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COVID-19 Safe Automatic Health Prediction and Detection Using Deep Learning in Post Pandemic

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ABSTRACT: The current and on-going coronavirus (COVID-19) has disrupted many human lives all over the world and seems very difficult to confront this global crisis as the infection is transmitted by physical contact. In this paper a potential application of the Internet of Things(IoT) in healthcare and physical distance monitoring for pandemic situations. The proposed framework consists of three parts: alight weight and low cost IoT node, a web app, and fog-based Machine Learning (ML) tools for data analysis and diagnosis. The IoT nodetracks health parameters, including body temperature, cough rate, respiratory rate, and blood oxygen saturation, and then updates the smartphone app to display the user health conditions. The app notifies the user to maintain a physical distance of 2 m (or 6 ft), which is a keyfactor in controlling virus spread. In addition, a RNN (running at the fog server) considers the environmental risk and user health conditions to predict the risk of spreading infection in real time. The environmental risk conveys from the virtual zone concept and provides updated information for different places. The proposed research collected COVID −19 data using three types of sensors for temperature sensing and detecting the respiratory rate. After pre-processing, 300 instances are taken for experimental results considering the demographic features: Sex, Patient Age, Temperature, Finding and Clinical Trials. Classification is performed using SIRmode and finally predicted 188 confirmed cases using RNN with LSTM model.

KEYWORDS: RNN; Covid19; IoMT; Prediction; ML, Healthcare

I. INTRODUCTION

The Internet of Things (IoT) is a well-defined scheme of interconnected computing tactics, digital, and mechanical devices possessing the capability of transmission of data over the defined network without having any human involvement at any level. All these discussed devices are associated with their particular unique identification numbers or codes. IoT is now well established and proven technology which acts as a junction to the umpteen tactics, instantaneous analytics, philosophy of machine learning, sensory products, etc. Moreover, IoT in typical daily functioning is recognized as the utility of the products or the appliances serve the reallife requirements of human beings in various means such as; security system of the home, smart lighting arrangements, and many more others which is easily controllable through our daily using smart speakers, smartphones, etc..

In the present pandemic situation, all the countries, including India, are fighting with COVID-19 and still looking for a practical and cost-effective solution to face the problems arising in several ways. Researchers in physical sciences and engineering are attempting to take such challenges, to grow new theories, to describe new study problems, to generate user-centred explanations, and to edify ourselves and the overall civilian. This brief review has aimed to provide awareness of this innovative technology and its significant applications for COVID-19 pandemic.

The Internet of Things , a technology that enables the automated exchange of key information between machines, and then ultimately to humans, promises a future where a whopping 50 billion devices will have the ability to "talk to each other" by 2020. The 'things' that are getting connected vary significantly in size and shape include tiny wireless sensors (smart dust) to electrical appliances at home to electronics used in space experiments. Things are characterized as low-memory and low-power devices, where memory is measured in bits or bytes (not megabytes or gigabytes) and power consumption is so low that devices can run for years with a pair of AA size battery.

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II. RELATED WORK

During the last several years, different IoT applications have been proposed to improve healthcare systems. The IoT can be used for remote patient monitoring, e.g., connecting seniors who have chronic diseases to doctors and medical resources. IoT applications have been implemented to aid people with Parkinson's and Alzheimer's disease. It offers disaster management for seniors who are living alone and need special care and can also be applied to manage equipment and patients in hospitals. In a smart healthcare setting, the IoT can help to provide a remote diagnosis prior to hospitals for more efficient treatment. Providing more data about the coughing of COVID-19 patients will make such AI models much more effective. One of the first projects that utilized users' phones to study how fast an infectious disease spreads. Mobile phones were used to collect some data, such as the presence of nearby Bluetooth devices, GPS coordination, and flu symptoms. Then, the data were sent to a server via 3G/GPRS. The proposed framework could be used for rural areas or developing countries, where opportunistic networks and satellite communications were employed for the transmission of data. Another recent study evaluates how much active contact tracing and surveillance can reduce the spread of infectious diseases. Author P. Pandey and R. Litoriya gives an overview of disaster alert system for elderly (DASE) is taken. The system makes use of an android device, which is easily available, to receive disaster warnings from authentic disaster intimation services, for example, India Meteorological Department (IMD). On receiving the notification, the local eco-system of IoT devices becomes functional, and intimation module starts computing the risk of threat associated with an elderly living alone in his/her house. Note that mere disaster warning does not push intimation services to begin functioning. The following problems were found by analyzing the literature in the problematic current pandemic situation, the number of infected patients is increasing day by day globally, and there is a vast need to utilize the well adequate and organized facilities offered with the Internet of Things methodology. Furthermore, IoT has already been employed to serve the asked purposes in different domains in which the Internet of Healthcare Things (IoHT) or Internet of Medical Things (IoMT) are associated with the present issues. By following up the guidelines and the facilities of IoHT/IoMT, the number of resolved cases can be enhanced and improved too. The main objective of the project is to develop a low-cost and lightweight IoT node to monitor continually a person's body temperature, heart rate, and blood oxygen saturation, and periodically monitor coughing pattern.To create a web app to display the parameters and individual risk factors.To create a fog server that collects data from the IoT nodes and applies a machine learning algorithm to send the necessary information to users.

