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Substantial Phase Exploration for Intuiting Covid using form Expedient with Variance Sensor

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Abstract

This article focuses on implementing wireless sensors for monitoring exact distance between two individuals and to check whether everybody have sanitized their hands for stopping the spread of Corona Virus Disease (COVID). The idea behind this method is executed by implementing an objective function which focuses on maximizing distance, energy of nodes and minimizing the cost of implementation. Also, the proposed model is integrated with a variance detector which is denoted as Controlled Incongruity Algorithm (CIA). This variance detector is will sense the value and it will report to an online monitoring system named Things speak and for visualizing the sensed values it will be simulated using MATLAB. Even loss which is produced by sensors is found to be low when CIA is implemented. To validate the efficiency of proposed method it has been compared with prevailing methods and results prove that the better performance is obtained and the proposed method is improved by 76.8% than other outcomes observed from existing literatures.

Keywords: Wireless sensors; COVID; Energy consumption; Angle of inclination; Internet of Things (IoT).

1 Introduction

Recently, Internet of Things (IoT) has been emerging as a useful platform for medical applications. This helps the doctors all over the world to take care of their patients in the place where they are residing. This type of developments is possible only by using intelligent monitoring devices like sensors. In line with above concern, sensors can also be designed and used for handling the current pandemic Corona Virus Disease (COVID). It is well know that no medicine is available for stopping COVID and only way is to maintain distance among individuals. Even the sensors can be designed for monitoring whether hands of individuals are sanitized or not.

Therefore, an ultrasonic distance sensor can be integrated with high performance boards with a micro server as shown in Figure 1a. In addition, these sensors are designed for installing in all public places which even includes small shops.Therefore, in this case different LEDs can be connected for determining distance as shown in Figure 1b. This method is not a complete remedial method for COVID but by implementing this technology the people can preserve themselves from COVID and the monitoring station will try to stop the anomaly behavior of each individual.

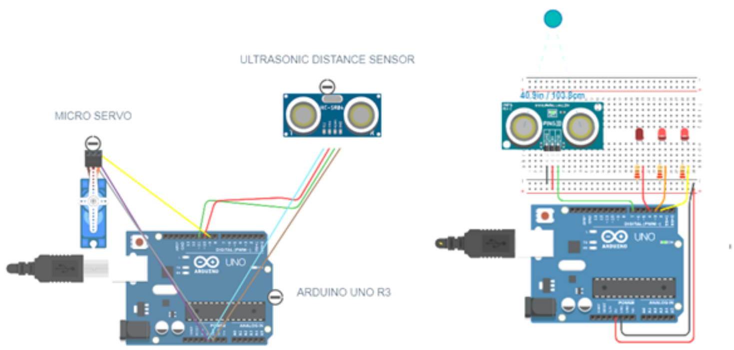

Figure 1: Implementation of proposed method for monitoring COVID (a) With micro server (b) Without micro server

1.1 Literature works

For integrating sensors in general public it is necessary that basic parameters and design of sensors have to be surveyed. Therefore, this section focuses on literature works by examining different parameters that have been discussed by several authors. The basic parameter for monitoring distance with basic principles of infrared illumination in mobile robots is discussed [1]. The authors have designed a low cost sensor but the major disadvantage is that the sensors are designed for monitoring very low distance which is up to 1 meter. Also, the angle of inclination for installing sensors is much hard task in public which is also discussed with necessary formulations. But after installation it is observed that energy consumption is much lesser and therefore it needs to be solved. For solving the problem of energy consumption high power wireless nodes have been deployed [2] and after deployment it is observed that even additional energy can be saved. However there is advantage of much higher energy saving the method suffers from disadvantage that error rate is much higher where, exact parametric values cannot be obtained [2]. In addition, the distance between individuals and walls should be maintained and in this case ultrasonic sensors have been designed with exact angle of inclination [3].

