Web-Oriented Things Systems with 5T Policy to Manage and Contain COVID-19

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Web-Oriented Things Systems with 5T Policy to Manage and Contain COVID-19

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ABSTRACT

Digital technology is one of the sectors in the limelight and optimally used for various purposes throughout the outbreak of the COVID-19 pandemic. If the planet succeeds in recovering from the worst catastrophe likely caused by the SARS-COV-2 virus only by the digital technology that is commonly used. Internet-generated data, new technologies, and intelligent devices are used in all aspects of pandemic regulations. 5 T strategy – testing, tracing, treatment, tracking, and technology are commonly used by institutions to control and contain the spread of viruses. The technology is primarily used to handle early detection, touch tracking, treating infected individuals, and monitor and control the spread of the virus. Mobile technology offers a powerful method to support this mission through the use of 'apps' collecting user data. Therefore, an overwhelming number of applications worked showed how successful they can be in identifying and informing individuals who might come into contact with infected persons, concentrating on self-diagnosing the disease, monitoring the symptoms, and reporting cases to health authorities. Web-based platforms pledge increased incentives for a more timely and efficient distribution of information and data analysis related to the pandemic. Online applications developed using AI, ML, IoT, Edge Computing and Cloud Resources are particularly useful for the rapid identification of an outbreak of an infectious disease which is necessary to formulate responses to public health quickly and effectively. Such web-based resources include search requests, website and social media data mining, blog processing, and analysis involving keywords for the disease, text mining, and geographic information system data analysis. These new systems of analytics and information are designed to complement traditional sources of disease knowledge. This chapter addresses various methods of technology used for its control and containment during the COVID-19 outbreak, and what are the prospects in that direction. Also, provides a possible control framework for related pandemics.

Keywords: COVID-19, Pandemic, Mobile Apps, Web-of-Things, Internet, Virus, Web Applications.

1. INTRODUCTION:

The cause of person-to-person transmission disease COVID-19 is 'Novel Corona Virus.' The outbreak of this virus came to the fore on December 31, 2019, when China, the country where it originated, shared reports of

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a bunch of cases of pneumonia of an unidentified source in Wuhan City in its Hubei Province with the World Health Organization (WHO). Then, the disease spread to more provinces in China and around the world. The WHO has identified the virus SARS-CoV-2 and the disease it causes is called COVID with the year 2019 recognized. Now it has been declared a pandemic by the WHO. Signs of the condition include fever, dry cough, trouble breathing. Any infected people can suffer from aches and pains, nasal congestion, runny nose, sore throat, or diarrhea [1-2].

The primary cause for transmitting this disease is the respiratory droplets that the virus-infected person releases when he/she coughs or sneezes. An individual can be exposed to two types of virus infection-direct close contact, and indirect contact. One can catch the infection by direct contact by being in direct close contact with patients infected. The droplets that a virus-infected individual creates survive several days on surfaces and clothing. Thus, touching any such infested surface or material and then touching one's mouth, nose or eyes can indirectly transmit the disease [2].

To avoid the spreading of COVID-19 the public must practice social distancing and good hygiene. It is possible to adhere to social distance by avoiding sporting, religious, political, social, or other gatherings that attract large numbers of people. To prevent direct droplet contact, one must maintain a healthy distance of at minimum one meter between him/her and other people while communicating, more specifically while having symptoms such as cough, fever, etc. Better isolating one-self by remaining at home to feel safe as much as possible. Be connected-less by avoiding physical gestures such as handshakes, holding hands, or hugs. Even stop hitting railings, door handles, tabletop surfaces, tables, benches, etc. Another way to avoid the infection is through the practice of good personal and social hygiene. Sanitize hands by washing with soap and water regularly, or by using sanitizers. After visiting public places or meeting other people particularly if they are ill, sanitizing one-self is very much needed. After touching the face, coughing or sneezing, before preparing food, eating or feeding children, before and after using the toilet, etc., keep oneself clean. One has to cover the nose and mouth when coughing or sneezing with a handkerchief or, at least, bent elbow. Strictly avoid coughing or screaming at public places to prevent droplets from spreading. Finally, do not touch eyes, nose, and mouth with unwashed hands and always ensure that the surfaces and items are cleaned regularly [3].