III. PROPOSED ALGORITHM

The proposed system predicts of confirmed cases, negative cases, released, and deceased cases of Covid 19 corona virus are obtained using a Recurrent Neural Network method. A Recurrent Neural Network (RNN) is kind of neural network architecture that considers both sequential and parallel information processing. Incorporating memory cells to neural network; it is possible to simulate the operations similar to human brain. Following diagram depicts the general structure of a RNN. Another RNN called Bidirectional RNN (BRNN) accesses future and past context in both directions. There are alternatives from RNN depending on the gating units, such as Long Short Term Memory (LSTM) RNN and Gated Recurrent Unit (GRU) RNN.

Traditional RNN lacks of considering context based prediction, which can be overcome by introducing Long short-term memory (LSTM). LSTM has a good potential to regulate gradient flow and enable better preservation of long-range dependencies. Gated Recurrent Unit (GRU) is quite similar to LSTM, where the gating units of GRU control the flow of information inside the unit, without considering separate memory cells. Like LSTM, GRU lacks of having memory cells in it and it has a lesser number of gates are required and the gates are activated using current input as well as previous output. As compared to LSTM, GRU has better convergence rate due to the reduction of parameters and in some cases GRU outperforms well over LSTM model

At first, Data are pre-processed by eliminating missing values, irrelevant values. Then data transforming operations are performed so that it can be given as input to the Deep Learning Models. In this paper, three models are implemented and applied on the dataset for verifying the given prediction results with respect to available data set. The prediction results are measured with respect to performance measure metrics such as- accuracy and RMSE. The accuracy of these three models can be improved by choosing proper parameter values. The default parameters may not provide the maximum performance. Hyper-parameter setting is necessary to improve the accuracy level. However, the RMSE value should be optimised as to signify a better model. It is to be noted here that the dataset contains cases for confirmed, negative, released, dead patients. It is tested in clinical laboratory in presence of clinical doctors. This methodology is performed for each of these individual cases separately. The below figure denotes the proposed methodology.

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Deep learning speculates that a deep sequential or hierarchical model is more efficient in classification or regression tasks than shallow models.LSTM contain hidden states distributed across time, and this allows them to store a lot of information about the past. They are most commonly used in forecasting applications due to their ability to process variable length sequential data. Neural networks have major disadvantage that they cannot overcome vanishing gradient or exploding gradient problem and also they can store only short-term memory because they involve hidden layer activation functions of the previous time step only.

The LSTM-based consists of a four-layer deep network with three fully connected layers and a time distributed LSTM layer. It takes as input the last 14 days' data which includes not just the time series of confirmed cases/deaths but also 20+ other features such as temperature readings and healthcare facilities to predict accurately the number of cases and deaths for each day over the next 14 days. It was trained on around 80 examples of 14-day intervals and the results were remarkably accurate, as shown below, even with such a small dataset.