Even though a low cost sensor for moving environment is designed, straight angle measurement which is much necessary for monitoring in epidemic situation has been inapt. If both straight and cross angle measurements are made then, it would be a major advantage to the society [3]. To overcome the drawback in [3] a new technology using robotic application have been developed [4]. This kind of robotic environment will be mostly used in applications like vehicle monitoring where, exact distance of other vehicles can be informed to all individuals. Additionally, an alarm gust will also be deployed and if two vehicles are getting closer and any indication of accident is present then the alarm will be automatically switched on. But, installing the sensors of this type will be much higher and public cannot be able to afford much higher cost [4]. Consequently, for reducing the cost of sensor which needs to be installed in highways an ultrasonic pulse with a new method on selecting ground based points with necessary threshold parameters have been designed [5]. If this case [5] is considered then, cost of installing sensors in important points will reduce but the pulse will produce only less energy where information cannot be processed in a correct way between transmitter and receiver [5].Furthermore, the sensors designed [1-5] cannot be able to monitor any one necessary parameters therefore, the authors [6] have combined two different techniques such as ultrasonic and infrared sensors for measuring distance. Even if accurate distance is monitored and the values are correct but when two methods are combined it is apparent that cost will be much higher [6]. From examining [6] it is observed that instead of using two different methods, if thermal sensors are implemented then, it is easy to predict the position of each individual [7]. Still, this virtuous method suffers from disadvantage that exact values can only be obtained if sensors are installed only on ceiling of all buildings [7] and angle of inclining sensors ismissing. After some years a unique application on door step have been developed for computing group of peoples and exact distance between them which is denoted as smart construction monitoring [8]. In this application a lot of security measures have been updated from existing platforms and also an array of sensors have been implemented in grid based structure. But the problem with array structure is that when sensors are grouped the data that is sent from transmitter to receiver have to be arranged in order for saving the energy consumption which is not possible with this type of IR sensors [8].For implementing sensor arrays another method that is diverse from [8] have been introduced with photodiodes and bridge routes [9].When photodiode is introduced exact measurement accuracy will be much higher and values will be obtained exactly within 2.5ms. But this creates an uncertainty where, bandwidth supplied by source should be much higher [9] where, it is not possible in all situations. Even for better installation a comparison have been made between ultrasonic and infrared sensors for detecting obstacles with exact detachment rate [10].The aforementioned model is examined using vehicular applications and a time of flight method is enabled which makes the entire system to provide more accurate results. But unreasonably more energy have been used which makes the cost to rise beyond exact economic value [10]. When sensors are tested for integrating in medical application mainly for Corona Virus Disease (COVID) a new method using neural network have been applied. When this neural network is introduced it can able to detect the affected patients immediately with ten days. A common drawback in neural network is more data needs to be specified at same time and during each stage separate operations will be performed [11].To introduce a new method that differs from neural network, a block chain technology has been integrated [12]. When this block chain is introduced then, it is very easy to store large amount of data. This creates may positive advantage over other methods because these systems can be introduced in mobile environments where correct of inclination will be specified. But the authors have not explained about security measures that are involved during this risk process on storing large amount of data [12].To have complete exploration on security an energy cost behavioral model have been implemented [13] where, different position of sensor is acquired in accurate way and complete analysis for integrating in public places have been made with help of EC curve. However, uniform distribution of data is necessary for implementing in low cost condition [13-18].

1.2 Research gap and motivation

All the existing work which provides base information [1-18] fails to detect any one basic parametric value like energy consumption or cost of installation. Moreover, the existing articles have not focused on detecting any pandemic situations like COVID. But only basic parametric values have been measured to some extent. Therefore the existing research gap on monitoring the distance with high node energy at low cost has been missing in all conventional models. Therefore, the authors have formed a base work by maximizing distance, energy and minimizing the cost of installation with proper angle of inclination of sensors by formulating the objective function (Equation (7)) and integrating it with deep learning model for building the research gap. The procedure of node identification is deliberated in Figure 2.

1.3 Objectives

The main objective of this research work is to safeguard every individual before distressing COVID and in addition for making the spread of COVID to remain in stationary condition by monitoring the distance between each individual using an online monitoring system (Things speak). In addition, the objective on minimizing the

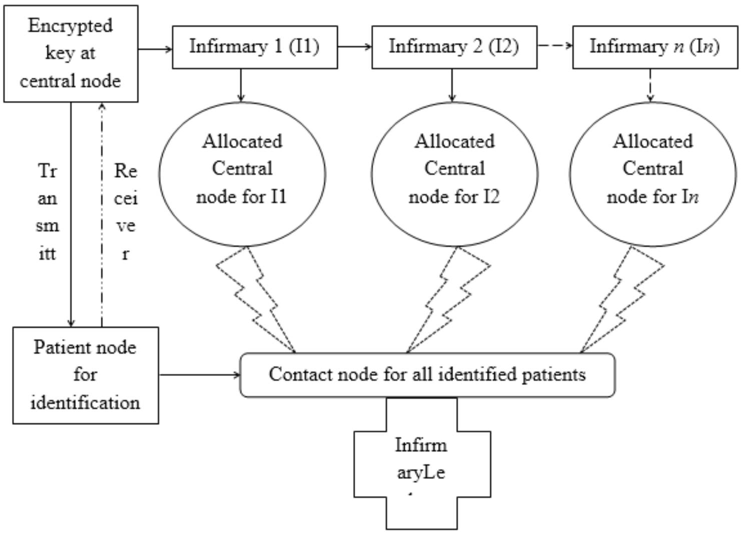

Figure 2: Node identificationprocedures for patients and infirmaries

cost of installation with high energy for transferring the information from source to destination is also fulfilled. The main purpose of considering this objective is that no medicine is available for COVID and all people have to maintain distance between them with proper sanitizing lifestyle. This is possible only by implementing a monitoring device like sensors. Therefore, a cost efficient sensor will be installed in all public places with correct angle of inclination for monitoring the distance between each individual.