The year 2020 should have been the start of an exhilarating era in medication and science, with the turn of events and the creation of a few computerized technologies that can be applied to deal with foremost clinical problems and ailments. These computerized developments combine the web of things (WoT) with cutting-edge media communication systems (e.g., 5G), comprehensive knowledge research; man-made brainpower (AI) that uses profound computing, and creativity in the blockchain. They are strongly interrelated. The multiplication of IoT in medical clinics and centers encourages the foundation of a deeply interconnected advanced biological system, empowering ongoing information on a scale that AI and deep learning frameworks could then use to understand social insurance patterns, model hazard affiliations, and predict outcomes. This is enhanced by the innovation of blockchain, a back-connected database with cryptographic conventions, and a system of dispersed PCs in different associations, incorporating shared systems to ensure that information is duplicated in different physical areas, with adjusted calculations to ensure that information is nevertheless discernible [4-5].

Nonetheless, the planet is facing an unprecedented worldwide health emergency almost a year into 2020; the episode of a new respiratory disease-caused coronavirus (COVID-19). As knowledge on COVID-19 is progressing, increasing data indicates that it is less harmful than at first assumed by all accounts (with a death rate of about 2 percent), though increasingly contagious. The impact of COVID-19 is likely to be more prominent than that of the 2003 extreme, serious respiratory disease (SARS) [6].

Under what form will this latest situation be dealt with by 2020? How does it equate 2003 with the SARS pestilence? Many nations, including that, are used for SARS in 2003, relied on an extrapolation of great disease control and general well-being initiatives to contain the COVID-19 pandemic. This pandemic has ignited unprecedented interest in advanced health engineering arrangements and has revealed successful strategies such as community monitoring, following the disease, coordinating inventory use and resource distribution, and reaction-oriented preparation [7].

Digital technology is used optimally in different ways during the outbreak of the COVID-19 pandemic for different reasons. Data generated on the Internet, emerging technologies, and smart devices are used in all aspects of pandemic regulations. 5T policy – test, trace, treat, track, and technology, were largely used by establishments to manage and contain virus spread. The technology is predominantly used for managing

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early testing, contact tracing, treat infected persons, and track and control the management of virus spread. Contact tracing is a necessary pointer of general wellbeing, and a fundamental part of deliberate methodologies to screen COVID-19 spread [8]. The chain of transmission from one to another can be contained by identifying individuals infected, isolating, and tracking them to ensure immediate isolation, testing, and providing care in the event of symptoms emerging. Such interventions will reduce the number of new cases when applied consistently and efficiently. Mobile technology provides a powerful tool for promoting this mission utilizing 'apps' that capture user data. Huge numbers of the applications worked, therefore, have demonstrated how effective they can be when recognizing and telling individuals who may come into contact with infected people, focusing on self-diagnosing the malady, tracking the symptoms, and reporting cases to health authorities. Web-based platforms promise expanded incentives for more timely and reliable dissemination of pandemic-relevant knowledge and data analysis. Online applications developed using AI, ML, IoT, Edge Computing and Cloud Resources are especially useful for the rapid detection of an infectious disease outbreak, which is important to formulate responses to public health quickly and effectively. Such web-based tools include search requests, site and social media data mining, blog processing, and analysis that involves disease keywords, text mining, and data analysis of the geographic information system. Such modern analytical and information platforms are intended to supplement existing disease intelligence sources [9-10]. Given the appeal of these new methods, more research is required to assess the accuracy of web data as increased public engagement does not automatically mean greater consistency in the information given. This chapter discusses various technology methods used during the COVID-19 outbreak for its control and containment, and what are the prospects in that direction. Also, presents a structure for potential management of similar pandemics.

2. OBJECTIVES OF THE STUDY:

This paper mainly focuses on various issues related to the application of adaptive technologies in the control and management of COVID-19 pandemic disease. The main objectives include:

- To analyze the impact of COVID-19 on technology and its applications
- To comprehend the application of web on COVID-19 data analytics
- To understand the impact of Mobile technology on COVID-19 data analytics
- To study the integration of 5T policy by the authorities to control and manage COVID-19
- To evaluate tools used for the implementation of 5T policy during the COVID-19 period
- To investigate the triple-R approach adopted by the government to combat with COVID-19
- To discuss and recommend an ideal system for the control and management of pandemics

3. METHODOLOGY:

The authors are attempted in this paper to analyze How the integration of adaptive technologies with healthcare for the early identification and control of pandemic diseases benefited to contain COVID-19 pandemic. This qualitative research paper is developed by observing and analyzing existing information on the topic using the keywords "COVID-19", "IOT and COVID-19", "Impact of COVID-19 on Technology", "Web-based COVID-19 analytics", "Mobile-based COVID-19 analytics", "5T policy for COVID-19", and "Triple-R Approach for COVID-19", available in online articles, peer-reviewed journals, magazines, and a few official websites.

