prior to exposure, the face mask or cover must be worn. (2) When leaving a private location, a person must maintain a public distance throughout his or her time in public settings. As a result, there is no lasting treatment in the absence of medical assistance. Few initiatives are being done throughout the world to employ IOT data as a preventive or predictive strategy against Covid-19, or as models in epidemiology. With the use of a food security camera that can analyze live or offline to detect social divisions and face mask covering in the official, public, or public area, a vision tool for controlling social distance and face mask at work has been developed. will aid in the monitoring of health policy The Practicing Health regimen helps people live longer and reduce rashes [5].

The COVID-19 outbreak has wreaked havoc on human mobility patterns as well as social behavior connected to everyday mobility. In order to conduct corrective actions at this time, it is necessary to understand illness dissemination patterns and mechanisms among neighbors. Countries throughout the globe are pursuing developments in mobile technology and the Internet of Things (IoT) to help maintain track of common connections to track persons close to identified COVID-19 patients to improve the efficacy of social media tracking. Even once vaccine therapy becomes available in 2021, the COVID-19 management plan will continue to look to the future in terms of digital communication, which is an important aspect of the response, and the adoption of preventative measures like social isolation and masks. In-depth information of the applicability of the various technologies, as well as the usability, privacy, and trade-offs of ethical principles involved, after several months of usage of digital contact monitoring technology. Due to recent developing data on worldwide information for the distribution of digital contact tracking technology, we give a full study of digital communication tracking solutions in terms of their processes and technologies in this proposal. Data collecting and interpretation should be established in contact tracking apps. Figure 2 shows contact tracing zones in public spaces.

Related work

Sengupta *et al* [6] argue that a plan to respond to environmental outbreaks should be developed to aid in the tracking and tracking of safety-related problems in industrial and community settings. Controlling infectious diseases and their spread necessitates comprehensive communication. To track human activity, the framework will incorporate video feeds from surveillance cameras and IoT edge devices located in industrial or public spaces. The architecture suggested here is a hybrid method to integrating feeds from current cameras and IoT devices with cloud-based computer-based edges. S. Srinivasan et al provide a comprehensive and successful solution based on the binary category for detecting a person, detecting a breach of social distance, and detecting a face-to-face mask separation utilising object identification, integration, and Convolution Neural Network (CNN). In this scenario, video databases were monitored using YOLOv3, a local collection based on congestion audio applications (DBSCAN), Dual Shot Face Detector (DSFD), and MobileNetV2 based Binary classifier. They did this through comparative study on various facial expressions and face mask classification methods. Finally, a strategy for labelling video databases is proposed. Video data is utilised for system testing and to compensate for public data shortages. System performance is accurately assessed, Fl score as and predictive timing, which should be low enough to be applied in a practical way [7].

A Khanfor et al. [8] provide a functional framework for improving pedestrian safety while roaming the real-world map of the smart city using the notion of Social IoT (SIoT). The goal is to limit the danger of infection in highly populated places where social distance may be an issue. While analysing the movement of other devices, the proposed walkway proposes a pedestrian path in real time. First, IoT devices were divided into communities based on two SIoT connections that took into consideration device locations as well as friendship norms among their owners. As a result, the weights on the city map roadways represented their safety requirements. After that, they employ the Dijkstra algorithm, which is a navigation algorithm, to propose the safest path to go. The potential to achieve a trade between the two most secure and quicker routes depending on pedestrian preferences was demonstrated using imitation effects in a real-world IoT data collection. This research [9] proposes a signal processing architecture that enables for combined topic movement analysis and automated temperature testing. The system includes infrared sensors that use temperature data to track subject mobility and health. Existing IoT wireless devices placed according to different structures link the sensors to the network. The goal of the programme is to link the local action of the headers by tracking their equal distance and route of arrival, as well as the remarkable finding of body temperature in individuals near the IR sensors. This article examines acceptable practises as well as proper application implementation employing field standards, with a focus on Bayesian approaches. For privacy neutrality, the suggested framework may be used to both public and private health-care services, as well as intelligent living and shared space circumstances.