2 Problem formulation

In this section, the sensing units will be designed according to the distance requirements with necessary parameters. Since the sensors are designed for pandemic situation all necessary parameters must be integrated together.

2.1 Calculation of distance

It is well known that for preventing the pandemic COVID situation no remedy is available and the only way is to maintain distance. But most of the people are not maintaining distance properly in all places. Therefore, for monitoring the distance between individuals a distance monitoring sensor will be placed and it will be formulated as given in Equation (1).

$$D_i = \sum_{i}^{n} CT_i(meters) \tag{1}$$

Where,
Crepresents distance between each individual
T_idenotes the time that both individuals are standing close to each other
Equation (1) represents the mutual formulation of sensors whereas, it differs in each situation based on selective criteria as shown in Equation (2).

$$D_i = \frac{3 * V(i)}{10(meters)} \tag{2}$$

Where,
V(i)represents the output voltage obtained from each sensor
The intention behind the distance of 10 meter is that the signals can be emitted up to that distance and corresponding signals will be reverted to transducer only if the limit is maintained within 10 meters. Equation (2) will be implemented if the distance is calculated using output voltage. The value 3 indicates angle of inclining each sensor and 10 represents distance between each obstacle (In 360 degree view).In addition, if both equations are implemented for designing the sensor then it should provide high accurate values and it can be observed using Equation (3).

$$A_i = 100 - D_i \tag{3}$$

Where,
A represents the accuracy of sensor for calculating the distance (For both Equation (1) and (2))

The value of 100 represents the full scale reference accuracy where the difference with respect to distance values will provide exact accuracy of proposed model.

2.2 Angle of inclination

Angle of inclination for implementing sensors in outside environment is much important. If the sensors are not mounted properly in objects then, necessary parametric value cannot be evaluated properly and exact value will be much different where, Equation (3) will not be satisfied. Therefore, the position for mounting the sensors can be formulated in a collective way as given in Equation (4).

$$\phi_i(D_i) = \frac{\rho_i}{(D_i^2)} + \gamma_i(radians) \tag{4}$$

Where, ϕ_i (D i)indicates that angle of inclining sensors will vary depending on distance ρ_i represents the replication of ith target source γ_i denotes the radiation of integrated sensors (0 or 1) Equation (4) cannot be implemented if necessary constraints in Equations (1) and (2) are satisfied. Also, two different values will be indicated when radiation occurs through sensors. Therefore, the value will change at different times where, exact value will be obtained in all circumstances.

2.3 Energy consumption

Once the accuracy of designed sensor is much higher then, the next parameter for valuation is consumption of energy by all nodes that are connected with sensors. Always the sensors should be designed in a correct way that it should maximize the energy consumption which indicates that power transmitted form source to destination should be much higher. Calculation of power that is consumed by nodes (Both transmitter and receiver) can be expressed as,

$$E_i^{Tx,Rx} = TP_i^{A+D} + TP_i^{amplifier} M^1 L^2 T^{-2} \tag{5}$$

Where, $TP_i^{(A+D)}$denotes the total power that is supplied to all paths inside the sensors.
$TP_i^{amplifier}$ represents the total power of amplifier that is present at transmitter side that includes peak-to-average power ratio

2.4 Total cost

It is necessary that even in small industries and in other yards the sensors needs to be installed. Therefore, it should be fabricated in a way with much less cost as given in Equation (6). When considering the cost of sensor units distance, angle of inclination and width of sensors will also be included.

$$C_i = (w_i * D_i) + \phi_i \tag{6}$$

Where, w_i represents the width of installed sensors

2.5 Objective function

By considering Equations (1) to (6) the objective function on implementing sensors for distance monitoring and hand sanitizing can be modeled as follows,

$$O(i) = max \sum_{(i=1)}^{n} D_i, E_i, min \sum_{(i=1)}^{n} C_i \tag{7}$$

If the objective function in Equation (7) is implemented then sensors will be fabricated in right way and exact results will be predicted in online monitoring system.