4. IMPACT OF COVID-19 ON TECHNOLOGY AND ITS APPLICATIONS:

Covid-19 has had an unparalleled influence on culture and the economy. People became digitally minded and began working from home. Many innovations will be implemented and accelerated in the near term. IoT policymakers and analysts have identified and focused on the effects of COVID-19 in many organizations. But not all current programs, which involve highly strategic measures and ventures involving developments specifically linked to COVID-19, are paused. The company needs to have some facts in place that could drive technologies and applications. As the demand for goods and services is diminishing, the cost of these services must be reduced. Material production and quality at construction sites cannot be visited. The employee's position and manufacturing are also expected to be transparent. It aims for the automation of business and its operations using robots, driverless cars, and other technologies. The effect of Covid-19 also

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affects supply chain management and its techniques. It has made businesses concentrate on multi-suppliers instead of single and few capitals. Most important innovations related to data, AI, and health technologies in the coming 2-5 years are expected by the experts. Table 1 and Figure 1 shows that all the respondents will not predict the uniform innovations with technologies in all the area around the globe [11].

Table 1: Prediction on the Impact of COVID-19 on technological innovations in the 2-5 years [11].

Tech Area	Innovations in the future
Future of work	17.40%
Data & AI	33.00%
Trust & Supply chains	19.30%
Space Tech	1.80%
Medical Bioengineering	25.70%
Others	2.80%
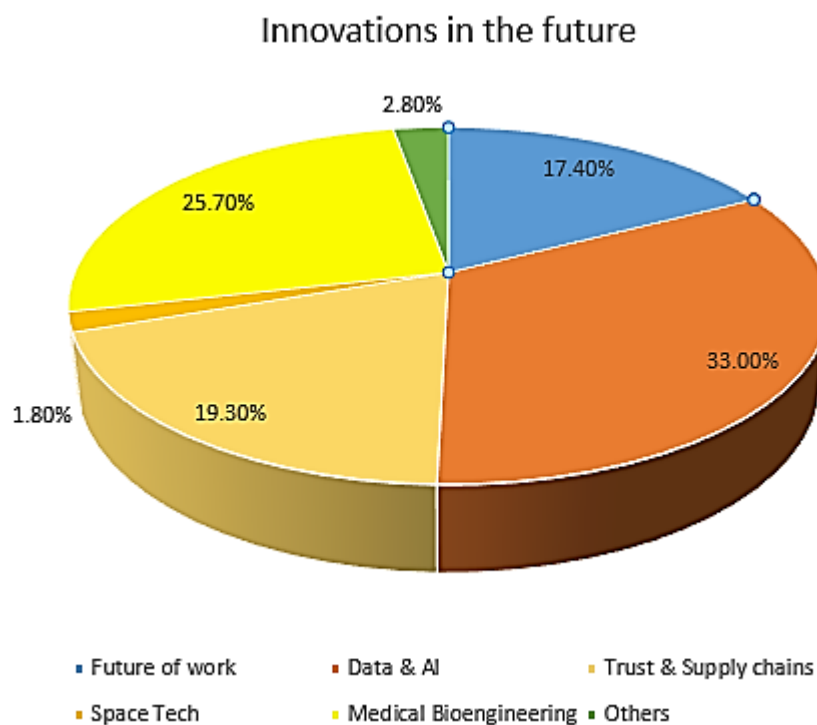
Fig. 1: Prediction on the Impact of COVID-19 on technological innovations in the future around the world [11].

Some of the impacts on technologies and their applications are listed below [10].

- Conference resources like Zoom, Cisco WebEx are booming to connect people to different locations digitally. Remote asset access tools such as Librestream are also in high demand to link people to their machines and properties. These tools can provide automated inspections and diagnostics with virtual support.
- Production, delivery, and distribution were delayed with varying product requirements. As a result, businesses have adopted digital twins to create digital images and educate consumers about product attributes and risk factors for automated decision-making. Llamasoft, a tech firm headquartered in the US, combined digital twins with data science to model its brands and supply chain management.
- Monitoring of public areas, tracking, transmitting of messages, spraying of drugs, other medical supplies, and the needs of people during the COVID-19 pandemic was addressed by Drones and their technology. They help deliver medical samples and medicines linked to the virus COVID-19.