W. Lv and colleagues propose chain, an expanded and illegal blockchain protocol. 1) By integrating the anonymous evidence-based protocol with the key security mechanism, the SRC protocol's SRC secrecy and the accompanying block structure are enhanced. As a result, there is no longer any link between personal identify and on-chain location data. The on-chain property owner may still claim ownership at that moment without releasing the secret key to anybody else. 2) Proposed a field-based practise of incentives to encourage IoT witnesses to promote the monitoring industry's oversight. The suggested communication tracking and location verification technique works effectively in the actual world, according to several results. To assure the availability of monitoring of digital communications in the actual world, the suggested contract tracking protocol's power consumption, time delay for each procedure, and BLE performance have been studied [10].

S. Arun Kumar et al. present a preventative method in this study, proposing the notion of a smart wrist band with a heat sensor and IoT technology. Blood pressure measures are also taken from time to time with the use of a blood pressure sensor. As a result, once the temperature or blood pressure are determined to be abnormal, this gadget helps to generate an alarm. With the use of IoT technology, faster information is transmitted on to the basic level user and second level relatives. As a result, by monitoring and notifying victims, this joint and active wrist band plays a critical role in saving lives.Because bacterial diseases are linked to a rise in body temperature, our device will be extremely useful in detecting them early. Traditional measurement methods frequently need human participation and are not of combined size. These issues are addressed in this architecture, which involves minimum management and sensor configuration for temperature and blood pressure monitoring, data processing, and storage [11]. The goal of this article, by D. Chloros et al [12], is to investigate the developmental obstacles and potential for apps that track transmission, as well as how IoT systems might be used to record symptoms. The benefits and necessity for these apps' development will be highlighted by evaluating their potential. The Fluspot application was created specifically for this investigation. By raising public awareness and providing timely information, Fluspot hopes to help reduce the spread of infections this season. Fluspot uses a wearable IoT device to closely monitor flu flows and collect user inputs for viral propagation to the site. This anonymised and aggregated data is shown on a map to provide a more accurate picture of the situation in each location. Another major element is that the artefact's ability to monitor wearable indications is critical for users in their daily lives. The work by A. Waheed et al. [13] examines a range of technologies utilised in a variety of situations, including social isolation and prevention, isolation and isolation, COVID detection and assessment, therapy and patient care, and hospital administration. This study discusses transparent planning, technical techniques, and digital procedures, as well as the most up-to-date intelligent technologies in a range of disciplines that can aid in overcoming coronavirus intensity. IoT, AI, and machine learning play a significant role in the fight against COVID-19. AI has made a substantial contribution to the resource management pandemic, public awareness, security management, and supporting professionals in implementing stringent standards.

In the COVID-19 era, V. Shubina et al tracking of wearable contact is garnering increasing focus in order to successfully prevent sickness. As a result, identifying viable technologies for tracking wireless communication and their wearability is critical. Existing contact monitoring app trading necessitates a detailed examination of technical skills such as accuracy, power consumption, availability, error sources when dealing with wireless channels, privacy concerns, and hurdles to larger apparel market access. We find, based on considerable literature study, that demarcated buildings, when compared to intermediate techniques, provide a superior location to trade in terms of accuracy and user willingness to utilise them, taking privacy issues into account. This study gives a brief summary of the technological options available for human monitoring services, describes fundamental concepts that influence the efficiency of digital communication tracking, and discusses the effects of wear on coping with viral infection transmission [14]. T. Luo et al. [15] provide a model for infectious, contagious, infectious, asymptomatic disease, Diagnosis, and Death (SEINRHD). The model was created using epidemiological data from COVID-19 in China and the estimation of social network heterogeneity. The original Wuhan public epidemic was recreated and updated with accurate data. We utilised this model to look into strategies to manage the outbreak in instances when three-dimensional signals were not apparent. On the basis of effective replication rates, the occurrence of exceptionally high infections, and the kind and structure of transmission, the impact of undetected cases on the propagation of the epidemic was estimated. Asymptomatic patients can be managed to assist the infection curve shorten. When compared to asymptomatic and non-symptomatic tracking, tracking 75% of non-symptomatic patients results in a total reduction of 32.5 percent in new cases. During the outbreak, emphasis should be placed on illness control and prevention in families.