3 Optimization algorithm

To handle the pandemic COVID situation each and every individual should follow some consistency between them and all should regularly sanitize their hands. This is the only way for reducing the death rate across all countries. Therefore, for detecting the regularity of all people in public places an improveddeep learning optimization algorithm which is denoted as Controlled Incongruity Algorithm (CIA) have been integrated with proposed model. One major advantage on choosing CIA is that it can able to provide solutions only if the problem is convex in nature and it can able to converge earlier [19, 20]. For integrating the deep learning model with proposed objective function some basic integration formulations are essential. One important function in CIA is used for detecting losses of sensors using a conjugate function as given in Equation (8).

$$loss(i) = con(D_i - |l(D_i)|) \tag{8}$$

Where, $|l(D_i)|$ represents the lagrangian function of distance If this kind of deep learning algorithm is introduced then, loss which is produced by sensors will be much lesser and therefore exact langrangian controls can be made for distance measurements. For accurate measurements distance should always be measured from center of target and therefore, centric function can be given as,

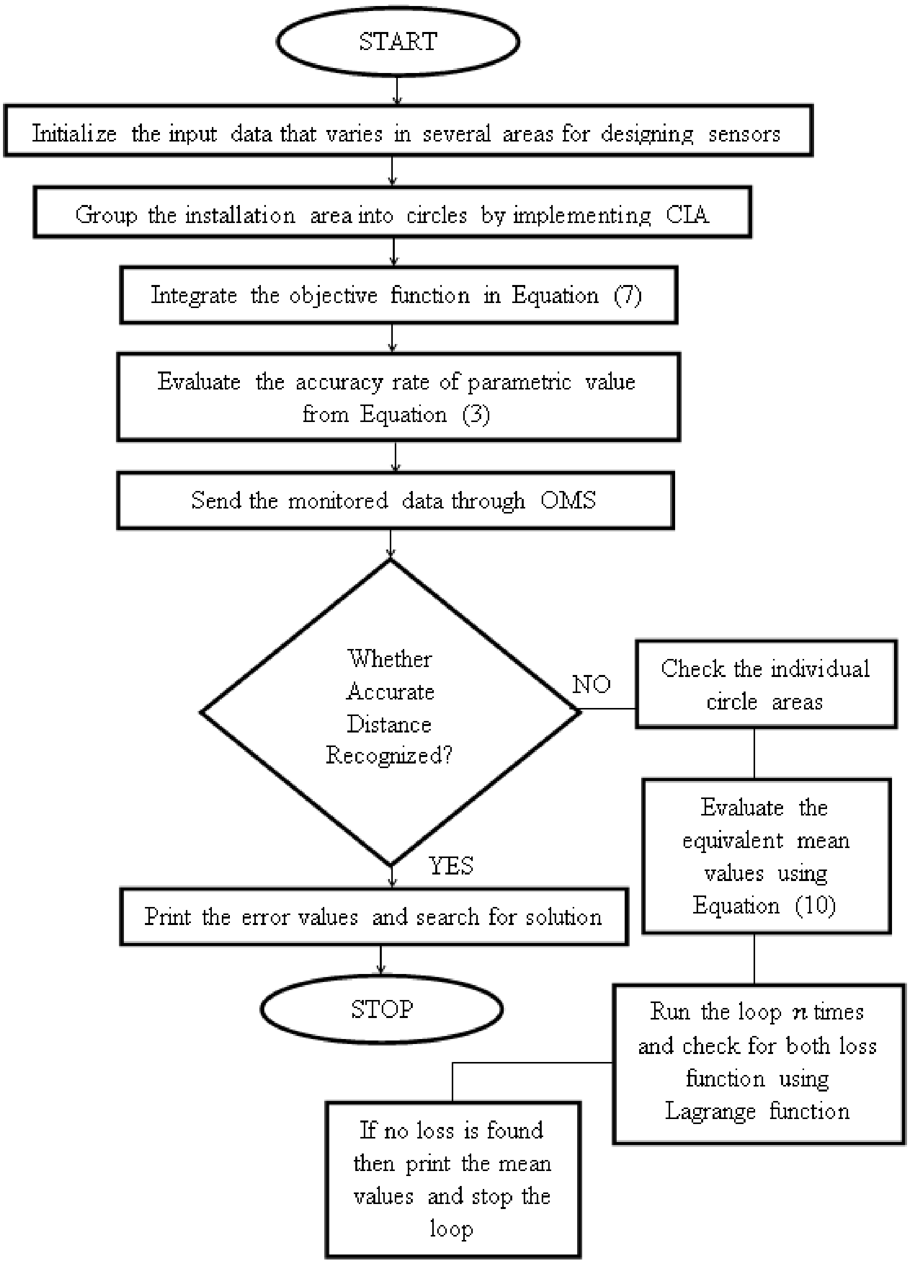

Figure 3: Flow chart of CIA for monitoring distance between entities

$$t_i = \sum_{(i=1)}^{n} (\phi_i - m_i) 2\Pi r \tag{9}$$

Where,
m_i denotes the mid value of target From Equation (9) it is clear that target centric function will be formulated only based on parameters like angle of inclination and area of circle. If sensors are not mounted at correct angle then the target cannot predict exact value which will result is wrong calculations. To avoid this situation area of circle with midpoint is also added for accurate calculations. Finally, the mean value of distance followed