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- More and more digital health solutions based on technology are being implemented during this pandemic era. Telehealth consultations to talk to patients through video conferencing for effective guidance, digital diagnostics, remote monitoring, and robotic assistance are some examples of digital health applications.
- Smart city projects are also underway. In Korea, "Smart City Data Hub" is used to collect data on coronavirus cases and the closest interaction with humans. This latest tool would also be used to monitor the spread of the pandemic [10].

5. WEB-BASED COVID-19 DATA ANALYTICS:

During the month of nation-wide lockdown in India, people googled for different items and news. The search trends depended upon the news on the media. More than forty different words and technologies became more popular between March and May this year [12].

- **COVID-19** or **Corona** was the highest word that was searched during March-April. All related terms such as Cold, Cough, Fever, etc. were searched by millions of people. During the early days of March 2020, Coronavirus was at the spike of Google search when compared to news, sports, movies, and music. During May the popularity of COVID-19 was pushed to 12th place as people started to search for other interesting items. **Symptoms of COVID-19** was also one of the frequently searched items on Google.
- **Online shopping** for grocery and essential items was at the peak before the 25th of March. It was converted to stockpiling because of a lack of awareness related to lockdown rules. People started hoarding of grocery and other essential items even though they had a very short shelf life.
- **Thank you quotes** for COVID-19 frontline warriors were the most searched terms during April.
- **Lockdown guidelines**, lockdown, seal down, etc. were the words that were searched by more than one million people on Google.
- **Plasma, Plasma therapy** were also being searched frequently when the media published the news that it is an effective treatment technique.
- **Quarantine, isolation**, home quarantine, quarantine, etc. were searched by millions of people between March and May 2020.
- **China and COVID-19** were also searched by millions of people between March and May
- **E-Pass** was another term that was searched by millions of people because of the inter-state travel restrictions.
- **Food recipes such as Cakes, Chats,** etc. were also searched by millions during March and May. When frontline COVID-19 warriors were busy in discharging their responsibilities, people at home were busy in preparing Dalgona coffee by watching the recipe online.
- **Containment zone, Green zone, Red zone**, **Hotspot,** etc were some of the words that are searched by lakhs of people. They were eager to know different zones in their state.
- **Search for items to maintain persona hygiene and**
- **Ramayana and Mahabharata** were re-telecasted during the lockdown. This led to a dent in the number of likes and views for Amazon Prime and Netflix.
- **Online games** were also the most frequently searched word between March and May. This shows people took the help of online games to overcome the boredom during the lockdown
- **COVID-19 Vaccine** was another frequently searched word during the lockdown. This word was searched frequently during April and May 2020.
- **Hydroxychloroquine** was another word that was most frequently searched during the COVID-19 disease outbreak. There were several opinions for and against the use of this drug as medicine for COVID-19, it became popular on the Internet.
- **Aarogya Setu App** was searched by millions of people during April and May 2020.
- **COVID-19 preventive measures, COVID-19 latest news, COVID-19 deaths**, etc. were also frequently searched by millions of people to know the latest news related to COVID-19.
- **How to queries** such as how to use PPE kit, how to use the Zoom App, how to prevent COVID-19, How to stay fit, how to lose weight etc. were frequently searched by lakhs of people.

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- **PPE kits, N95 Masks, Surgical Masks, Ventilators, etc.** were extensively searched by millions of people.
- **Natural immunity boosters, immunity booster recipes, immunity-boosting medicines** were extensively searched by millions of people to gain knowledge about different items that can be used for increasing immunity to fight against the disease.
- **Online games, online food delivery, online puzzles, online grocery** were extensively googled items between March and May 2020.
- **Swab test, rapid testing kit, antigens, incubation period** are some other terms that are extensively being googled by thousands of people these days.

In addition to this, studies show that millions of people worldwide suffered from the fear of losing their jobs. Fear and anxiety play a crucial role in human emotions. One of the major negative aspects created by the pandemic was the fear of losing the job. Several companies started to cut down the workforce because of the downtrend in their revenue. This resulted in millions of employees who suffer from depression. As a result of this, they started searching for openings in their respective fields [13].