Proposed Method

System Overviem

The following sub-systems make up the proposed system: 1) An Arduino Uno-based temperature measuring device 2) IoT system that measures the Arduino board via social distancing 3) on the server 4) A security guard smartphone application. To begin, everyone attempting to enter the residence must pass an unmodified temperature check. We're utilising an Arduino Uno with an infrared thermometer (e.g., MLX906148) or a hot camera sensor for this (AMG88339 for example). It also employs the ESP8266 Wi-Fi module for MQTT protocol connection with Edge servers. If that person's body temperature is anomalous, the door is locked, and a MQTT message is delivered to the server, providing both the temperature and the location where it was recorded. This message is received by the server, which then transmits it and carries on. with a security guard's smartphone app, so they can arrive and make sure the individual isn't attempting to enter a work zone. In specific regions, Arduino board devices verify whether public distances are being utilised properly or not. Similarly, when public distances do not operate well in particular rooms, a MQTT message will be sent to alert security personnel. Message processing, event logging, reflection, and message transmission are accomplished on the server side using the MQTT broker and the triple semantic store. Edge servers receive communications, do semantic annotations, and make assumptions to choose the appropriate security guard to notify. Security guards utilise a basic Android mobile app that receives MQTT messages from the server and visualises data about the position. Figure 3 depicts social distancing with a smart device for Covid-19, with the goal of ensuring that COVID-19 safety rules are followed appropriately indoors. The proposed calculation will provide a satisfactory result for physical separation using an ultrasonic sensor. The following is the pseudo-code for the suggested calculation:

IR Sensor

There are two sorts of temperature measurement tools: touch and non-touch. Thermocouples, heat-resistant heat exchangers (RTDs), thermistors, and semiconductor temperature sensors are examples of infrared temperature sensors used in communication equipment. Because contact lenses monitor temperature, they require physical contact with the item being measured to bring the sensor body up to temperature. When a relatively big sensor meets a tiny object and functions as a heat sink, the temperature of the object may be altered. Figure 5: Infrared sensor

Ultrasonic Sensor

Ultrasonic sensors use ultrasonic waves to measure distance. The sensor head sends out an ultrasonic wave that is reflected back to it from the direction. Ultrasonic sensors use the time between output and reception to calculate the distance to the target. The ultrasonic sensor can identify items that are far away from the robot. The ultrasonic sensor, unlike the touch sensor, is not affected by physical contact. The range gives you plenty of room to react.For distances of 10 inches or more, an ultrasonic sensor is often utilised, whereas for shorter distances, a light sensor is typically employed. Ultrasonic sensors detect moving things and measure each object's relative location and movement. The vertical movement of each ultrasonic sensor is measured using a measurement of the measurement range, and the movement in the measuring area is measured using a modified distance data conversion. Figure 6 depicts an ultrasonic sensor.

Social Distancing Algorithm

This is the second step of our framework proposal. The suggested social distance monitoring algorithm serves two purposes. Function 1 aids in the identification of things in the picture. It employs a detection approach to offer human positions as aggregate values like XA (left), YA (top), XB (right), and YB (bottom) (bottom).

$X = (X_A + X_{B)} / 2$ (1)

$Y = (Y_A + Y_{B)} / 2$ (2)

where XA, YA, XB, and YB are the left, top, right, and bottom compound numbers of an object. Coin or centroid values are X and Y. These parameters are also passed on to the next function, which calculates social distance. The distance between the two items is calculated using the Euclidean distance, which indicates their closeness, as indicated in Eq. 3. When comparing this distance vector to the previously indicated threshold value, the choice was taken. If the Euclidean range is less than a specific threshold, it is thought that the two elements did not adhere to the conditions of social reduction or did not generate enough space between them.

$D = \sqrt{(X2 - X1)2} + (Y2 - Y1)2$ (3)

Where (X1, X2) and (Y1, Y2) are Centroid values of two objects.