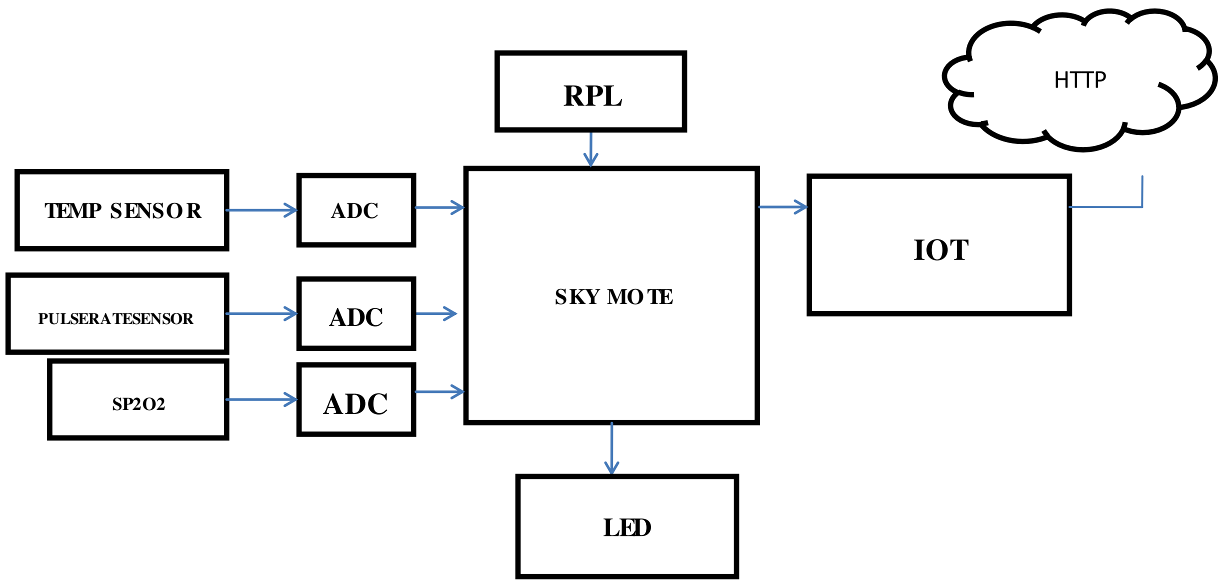

Figure 3.1 Proposed Block Diagram

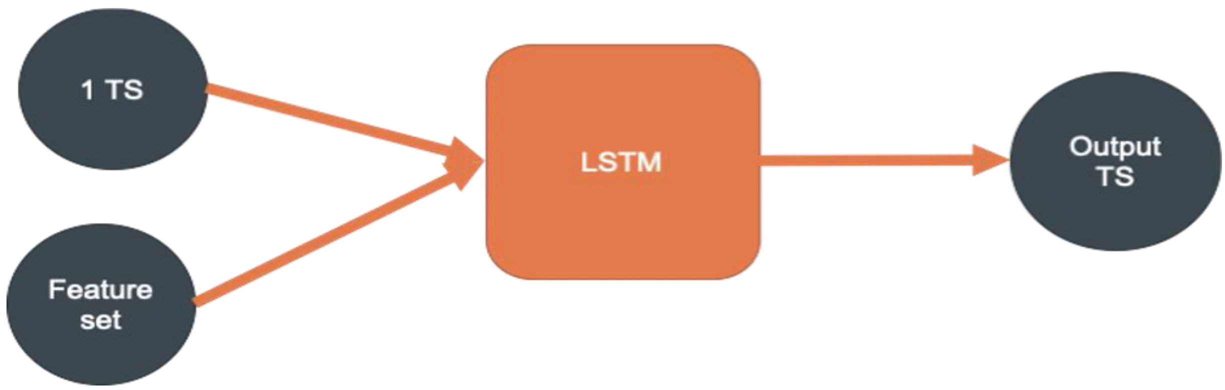

Figure 3.2 LSTM Block Diagram

MQTT is an OASIS standard messaging protocol for the Internet of Things (IoT). It is designed as an extremely lightweight publish/subscribe messaging transport that is ideal for connecting remote devices with a small code footprint and minimal network bandwidth. MQTT today is used in a wide variety of industries, such as automotive, manufacturing, telecommunications, oil and gas, etc.

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Publish

An MQTT client can publish messages as soon as it connects to a broker. MQTT utilizes topic-based filtering of the messages on the broker (see part 2 for details). Each message must contain a topic that the broker can use to forward the message to interested clients. Typically, each message has a payload which contains the data to transmit in byte format. MQTT is data-agnostic. The use case of the client determines how the payload is structured. The sending client (publisher) decides whether it wants to send binary data, text data, or even full-fledged XML or JSON.

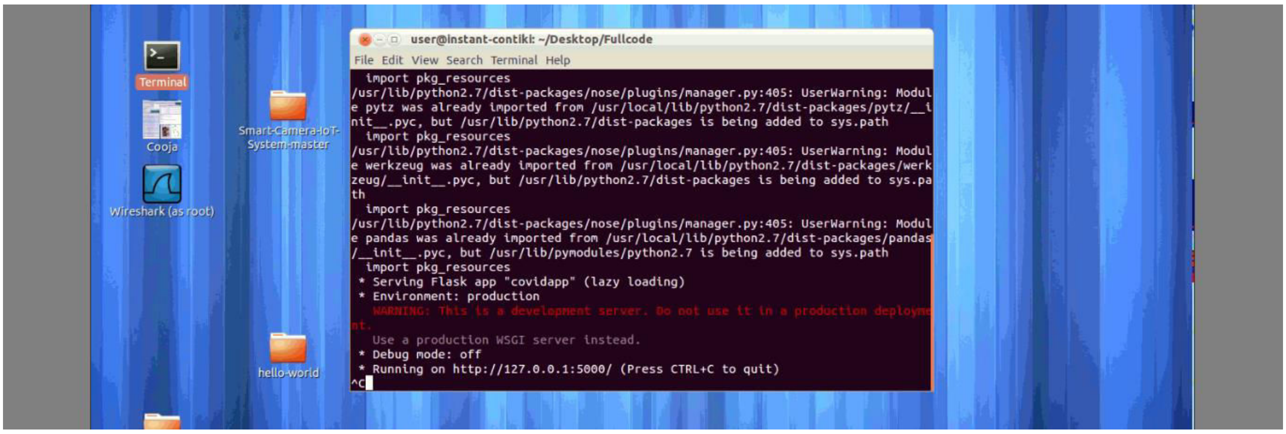
IV. SIMULATION RESULTS

Contiki is an OS just like Microsoft Windows and Linux, but for a very specific purpose and mainly focused on 'things' in the IoT. Various functions of an OS include program/process management, resource management, memory management and communication management. Contiki OS comes with a wealthy set of capabilities which might be device and programmer friendly. It may run on gadgets inclusive of 8051 SoC to ARM-powered gadgets. Ports are on different platforms together with Arduino and Atmel. While popular compliance may be needed to interoperate with public networks (together with net), more green and optimized protocols are also supported. One such example is the Rime stack, advanced to optimize the IPv6 protocol. Cooja is the Contiki network simulator. Cooja allows large and small networks of Contiki motes to be simulated. Motes can be emulated at the hardware level, which is slower but allows precise inspection of the system behavior, or at a less detailed level, which is faster and allows simulation of larger networks. Cooja is a highly useful tool for Contiki development as it allows developers to test their code and systems long before running it on the target hardware. Developers regularly set up new simulations both to debug their software and to verify the behavior of their systems.

