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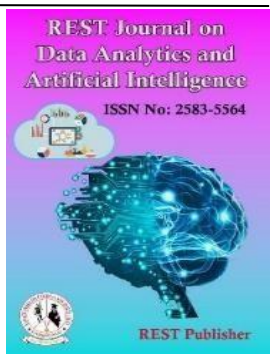

Deep Q-Network (DQN): Reinforcement Learning Based Approach for Secure Social Distancing Adherence with SARS-CoV-2 in Public Places

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Abstract- *The estimates taken far and wide to deal with the SARS-CoV-2 pandemic, limiting travel, shuttering superfluous organizations and implementing all social separating arrangements, are having serious monetary consequences. a noteworthy decrease in economic action spread over the economy the world, lasting in excess of a few months, typically clear in genuine GDP. Where it is formally announced a downturn. To quicken a strong expected recuperation with rising protectionism and unilateralism. There is a requirement for individuals to come out and face the circumstance. Despite the fact that it is established that separating individuals and investigating their contacts would be inadequate to control the SARS-CoV-2 pandemic, in light of the fact that there would be an excess of deferral between the beginning of indications and seclusion. Consequently, in these sorts of conditions it is to keep people groups from infection influence and early anticipation of these tainted individuals may prompt re development the economy too. We built up a numerical model utilizing profound Deep reinforcement learning (DRL) which is poised to revolutionize the field of artificial intelligence and the use of central algorithms in deep RL, specifically the deep Q-network (DQN), trust region policy optimization (TRPO). The proposed astute checking framework can be utilized as a reciprocal apparatus to be introduced at better places and consequently screen individuals receiving the security rules. With these prudent estimations, people will have the option to win this battle against SARS-CoV-2.*

Keywords- *SARS-CoV-2, Deep reinforcement learning (DRL), reinforcement learning (RL), deep Q-network (DQN), trust region policy optimization (TRPO).*

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1. INTRODUCTION

The outbreak of SARS-CoV-2 in December 2019, the disease has spread to almost 180+ countries around the globe, the World Health Organization declaring it a public health emergency. The global impacts of the SARS-CoV-2 (Severe Acute Respiratory Syndrome COrona Virus 2) are already starting to be felt, and will significantly affect almost all the sector Industries, SARS-CoV-2 also affect the economy worldwide such as, directly affecting production and demand, creating supply chain and market disturbance, and its financial impact on firms and financial markets and it fallen to a great economic crisis all over the world, in-order to recover the economic crisis. The people undergone different lockdown period during the initial stages of SARS-CoV-2. The Government need to give relaxations in the lockdown, but it is necessary to follow certain measures to keep safe, and to avoid the spread of this deadly infectious disease in broad range. To prevent the disease, it is necessary to follow the regular recommendations given by the WHO to minimize the infection, spread of diseases, and to reduce the infected ratio day by day. It is mandatory to avoid sneezing and cough at the public place. The hand cleaning with soap and sanitizer, mouth and nose coverage with mask during sneezing and coughing are essential. Washing foodstuff before cooking thoroughly, which bought from outside. The simple house-keeping strategies may kill the disinfectants virus on the surfaces. It is always better to avoid the interactions with anyone; suspecting respiratory problem symptoms like sneezing, coughing, breathing problem, and people aged above 60. The common responsibility strategies includes varying levels of contact tracing and self-isolation or quarantine; promotion of public health measures, including hand washing, respiratory etiquette, and social distancing;

preparation of health systems for a surge of severely ill patients who require isolation, oxygen, and mechanical ventilation; strengthening health facility infection prevention and control, with special attention to nursing home facilities; and postponement or cancellation of large-scale public gatherings, However, even if these techniques are taken, that is, testing, sanitization and social distancing/lock down/quarantine, there need to be an optimal level of each parameter in order to protect human civilization from the virus and continue their routine life activities, at the same time with no or little effect on the quality of life, economy and resource. Machine learning (ML) techniques have made tremendous progress in different domains [2–5] particularly in health care [6–10] in last few decades. However, these algorithms are focused to diagnose diseases or to forecast future results [11–13], but not directly on the treatment of diseases. Recently, reinforcement learning (RL) [15–17] has gained more popularity in video games [18–20], where agents can become familiar with the environment by collaborating with environment and get feedback and during this procedure learns good and terrible activities. In this article, RL algorithms are utilized to locate peoples in public places and to observe them. After much iteration, the algorithm is able to learn the best policy that can help the government to implement a strategy to protect the spread of the virus through public place gatherings. A machine learning technique enables the users to invent tremendous activities in various domains, especially in the field of health care. Machine learning algorithms improve the efficiency in the disease prediction, prevention and monitoring of various diseases. It acts like a model and provides a result based on previous activity. Learning is a process by which a system improves performance from experience. Machine learning helps the programmers to create and invent programs to solve real time problems. It helps to develop or construct too difficult systems/models which are practically difficult to program. deep Q-network (DQN) is a neural network which provides solutions to the real time environment successfully.