Predictive analytics was used to estimate the number of infected. Since the statistical data about the population, susceptible, infected, recovered, and dead is accurately available the Susceptible Infected Recovered Dead (SIRD) model is used to estimate the amount of contagiousness which is nothing but the estimation of the number of people who may catch the infection from a single infected person can be calculated. Using the SIRD model, the basic reproduction number (R_0) is calculated. This estimation is not a straight forward one as it depended upon several factors. There were people with mild symptoms, asymptomatic people. The SIRD model used a statistical technique to estimate the value of R_0. This value represents the average number of secondary cases from a single infected case. The SIRD model uses the method of least squares with a sliding window of equal interval. This model considered the number of population N as a constant. If S(t), I(t), R(t) and D(t), C(t) represent the number of susceptible, infected, recovered, dead, and resolved cases at a given time 't' and N is the total number of populations, then the equation

$$S(t) + I(t) + R(t) + D(t) + C(t) = N \qquad (1)$$

It is the fact that the total number of suspected, recovered, infected dead, and resolved is always equal to N. It is mentioned in the equation (1). If α, β, and γ represent the estimated infection rate, recovery rate, and mortality rate respectively, then each parameter can be calculated using the formulae

$$S(t) = S(t-1) - \frac{\alpha}{N} S(t-1) I(t-1) \qquad (2)$$

$$I(t) = I(t-1) + \frac{\alpha}{N} S(t-1) I(t-1) \qquad (3)$$

$$R(t) = R(t-1) + \beta I(t-1) \text{ and} \qquad (4)$$

$$D(t) = D(t-1) + \gamma I(t-1) \qquad (5)$$

The estimation of basic reproduction number R_0 was done using the formula

$$R_0 = \frac{\alpha}{\beta + \gamma} \qquad (6)$$

The number of susceptible at time t is estimated using the equation (2). To calculate this, it requires the estimated infection rate α, and using the same α the count of infected at time t is calculated using the equation (3). The number of recovered at time t is calculated using the equation (4). It requires parameter β which represents the estimated recovery rate. The number of deaths can be calculated using equation (5). The parameter required to calculate this is γ. The value of R_0 is calculated using equation (6). To check the accuracy, the root means square error can also be calculated.

It is found that the infection rate depends on several factors. It is low when safety measures like social distancing, the use of disinfectants, sanitization, etc. was observed strictly. Fatality, recovery, and infection rates depend upon several factors other than the severity of the reproduction rate of the virus. It also depends upon demographic data, the vulnerability of a person to the disease, and the number of resources such as oxygen cylinders and ventilators in the emergency care units [14].

6. MOBILE TECHNOLOGY BASED COVID-19 DATA ANALYTICS :

Restriction on face-to-face interactions made people relay entirely upon their smartphones to get connected. Plenty of smartphone apps were made use of during the lockdown period. Different categories of mobile apps

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being used extensively during the lockdown period include [15-16]:

- **Video conferencing apps**: There was a spike in the use of these apps for staying connected. Companies imposed work from home for their employees and used video conferencing apps such as Zoom, WebEx, Google meet, Skype, etc. to facilitate business meetings. A new word webinar was coined during the situation of the pandemic. These webinars were virtual conferences organized by using free or paid versions of video conferencing apps.
- **COVID-19 tracking apps**: These apps were used to track COVID-19 infected people or people who are observing quarantine or isolation in the locality. Apps such as Aarogya Setu are powerful tools as they alert the users about infected people near to them. These apps store data of subscribers in the government servers and enable self-assessment for COVID-19.
- **Teleconsulting apps**: People were forced to stay at home during the lockdown period. Telemedicine and teleconsulting apps were extensively used to avail healthcare and counseling facilities without moving to hospitals. This ensured better and continuous care for patients who suffer from chronic diseases such as diabetes, hypertension, etc. Because of the extensive use of telemedicine facility hospitals were less crowded with people suffering from non-critical illnesses. Expert medical practitioners were available at the fingertips of patients [17].
- **Online grocery apps:** Because of travel restrictions and lockdown policies people started to make use of online grocery apps such as Amazon, Bigbasket, etc. These apps ensured contactless delivery and payment to avoid the spreading of the disease. Bigbasket, a supermarket chain startup that has entered the industry helps consumers meet their needs. People will try to stop the situation of going out to buy groceries which in turn would increase the online grocery concept even further.
- **Online food delivery apps:** People were not interested to go out for having food during the lockdown period though hotels and eat-outs were transformed into takeaways. Bigbasket, a supermarket chain startup that has entered the industry helps consumers meet their needs. People will try to stop the situation of going out to buy groceries which in turn would increase the online grocery concept even further.
- **Online entertainment apps:** People used digital entertainment extensively during the lockdown. This resulted in a spike in the number of subscribers for Netflix, Amazon Prime, and Disney Play [18].
- **Online gaming apps**: When educational institutions were closed youngsters started downloading online/ offline gaming apps. First Person Shooter (FPS) remains as the popular online gaming app even after the release of lockdown. Other gaming apps such as Ludo King, Garena Free Fix, Scale, Perfect Cream, etc. are also being used extensively.
- **Social networking apps:** During the lockdown period, social networking sites experienced an increase in traffic. Because of lockdown, more and more people have wanted to remain connected using this forum to alleviate isolation when asked to maintain social distance. Meanwhile, organizations used the same technology to spread awareness of the disease among the citizens. Doctors and health workers used WhatsApp, Facebook, etc. to spread authentic news related to the disease. This gave a lot of confidence to people during a critical time.
- **Online payment apps:** Many business organizations encouraged cashless payment. Hence online payment apps like Google Pay, Phone Pay, PTM, etc. were extensively used these days to avoid the use of currency notes.
- **Online fitness tracking apps:** Fitness freaks had a lot of free time during the lockdown period. They utilized the same for staying fit and healthy using a variety of fitness apps available freely in the play store.