STEP1:To start Cooja, open terminal window go to the Cooja directory with the command: cdcontiki/tools/cooja

STEP2:Start Cooja with the command: Sudo ant run

When Cooja is compiled, it will start with a blue empty window. Now that Cooja is up and running, we can try it out with an example simulation.



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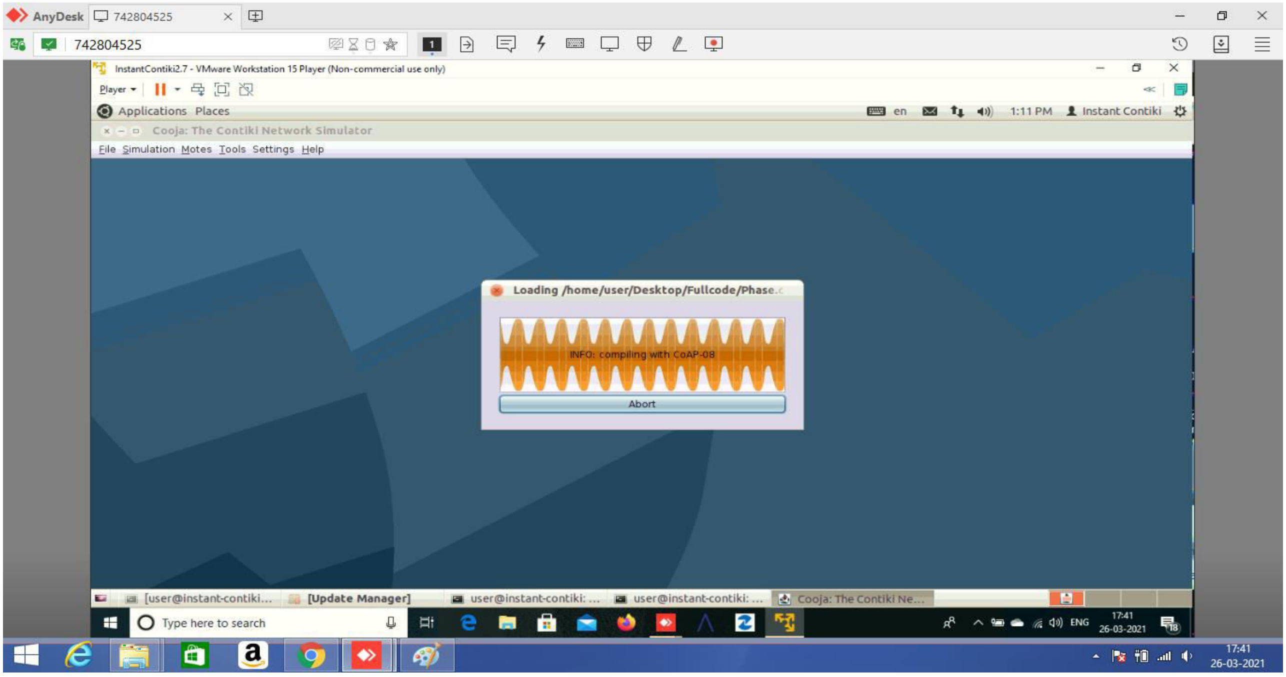