Table 1: Distance vs. accurate reading

Radius (m)	Angle of Incidence (Degrees)
10	-50
20	-32
30	-11
40	-3
50	8
60	16
70	26
80	39
90	60
100	90

by different people will be calculated as given in Equation (10). From Equation (10) the mean incongruity value will be calculated for all individuals. If any individual walks to maximum distance the sensor will be automatically switched off where, in this case energy loss will occur. To overcome this loss difference between maximum and minimum distance will be calculated in addition with area of circle. This makes the optimization process to converge earlier and within small values the sensor will be switched off and lot of energy can be saved. The flow chart of proposed CIA is shown in Figure 3.Since there is need of two different units in corresponding data set such as visible and hidden the Restricted Boltzmann machine is preferred as one type of deep learning technique in the proposed method that satisfies the required parametric features. The features that are present in this kind of machine are directly associated for high probability cases where low energy states are connected. Therefore in high probability variations there will be no internal layers that are associated without characterized response thus giving raise to unsupervised state of learning. However with these additional features interference with respect to input data can also be observed only if reinforced inputs are equivalent to original input. The best feature of CIA can be understood from the working model where in the first stage input data is directly transformed to number state. After this transformation encoding process will start with accelerative sensing of data points which are located at 10 meters from aerial points. In the next stage individual weights will be combined as the encoded output will reach from hidden layer to visible layer. Once the visible state is noticed then sensors will function by converting the encoded data for restoration units and this is termed as backward passing. At last stage both reconstructed and original data will be compared and the difference in comparison will provide the exact data set with fine tuning of parameters.

4 Results and discussion

The proposed method of installing sensors for being alert to prevent COVID have been monitored using an online monitoring system and it is executed using MATLAB where, different parametric values are monitored and they are listed as following scenarios.
Scenario 1: Angle of inclination
Scenario 2: Measurement of distance
Scenario 3: Calculation of energy consumption
Scenario 4: Cost of installation
Scenario 5: Proportion of gap
Scenario 1 For installing sensors one major prerequisite is inclining angle which is discussed in this scenario. For each public building the angle of inclination is different and it depends on radius of buildings. If correct angle of inclination is not provided then distance between two individual cannot be monitored properly which results in failure of installing sensors. Therefore, angle of inclination for mounting sensors in suitable places should be followed correctly. It is observed that angle of inclination for small radius will be tilted up to -50 degrees whereas, for large radius of buildings the angle of inclination will be 90 degrees. If in this angle the sensor is mounted then it can be able to detect each individual within the distance of 100 meters as shown in Figure 4. From Figure 4 and Table 1 it can be seen that sensors are inclined correctly at precise angles where, maximum and minimum limit will be -50 to 90 degrees. If radius of building is much higher then, angle of inclination can be calculated using Equation (4). This inclination value will be automatically fed as input to Things speak, an online monitoring system and if inclination angle varies an alert will be sent to the user and therefore, they have to re-install it. This parameter is not compared with any existing method because this is an unique parameter and no previous exists for comparison states.

Scenario 2 Once the sensors are mounted at correct angle, distance can be calculated which is conversed

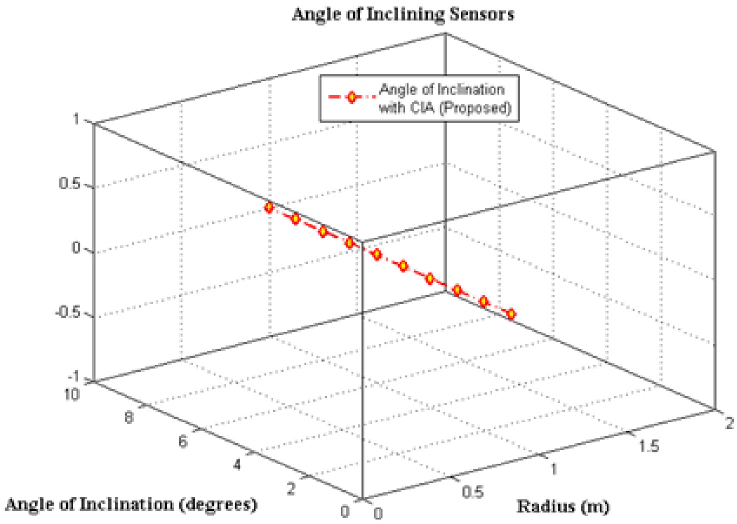

Figure 4: Angle of inclination (in degrees)

in this scenario. Generally, sensors should be able to monitor distance with less interpretation values. For monitoring long distance above 50 meters the interpretation values should be constant. By this monitoring station can detect whether each and every individuals are maintaining minimum distance between them. If any person is creating anomaly then interpretation will be stopped and alert will be sent to the users. In this case the data such as mobile numbers and names can also be fed as input and therefore, if any user violates guidelines then a message will be sent.