7. 5T POLICY FOR PANDEMIC MANAGEMENT AND CONTAINMENT :

Most of the countries in the world used the 5T policy to combat COVID-19. The five Ts are - Test, Trace, Treat, Track, and Technology. Figure 2 presents various elements of the 5T policy adapted to manage and contain COVID-19 effectively.

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Fig. 2: 5T Policy to Manage and Contain COVID-19

7.1 Testing

Aggressive testing is essential to curb COVID-19 spread. More tests imply less likelihood of spread. Early detection of the person infected reduces the risk of spreading through him/her. Thus, each government attempted to increase the testing at different levels, particularly at the early stage itself in hotspot areas to combat virus spread.

7.2 Tracing

Next comes tracing, after testing. People who have come into contact with a positive patient are identified and are asked to be self-quarantined. Well-trained field personnel execute responsibilities for contact tracing as per the detailed plan of the authority which prescribes step-by-step actions to be carried out by each individual designated [19]. The mobile app and web application Contact Tracing is used to overcome the enormous amount of effort, the forgetfulness of truly good people, and attempts to hide knowledge for multiple purposes. Authorities conducted a household survey to take priority identifying, protecting, and treating high-risk populations such as elderly people, people with co-morbidities, pregnant women, and those with influenza-like diseases. Data already available with the Department of Health complemented the data collected through the survey [20].

7.3 Treatment

Treating patients infected with COVD-19 needs massive medical supply & medical logistics and human resources. Patients are generally divided into three groups. Elderly people & minors with severe complications, patients with milder symptoms, and patients with no signs of COVID-19 illness. In emergency wards, general beds in hospitals, and the home itself, patients were treated as per the type. The medical personnel used technology to treat patients, track patients constantly, direct them, advise them, and increase their morale [21].

7.4 Tracking

Technology is used to monitor movements of foreign and domestic passengers, diseased individuals, and individuals who come into contact with the positive patients. Tacking applications allowed authorities to monitor them for a fair number of days while they are at home or in institutional quarantine. The Quarantine Watch Apps help field workers execute the quarantine. Online and mobile data are often used, under authorities' control, to track the movement of individuals [22].

7.5 Technology

Because of the COVID-19 pandemic, officials used technology to help government agencies handle the number of tasks that crop up. Technology is used for testing patients, tracing & tracking individuals, and treating patients. Optimum use of technology ensured reduced virus spread and increased recovery rate [23].

8. TOOLS USED TO IMPLEMENT 5T POLICY DURING COVID-19 :

The Pharmaceutical and Information Technology department is seeking to fight the COVID-19 pandemic. With the frequency of new COVID-19 cases increasing by the day, stakeholders in the healthcare sector continue to look for resources and drugs to help stem the tide. During the COVID-19 pandemic time, the

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quicker and more reliable implementation of solutions to 5T policies is implemented. To control the critical situations that occurred during this pandemic outbreak, the promotion and strategic services are put in place. The digital health group is seeking to find a new range of tools to enforce 5T policies to address COVID-19 incidents, such as testing, tracking, tracking, treatment, and technology [24]. Several groups of companies like startups are working on this. Many apps are being built by the state, nation, and worldwide over the last couple of weeks to bend the growing COVID-19 curve. These include tools, solutions, applications, and medical-related support services. During the time, a few tools/apps were also created to assist the wider society or those who have especially affected.