Pseudocode

To distinguish between human and object in the context of physical removal.
1. Human or item in the range of ultrasonic sensors.
2. output: Notifying the client with a sound signal.
3. Uses the ULTRASONIC sensor module to detect the presence of individuals.
4. If a person or moving object is detected, measure the distance between them.
5. If the distance is less than 2 metres, activate the sound directive for that distance alone.
6. Prepare a message and caution for safe separation and disinfection if the distance is similar to 1.5 m.
7. The message will be repeated till the person does not clean. Individuals must push the reset button after disinfection.

Algorithm: Social Distancing Measurement

Input: I_N: Image I containing N Number of frames of size 225x225x3
Output :D: Distance between two objects
Initialize Parameter:
Threshold = 90.0,
Human_Count= 0;
Cvo = [],
Lcvo = [],
Cen = [],
Center = [],

Function Object_Coordinates(V)
Picks = Human_Detection_Framework (VN)
.
For (X_A,Y_A,X_B,Y_B) in Pick :
Cvo = [X_A,Y_A,X_B,Y_B]
C1 = ((X_A + X_B) * 0.5)
C2 = ((Y_A+Y_B)*0.5)
Cen = [C1,C2]
Center.append(Cen)
Lcvo.append(Cvo)
Human_Count +=1

End For
Return Human_Count, Lcvo,center,Image
End *Function*

Temperature Checking

Using a wireless IR sensor, the temperature checking system based on Adriano Uno detects the passenger's temperature. One by one, the passengers pass. If the temperature of the passenger is higher than the average human body temperature (37 °C), the Adriano Uno generates a signal to lock the door to prevent the person from entering the building and sends a MQTT message indicating that a person with a high body temperature has been detected at a specific location. Otherwise, the door to let the individual in is opened.

RESULT AND ANALYSIS

The IoT-based portable monitoring device is meant to measure the signals associated with COVID-19 and uses a machine learning model to anticipate the different machine learning techniques. Machine Learning techniques to increase the model's accuracy and impact, as well as to avoid disease transmission in future global health issues. Figure 7 shows the various machine learning algorithms. KNN delivers the best set of performance values with a 95 percent accuracy. The performance of two persons was examined in the distant sensing test, and it is projected to decline as the number of people inside the distance view rises. The distance monitor's performance fluctuates with object distance from the camera, as it does with the measurement initially derived between pixels and meters. Figure 8 shows how K-Means algorithms are used to calculate social distance. It is utilized to execute two points on the folks who have been detected. Because social distancing is tested between a minimum of two individuals, the cluster's minimum necessary points are set to two, and the two-person distance parameter is set to two meters. If the space between two people is very small, it is considered risky; if the distance is greater, it is considered safe. The performance of all of the models was evaluated using criteria such as accuracy, specificity, precision, recall/sensitivity, and F1 score, as shown in Table 1. KNN is trustworthy for monitoring IoT-based portable monitoring device is developed to measure the signals connected with COVID-19, according to the accuracy values of four models. With the highest F1 score of the four models, KNN emerges as the best. Although the SVM model is relatively similar to the decision tree, it cannot be regarded a robust model because to its poor recall of 0.83.

CONCLUSION

The proposed technology is based on real-time sensors such as infrared (IR) and ultrasonic sensors for effective social distancing and contact tracing for COVID-19 prevention. Temperature, heart rate, SpO2, and cough rate are all measured using the wearable sensor layer. It also sends real-time patient GPS position data to medical administrators and notifies family members to alleviate stress. During the epidemic, the app's peripheral interface is in charge of storing, collecting, and analysing data in order to monitor and govern public life and administration. The Android mobile app is quite helpful in informing family responders on patient status and lowering transmission rates. The wearable gadget is totally functional in terms of receiving patient health symptoms both during and after an illness. In order to control, monitor, and control patients who may be infected with COVID-19 in the spread of the disease, this system was tested and verified in real time at the hospital. A wearable gadget might be used as a model, allowing airport travellers to sit alone as they arrive and depart. This work has undergone significant investigation in order to deliver the greatest device performance by comparing current domains. The project's new features are used for a variety of purposes, including measuring health symptoms, tracking and monitoring a patient while detained, storing data to predict the situation, and notifying authorities in a timely manner so that they can be properly monitored and use the Android platform to stay informed. Respondents' family members' patient status. Our suggested technique might potentially be utilised to avoid disease spread in the future in the case of global health issues. Also, take use of this proposed technology, which can assist in diagnosing and treating early symptoms.