2. RELATED WORK

For humans, these are the most unprecedented moments on this Earth, on account of SARS-CoV-2. People discover new aspects forms of defending themselves from this infection. Specialists in various fields of computer engineering domains, for example, Visualization, information science, Artificial intelligence, and computer vision, are utilizing various methods that can assist the human populace with distinguishing the presence of the infection, finding of the infection, and potentially the treatment against the infection. in this paper, an examination is made utilizing deep Q-network(DQN)which is one of the most well-known RL methods. That helps to manage individuals to shield themselves from the spread of the infection dependent on the rules by CDC what's more, WHO. Comparative examinations in various areas are examined in this segment. In literature, it is observed that AI and ML have been used for diagnosis and treatment of different diseases.AI techniques are used in a study [1] to distinguish between SARS-CoV-2 and pneumonia on chest computed tomography (CT) images. The usage of AI to protect health care workers from the spread of COVID-19 is highlighted in Becky [2]. The analysis of ML algorithms for COVID-19 is bsed on the existing data is carried out in Malik [3] to understand the early dynamics of the infection. In Yan et al.[4],audio-based assessment of cough is explored. The article explored frequency of cough recognition algorithm. In joesph et al. [5], different AI applications are explored against COVID-19. The article studied the usage of ML algorithms to understand different perspectives of COVID-19 pandemic at different perspectives of COVID- 19 pandemic at different scales such as molecular, Clinical trials and social. The article also explored operational implementation of different AI projects related to COVID-19 , multidisciplinary partnership and open science. In Ali et al. [6].a preliminary diagnosis AI test for COVID-19 from coughing sound using mobile app is used. The article discussed an AI architecture to minimize misdiagnosis. The system makes a 90% accuracy by classifying patients having COVID-19 coughs and non-COVID-19 coughs. The article demonstrated that system can be used as a complementary proof of concept to control the number of clinical trials and eventually save resources for those who need it. Some other studies of using AI, ML and RL to diagnose and treat different diseases are discussed in literature. [7-10] For the detection of various diseases, various ML and RL algorithms have been used in previous studies. These algorithms operate by analyzing current information and predicting unknown information. In this paper, the proposed approach is different from the previous literature studies that the algorithm learns by communicating with the environment supervised algorithm is nowhere used in this study. Through designing the incentive feature to capture the characteristics that should be reduced or maximized, any environmental changes can be captured. Even if it is changing rapidly, using an adaptive and smart reward feature will enable RL agents to understand the environment. The dynamics of the dieses and it responses are growing very rapidly in the case of SARS-CoV-2.It is a growing pandemic and every day, with population changes , many mutations takes place. Also physicians and medical practitioners are unable to fully grasp its pattern of dissemination and the ever-evolving symptoms. By using these parameters in the reward function, the spread pattern and its effect on the quality of life , economy and resources can be captured by the RL. The agent will be able to learn the right policy to optimize his rewards. Although the article focuses on an ideal strategy for managing the spread of the virus in public places, where peoples move often.