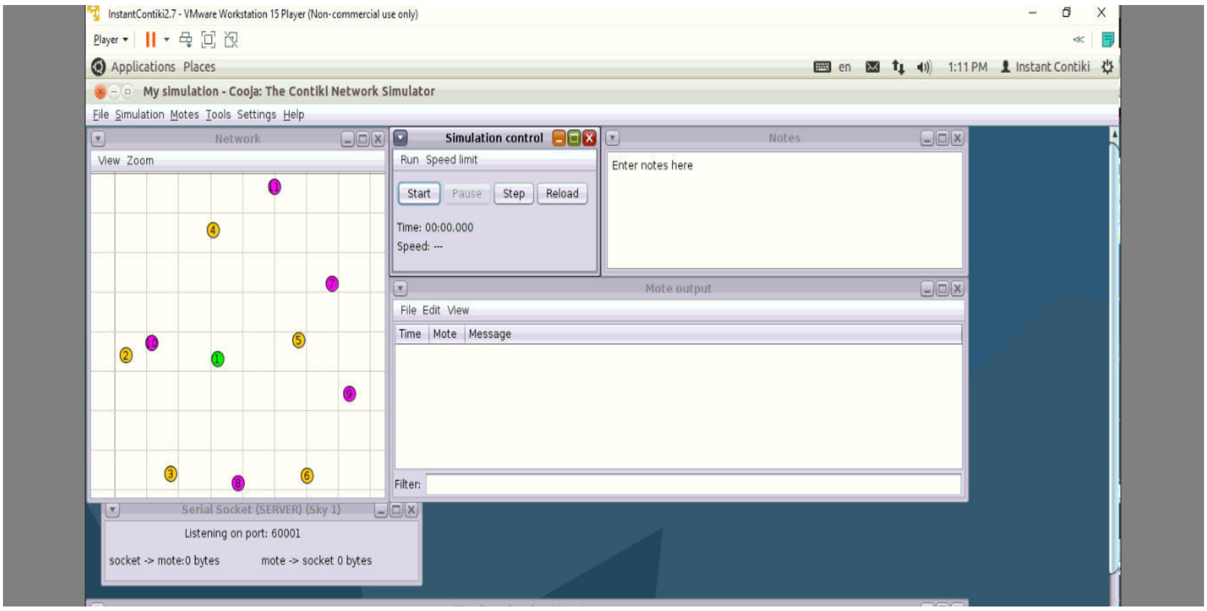

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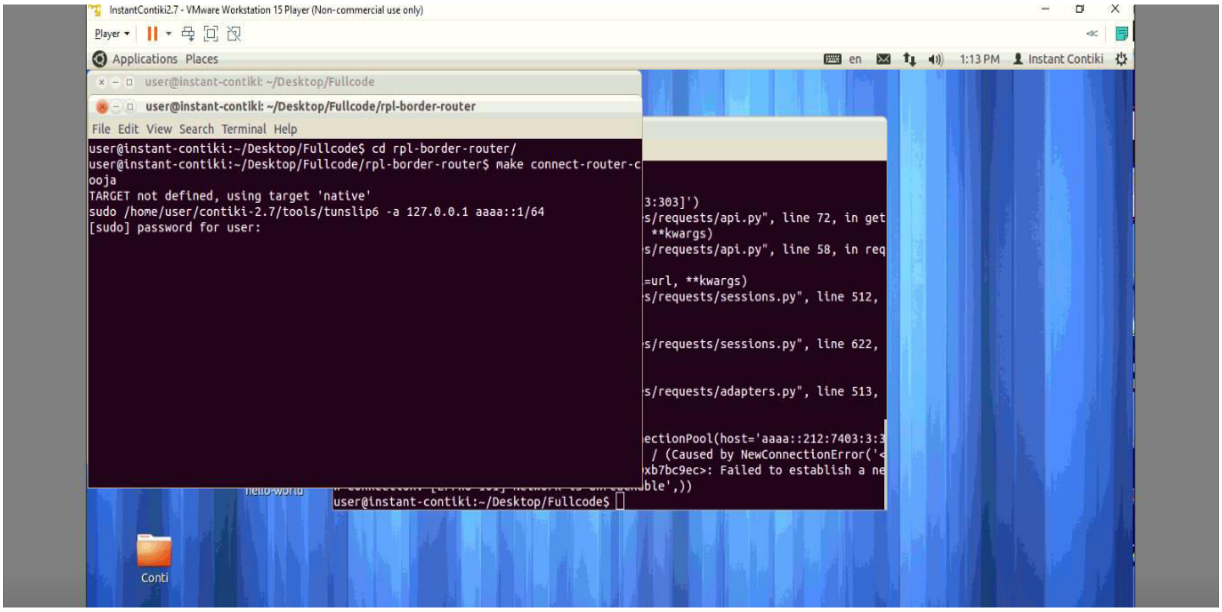