8.1 Test

Testing virus transmission leads to early detection and further spread can be minimized. Also, it treats those infected with the virus quickly. A lot of technologies and methods are actively developed to monitor such disease outbreak virus infection.

- **Temp Pal smart thermometer:** Cloud-based remote device, the world's smallest thermometer built by iWEECARE, called Temp Pal in Taiwan for temperature monitoring and warning whenever temperature appears abnormal. It helps to ease the burden of care providers by avoiding contact between social workers and patients [24].

- **Rapid test kits for COVID-19**: Biolidics Rapid Test Kit makes COVID-19 tests 95 percent accuracy in ten minutes. This successful kit was developed by the Singapore-based Meditech Company with HSA approval to solve the hard time needed to do the same with PCR testing [24].

- **Doubao**: Doubao has collaborated with Guahao.com to provide online diagnostics services. The platform provides free, unrestricted access to 24-hour online treatments for all forms of diseases. It helps relieve the scarcity of medical services, allows the diagnosis of infectious disease, and provides clear guidance for self-treatment [25-26].

- **X-ray tool**: Mumbai-based leading Healthcare company Qure.ai reported the implementation of its innovative diagnostic tools at Bolton NHS Foundation Trust, UK. The tool streamlines the detection of COVID-19 proliferation from chest X-rays, making it easier for health professionals to track the magnitude and rapid progression of infectious diseases.

- **VereCoV detection kit**: Veredus Labs offers a laptop-mounted testing system for the identification of Coronavirus Respiratory Syndrome (MERS-CoV), Coronavirus Extreme Acute Respiratory Syndrome (SARS-CoV), and COVID-2019 in one examination. This test kit is built by one who works on VereChip technology in Singapore.

- **Fever Patrol**: A distant thermometer that detects accurate body temperature in just a few seconds from a distance. This has been developed by a new tech startup company to monitor fever temperature without anybody's touch.

- The seriousness of pneumonia caused by COVID-19 is automatically identified by a system based on AI technology. A new smart device from Aikenist Technologies runs via X-ray and CT scans. AI support is offered to radiologists via the cloud-based, compatible through X-ray and CT scanning equipment.

- **KlinicApp and Practo:** KlinicApp and Practo are two COVID-19 apps that were designed at Mumbai to conduct home testing and doctor consultation.

8.2 Trace

- **GetAI:** IoT-based, automated driving technology with a GetAI-developed AI monitoring system is updated with new features. It includes 24-hour facial detection monitoring to read expressions and masks to alert operators to the automatic marking of abnormal data. R&D resources are added to the system for detecting temperature to replace the shortage of medical equipment required [26].

- **COVIDSafe**: A smartphone-based contact tracing software called COVIDSafe introduced by Australia Business, which is used only by state and territorial health authorities to collect data about individuals exposed to COVID-19. This advises individuals who need to be screened and quarantined. Bluetooth allowed Australia-developed mobile applications to track the contact information. Whenever the app identifies another user, the date, time, distance, length, and reference code of the contact person will be noted, they will be encrypted and stored on the person's phone with protection. The contact information stored on people's mobiles is removed on a 21-day rolling period. At this time the incubation period COVID-19 and the time it would take to get examined is taken into consideration [28].

- **TraceTogether**: TraceTogether is a prominent Smartphone app in Singapore with a mobile number. It's a contact tracing software that uses Bluetooth to record infected individuals and alert those who have been close to them for the past 15 days. Both phones can share a Temporary ID using Bluetooth when two people are next to each other using the app. This Temporary ID is created by encrypting the User ID using a private key kept by the Health Ministry (MOH). It can only be decrypted by MOH and does not disclose the other person's name or gender. The app was created by the Government Technology Agency in partnership with MOH and has become a reference for many other contact tracing applications in most other parts of the world [29].

- **HaMagen:** Launched by Israel's health ministry, the app uses contact tracing to prevent the spread of mortal contagion.

- **NHS smartphone app:** NHS has developed a contact tracing system in England to keep track of people's movements and alert those who come in close touch with those who have been infected.