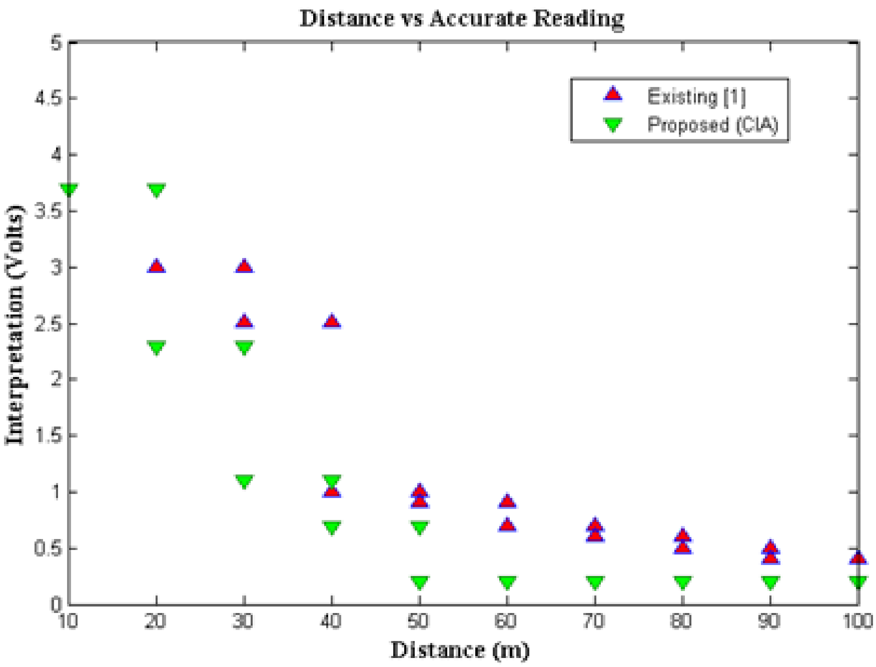

Figure 5: Distance vs accurate reading

Figure 5 and Table 2 shows calculation of distance which is obtained in a small yard. The results are monitored for a single day using Thing speak and it is visualized in MATLAB. For the proposed method if the users are between 50-100 meters a constant voltage will be supplied because in this case there is no need for monitoring but if the users are closer between 10-40 meters then, more interpretation is needed which is greater than 3 volts. But in existing method [1] even if individuals are at long distance more interpretation is needed and more wastage will occur. Therefore, the proposed method proves to be more efficient then existing method for monitoring distance between individuals.

Table 2: Distance vs. accurate reading

Distance (m)	Interpretation (Volts) [1]	Proposed
10	5	3.7
20	3	2.3
30	2.5	1.1
40	1	0.7
50	0.9	0.2
60	0.7	0.2
70	0.6	0.2
80	0.5	0.2
90	0.4	0.2
100	0.4	0.2

Table 3: Consumption of energy

Packets at receiver	Energy consumption (mW) [2]	Proposed
20	2	1.76
40	3	2.37
60	4	3.49
80	6	5.24
100	8	7.19

Scenario 3 In this scenario the basic parameter that is necessary for sensors during transfer of information which is referred as energy consumption is determined.For transferring information from source to destination amount of energy supplied to nodes should be much higher. This is one important characteristic that is much needed for proposed method. Figure 6 and Table 3 portrays energy that is consumed by nodes for transferring information and it can be seen that more energy is supplied in proposed method because for monitoring this pandemic situation more energy is required as number of peoples are higher. It can also be observed that the packets arrived at receiver will consume up to 8 mW for 100 nodes whereas, the existing method [2] consumes only 7.19 mW. In this case if energy is supplied much lower then information will not reach the receiver and therefore, the interpretation values will be much higher for existing method as shown in Figure 3.

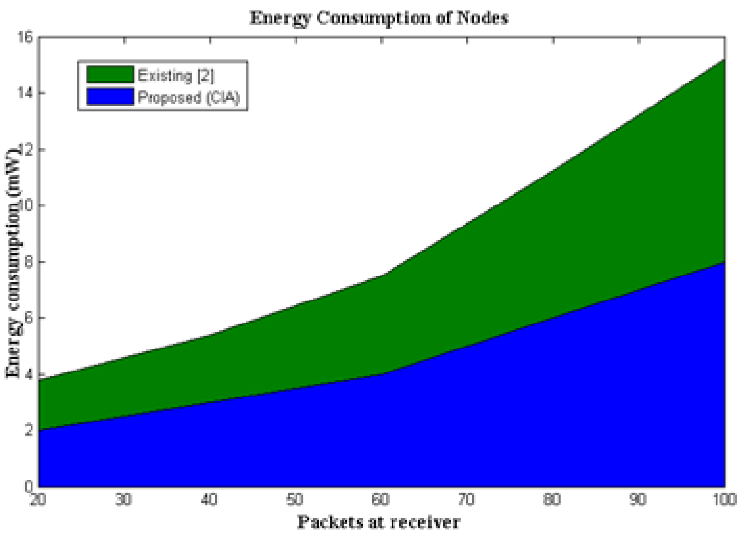

Figure 6: Comparison of energy consumption

Scenario 4 The sensors designed for this COVID situation have to be installed in all local places therefore, cost of installation should be much lesser. Here, the cost will be calculated by taking into account the width of current abode and angle of inclination. If these two bounds are considered then, automatically cost of installing sensors will be much lesser. Figure 7 displays the simulation results that is obtained after integrating Equation