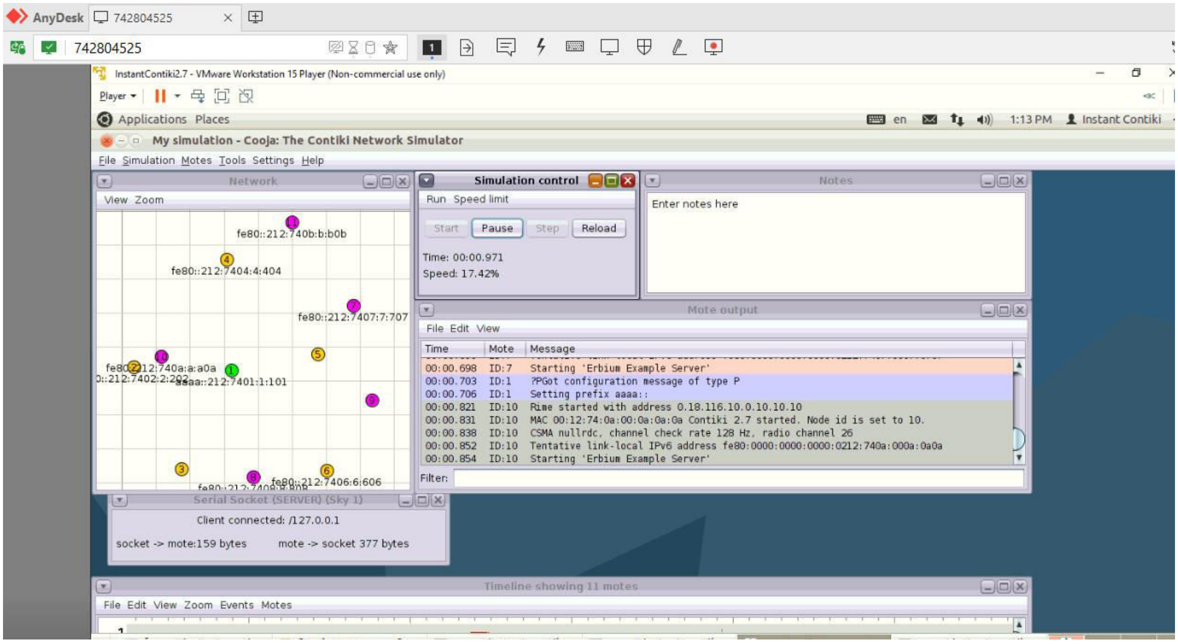

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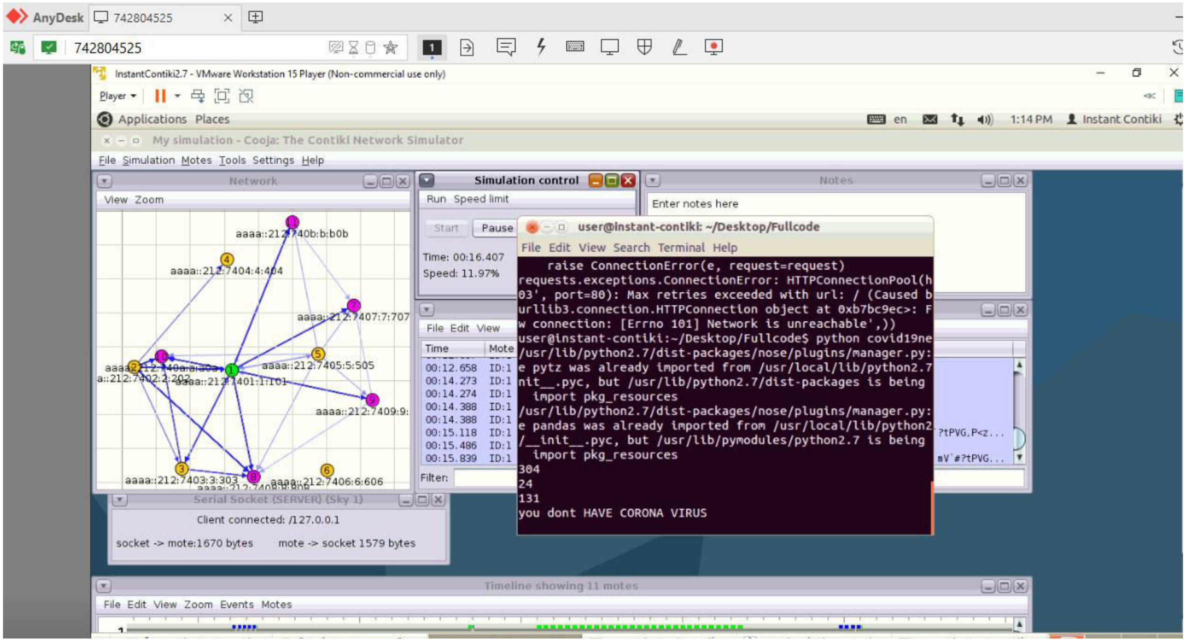