3. METHODOLOGY

The arrival of deep learning has had a huge force on many areas in machine learning, it helps to significantly get better cutting edge in errands such as speech recognition object detection, and language translation. Deep learning has similarly raise up the rate in RL, with the use of deep learning algorithms within RL defining the field of DRL. Deep learning facilitates RL to give an extent to decision-making problems that were obdurate in the past, these algorithms have also been extended to a wide range of problems, such as robotics, where control policies can now be trained directly from real-world camera inputs. The Reward-driven behavior of the RL agent work together with its surroundings and observes the consequences of its proceedings, the reward it time-honored helps to learn and alter its performance based on that situation. This method of learning by trail-and-error leads to behaviorist psychology which is one of the important practicalities of RL. Every interaction with the environment succumb information, which the agent uses it for further update of its knowledge. This perception-action-learning loop is illustrated in Figure

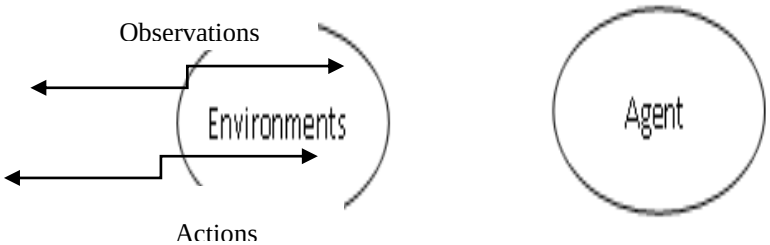

FIGURE 1.

Several successes in DRL help to scale up previous high-dimensional problems in RL. The RL agents use the idea of Convolutional neural networks (CNNs) as its components to learn from raw, high dimensional visual inputs. In specific, DRL uses the optimal policy in deep neural networks for training. We create an artificial environment with regard to particulates such that we arbitrarily maneuver conditions of people in that particular place (e.g., distance between the peoples, face recognition for mask detection, checking for people body temperature) via bootstrap sampling. An integrated data pool have built with real image sequences in proportion, we initially build an integrated data pool consisting of real image sequences in a proportion to balanced class labels (e.g., safe and harmful). The proposed planning framework uses the combination of deep neural network and a model free RL strategy, namely, Q-learning. Our work aims at planning a set of strategy that helps to find the distance between the peoples in a known environment. A deep Q-network is adopted for various strategies planning, which uses built deep neural network (DNN) to derive the correlation between state and action. The DQN approximates the optimal selection of actions in time based on the instantiates configuration of the environment. With awareness of this configuration and the feedback reward at every time step, the proposed model raises the alarm. When this continuous learning ensue future, the system discern its own dynamics and learn to deal with the external environment by developing the correlation between each state-action pair (State , Action) and its Q(State , Action) value function. The execution sequences at a time period of t_{i+1} , the agent uses DNN to calculate the Q(State $_i$, Action $_i$) and It may select the action randomly or by choosing highest estimated Q(State $_i$, Action $_i$) . Then the agent stores the total reward R(State $_i$, Action $_i$) experienced in decision period t $_i$, then this becomes the newly predictable Q-value. After all of these the model learns optimal approach which is used by the agent to map the current state to the action that promises highest feedback reward. Figure 2 shows how deep convolutional network is applied in this model.