Table 4: Consumption of energy

Number of nodes	Cost [12]	Proposed
20	16000	14500
40	29300	25000
60	53800	46100
80	60400	52600
100	73900	65600

(6). From Figure 7 and Table 4 it can be observed that cost of installing sensors through proposed method is much lesser than existing method [12].For example if number of nodes is 60 then, cost of installation for proposed method will be 46.1K whereas, for existing method it is found to be 53.8K respectively. This shows

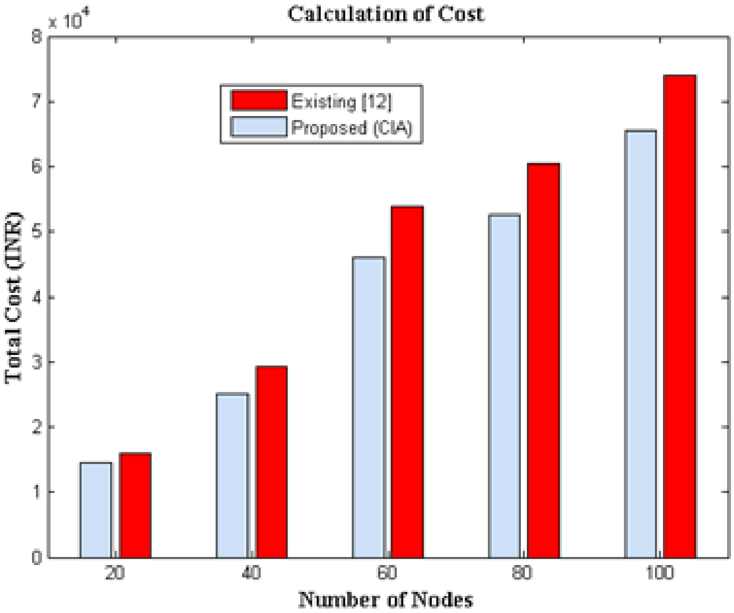

Figure 7: Calculation of total cost (INR)

that if angle of inclination is correct then, cost of installation will be much lesser. This parameter will not be fed as input values to Things speak but for providing information to public it has been included. Even a small dealer should be in a position to buy this sensor because it is much necessary to monitor distance which is the only way to stop this pandemic situation. So, if the proposed method is implemented in real time all small dealers can buy this type of sensor and they can install it at much lower rate.

Scenario 5 In this scenario accurate measurement distance and gap will be calculated between each individual. This is treated as special case because once an individual arrives at a shop a small sanitizer magnum will be kept where, if the person arrives within a particular distance they will be alerted to sanitize their hand. Next after sanitizing percentage of gap between each individuals will be observed and if either hands are not sanitized and if percentage of gap is low then an alarm message will be sent to particular person. This is monitored by Things speak and the results are visualized in MATLAB. Figure 8 shows the simulated results by taking distance in X-axis and percentage of gap in Y-axis. It can be seen in Figure 8 and Table 5 that a person is ready to go into s shop and when that person is outside at a distance of 50 meters then percentage of gap observed will be 36.

But once the person enters into the shop and it the shop is much smaller to a distance of 10 meter then gap maintained by that person is 1.3 whereas, for existing method [6] more gap is specified and it is not much possible for small sized shops. This proves that proposed method is capable of monitoring exact values than other existing methods.