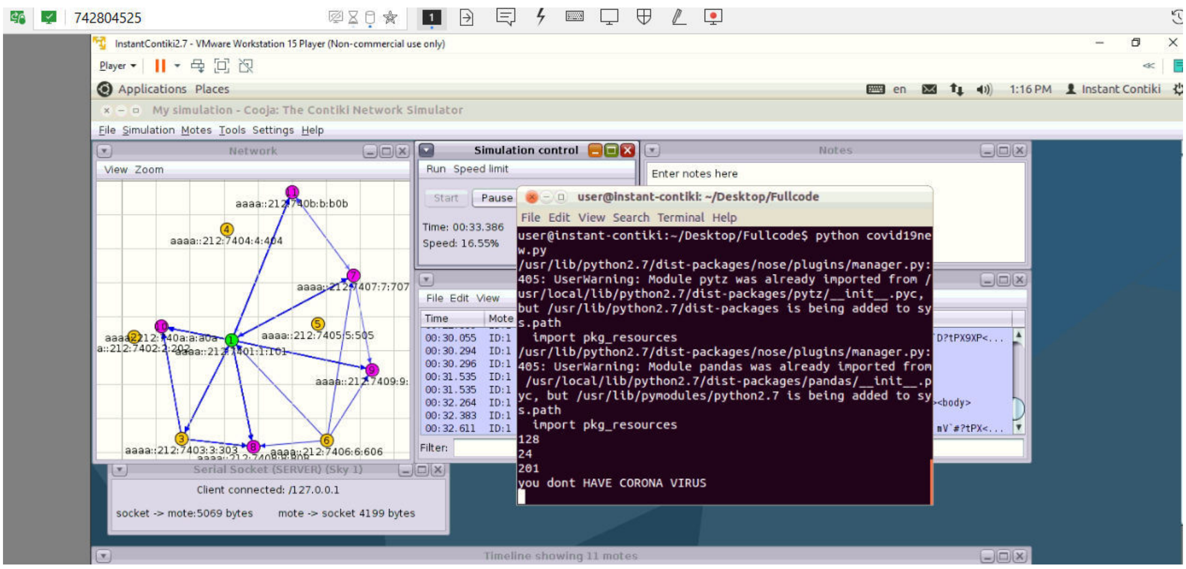

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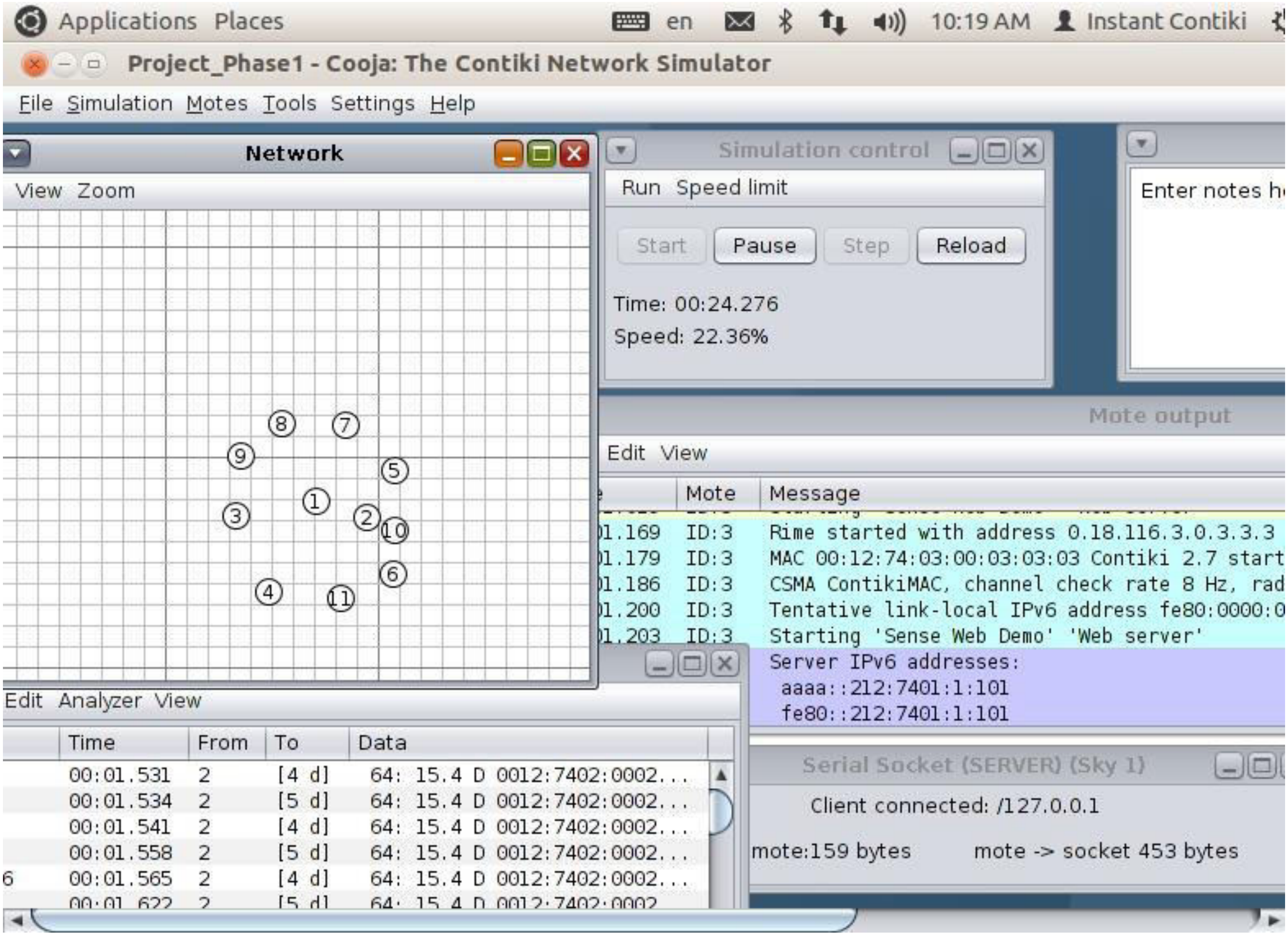