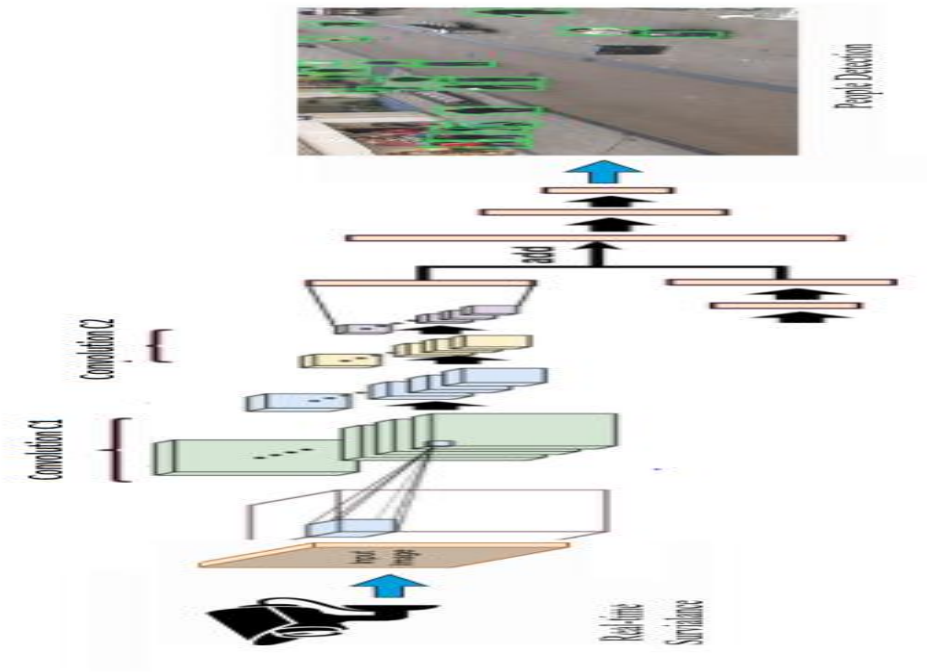

FIGURE 2. Social Distancing at mall

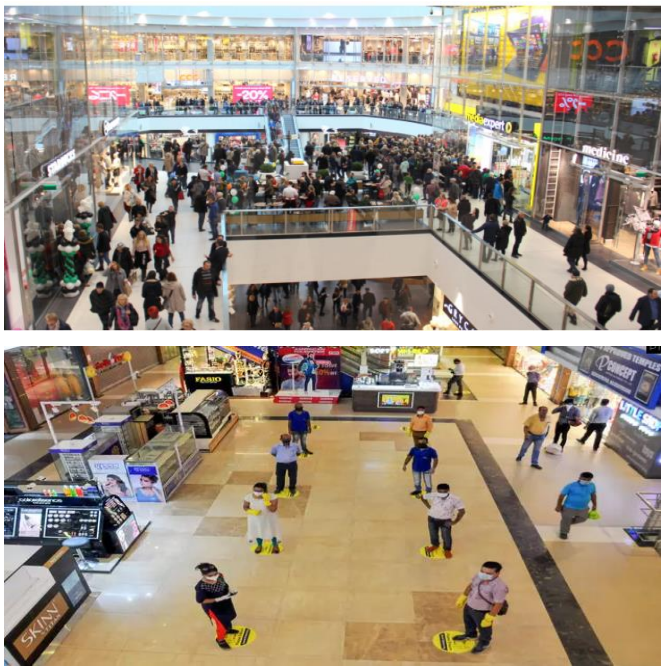

FIGURE 3. Wearing mask at public places

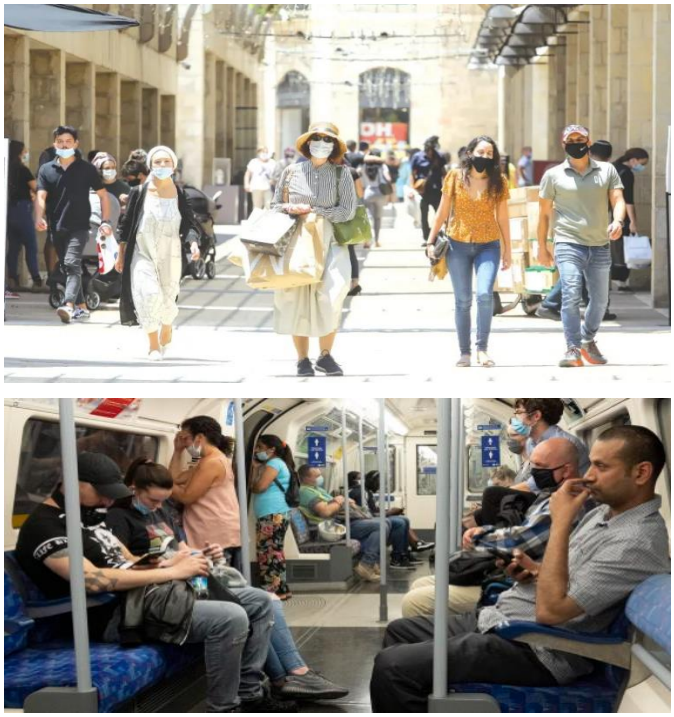

FIGURE 4.

4. CONCLUSION

A framework proposed using an deep Q-Network model to keep an eye on the social distance between the people in public places, We also take in identification of face masks that helps to ensures individuals protection by automatically monitoring these places to avoid the spread the SARS-CoV2. This system will operate in an efficient manner in the current situation and helps to track the public places easily in an automated way. The outcome of this research is applicable for wider community of researches not only in computer vision, AI, and health sectors, but also in other industrial applications such as pedestrian detection in driver assistance systems, autonomous vehicles, anomaly behavior detections, and variety of surveillance security systems.

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