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Table 1. Classification result for four models

Models	Evaluation Metrices								
	TP	TN	FP	FN	Accuracy	Specificity	Precision	Recall	F1Score
SVM	28	6	2	3	0.60	0.70	0.63	0.90	0.75
Random Forest	29	6	2	2	0.88	0.75	0.73	0.75	0.90
KNN	29	5	3	2	0.95	0.89	0.90	0.93	0.92
Decision tree	26	6	2	5	0.65	0.75	0.69	0.73	0.72

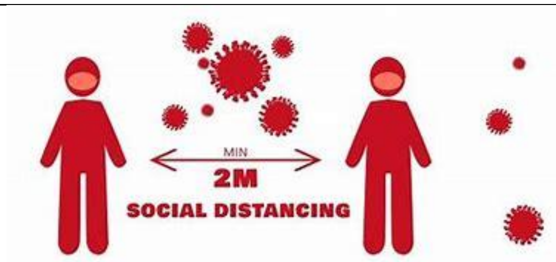

Fig.1.Social distancing [4]

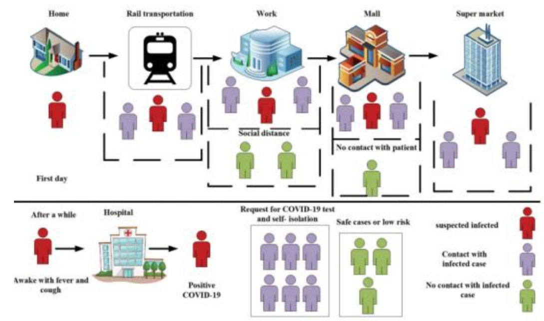

Fig.2. Contact tracing areas in public places

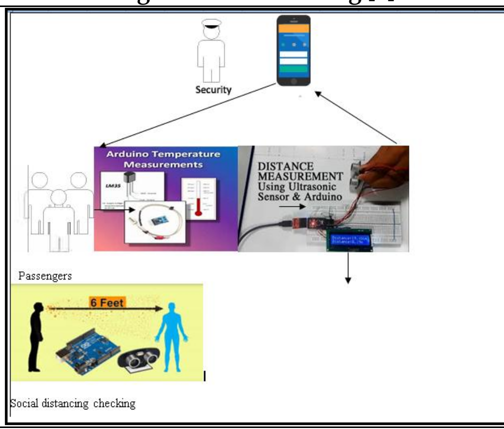

Fig. 3. Overall Architecture of Social Distancing

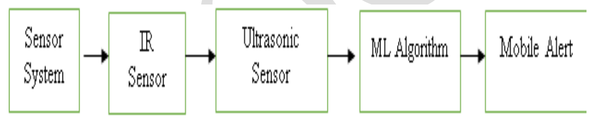

Fig.4.Social Distancing using Smart Device For COVID-19

Fig. 5. IR Sensor

Fig . 6. Ultrasonic Sensor

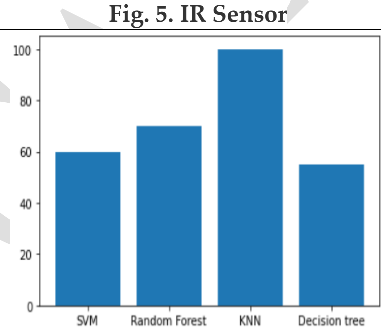

Fig.7. Machine learning's algorithms

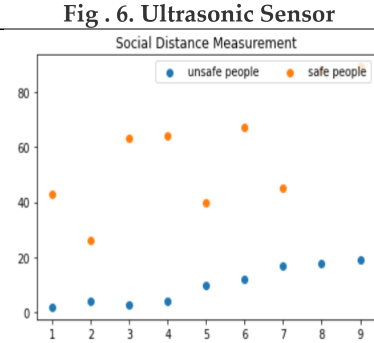

Fig.8. Social Distance Measurement