Figure 4.1 Distributions of Motes for Communication

Figure 4.1 shows the distribution of sky motes for HTTP & CoAP Communication. Add 10 motes using Random positioning. Next in the Network Panel, click on View and add the following: Radio Environment, Mote ID and addresses. Now if you click on a Mote, it will display the Effective Radio coverage (green zone) and interference zone (grey zone) according to the selected medium model. The network setup for this demonstration can be seen in Figure 1.6 Mote 1 in this case is a Border Router mote which is compiled using firmware to be found in /contiki/examples/ipv6/rpl-border-router/border-router.c. To establish the bridge with the Border Router, first right click the Border Router mote 1 and select 'Mote tools for Sky1' then 'Serial Socket (SERVER)'. This will create a serial port on the Border Router which is accessible via UDP port number 60001 on the local machine.

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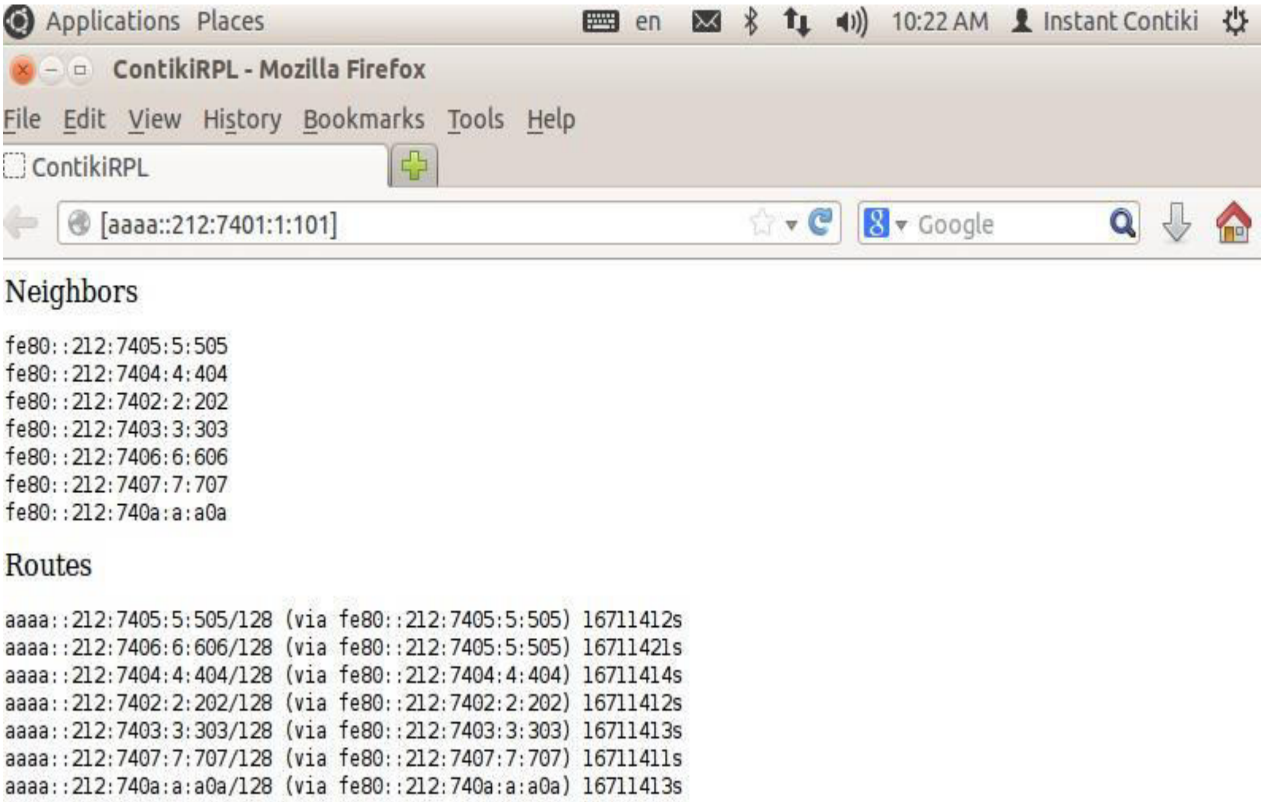

Figure 4.2 RPL Border Routers Routing table web pages for Proposed Model

V. CONCLUSION AND FUTURE WORK

IoT implementation impacts on reducing healthcare cost and improve treatment outcome of the infected patient. Therefore, this present study based research is attempted to explore, discuss, and highlight the overall applications of the well-proven IoT philosophy by offering a perspective roadmap to tackle the COVID-19 pandemic. Finally, twelve significant applications of IoT are identified and discussed. It has ultimately forced the researchers, academicians, and scientists to propose some productive solutions to overcome or confront this pandemic. Identifying an infected person in-crowd is very difficult. Isolating people from the infected is the only solution to avoid the spreading of this virus. The use of IoT with smart sensors to measure and record the body temperature of individuals will help to identify the infected. It will also help to maintain social distance. IoT based health care systems connected through cloud computing and using data analysis to make an effective decision based on real -time data can be used..

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