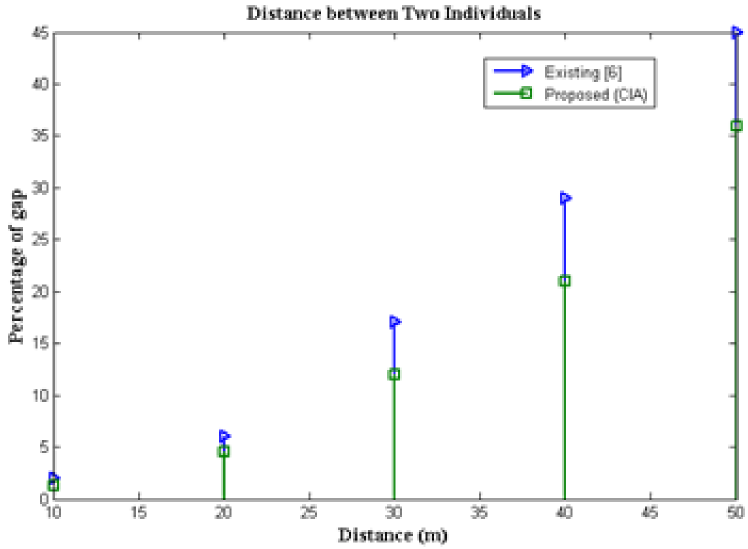

Figure 8: Accurate distance vs percentage of gap

Table 5: Accurate distance measurement

Distance (m)	Percentage of gap [6]	Proposed
10	2	1.3
20	6	4.6
30	17	12
40	29	21
50	45	36

4.1 4.1 Performance analysis of CIA

Beyond some real time factors it is much important to analyze the simulation time of implemented algorithm and it should be compared with existing one for understanding the performance and accuracy of parametric values. Therefore, when the proposed method is visualized in MATLAB simulation time is calculated by varying the number of rounds and is shown in Figure 9. From Figure 9 and Table 6 it can be seen that simulation time for proposed CIA is much lesser than existing method [11]. For accurate checking the numbers of rounds have been considered as 100 and even for all rounds simulation time is much lesser and it is considered as foremost advantage of integrated algorithm. For example, if the number of round is equal to 60 then simulation time for proposed method is 3.81 seconds whereas for existing method [11] it is equal to 5.16 seconds. This proves that proposed method is capable of converging solutions at earliest and all the parametric values will be obtained within fraction of seconds. It is important to prove the efficiency of proposed work using CIA by observing

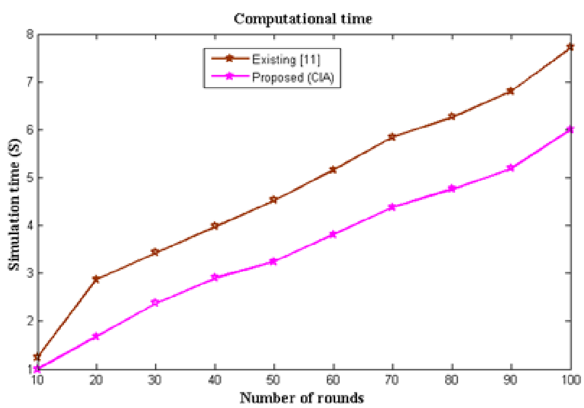

Figure 9: Computational time (seconds) of CIA

Table 6: Speed of measurement

Number of rounds	Speed of measurement [7] (Seconds)	Proposed
10	1.24	1
20	2.87	1.68
30	3.43	2.37
40	3.98	2.9
50	4.52	3.24
60	5.16	3.81
70	5.84	4.38
80	6.26	4.76
90	6.8	5.19
100	7.71	6

Table 7: Performance measurement of CIA

Algorithms	Recall	Precision	F-measure	Accuracy
Deep belief networks	45.06	42.97	41.54	42.37
Convolutional neural networks	76.79	81.24	83.45	88.92
Self-organizing maps	56.71	54.32	50.67	61.24
Multilayer perceptron	68.56	63.90	69.70	71.45
Proposed	82.43	84.12	88.03	92.48

several parametric values. But the exact performance measurement parameters are calculated with true positive and false negative values and are indicated in Table 7. The corresponding simulation plot is also deliberated in Figure 10 where four types of deep learning models are compared with projected algorithm. In this case it is substantiated that CIA performs much better with high true positive values and less false negative values this as a result high accuracy can be observed at several data set points. Due to high accurate points false alarm detection is reduced during the process of COVID detection thus resulting in Factor measurement of 88.03%. This analysis process that distance of separation will be measured accurately therefore no contact will be made between two individuals at any point of time.

5 Conclusion

Many countries around the world are suffering from COVID and day-by-day the count of people affected by this disease keeps on increasing. Even though preventive measures can be taken by staying at home it is not possible for all working people to stay at home all the time. Therefore, only way of preventing this pandemic situation is to maintain distance between two individuals which is monitored by wireless sensors and it has been addressed in this article. Most of the people are not maintaining even minimum distance between them when they are going in public places. To stop this sensors are designed in a way that it can monitor the movement of people using Things speak, an online monitoring system which will predict exact values when wireless sensors are connected. Moreover, the sensors are designed where, even small dealer can able to afford it and it can provide high energy by passing the information from transmitter to receiver. In addition, for effective functioning CIA algorithm have been implemented which can be treated as other advantage of proposed method. The projected method is simulated and compared with existing methods and in future it can be extended for detecting the humans by integrating it in their apparels with necessary energy consumption.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Conflict of interest

The authors declare no conflict of interest.

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