- **PinPoint**: A digital health company, CarePredict, has found a method for mapping the senior living facilities. It's built to trace the touch, direction, and location of room traffic. It provides details about both the member of staff and the patient who requested the service and their contact history.

- **COVIDmeter App**: COVIDmeter App was created by a Danish tech firm, Netcompany. It is used to diagnose and monitor themselves with signs of coronavirus, depending on their inputs.

- **YiTong Health**: During the COVID-19 outbreaks YiTong Health introduced a special online monitoring platform to report employee health. The tool will produce daily health reports for employees, automated risk evaluation, and provide COVID-19 precautionary training courses for employees. The tool is provided to the public for support during the outbreak [25]

- SAHYOG: Govt. Of India, mapping agency Survey has created the SAHYOG app, which will complement Aarogya Setu to achieve the goals of contact tracing, public awareness, and self-assessment. The key goal behind the introduction of this app is to further enhance the response mechanism for the administration. The app will serve as a crucial tool to help community members perform door-to-door surveys, monitor contacts, distribute vital products, and concentrate on awareness campaigns.

8.3 Treat

- **COVIDMD**: For patients who fill their histories with symptoms present, Fruit Street Health Company has introduced a new platform named COVIDMD for automated therapy and customized guidance. This telemedicine company develops this platform on the Salesforce Service Cloud to provide appointments and video consultations for the vulnerable, in particular, to deal with COVID-19 cases [26].

- **Plasma donation:** A new chatbot developed by Microsoft is being used to support people who have recovered from COVID-19 to identify possibilities for plasma donations. It is permitted to obtain their closest plasma donation Centre based on patient-related concerns regarding COVID-19 status [26].

- **Vici:** A robotic telemedicine cart, Vici built by Teladoc acquisition InTouch Health Company, allows quarantined persons to just get actions and procedures to be followed by a physician and nursing assistant to monitor him remotely to combat the coronavirus. This works with a self-fitted camera, display, and medical equipment [30].

- **Healthinote:** An app created by a Cognizant Group that provides up-to-date and checked health care data to aid them with their condition and treatment options. The software uses 3D and VR to help patients come to understand their condition with visualization. It also verifies adequate direction with COVID-19 by chopping off informal fake news that could generate contradictory and misleading details [7].

- **Ventilator splitters**: The Company Extrudify technologies, a 3D printing stratum up based in Mumbai have created a special form of the ventilator. They help up to 2 patients with one ventilator, as in a lack of equipment, during a critical period.

- **Face shields**: Healthcare staff requires massive quantities of face masks to get protection from infection with COVID-19. A Navi, Mumbai-based Divide By Zero Technologies developed these shields using 3D printing techniques [21].

- **Differential splitters**: A new ventilator function was invented by Ethereal Machines, a deep-tech startup based in Bengaluru. A different category of ventilator will provide or split oxygen into two parts, so a single ventilator can be used in multiple patients. This method is incorporated in 3D printing using computer-controlled numerical machining technology.

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- **Duo-vent**: Aerobiosys start-up company, IIT Hyderabad, has discovered a new ventilator mode. A person with chronic respiratory disease is provided preferential ventilation with varying pressure and oxygen concentrations. It is an AI-enabled ventilator, capable of minimizing lung damage at a low cost. It helps with treatment advice to minimize ventilation time. This will be very useful for countries with a low resource base, as in India [26].
- **Personal protective equipment**: Doctors and other health care professionals who treat patients with coronavirus need to provide their security. Personal protective devices, such as valves, ventilator modules, connectors, and reusable face masks, etc., are on a huge scale and are designed by a Karkhana.io start-up to comply with the government and the private hospital's orders [26].
- **CPAP System**: The Bengaluru-based start-up company MedTech has produced a Continuous Positive Airway Pressure system running without electricity. It has a 6-hour battery reserve and the ventilator takes up the ambient air in the lack of oxygen [26].

8.4 Track

- **The Corona DataSpende:** This German smartwatch software tracks coronavirus spread via the compilation of critical signs from participants wearing a smartwatch or exercise tracker-pulse rate, body temperature, sleep patterns.
- **COVID Symptom Tracker:** This app was created in partnership with the company named Zoe Global by doctors and researchers at King's College London and St. Thomas Hospitals. For scientific research, the program investigates the symptoms of the virus and also helps track how it spreads. The scientists are researching high-risk areas in the UK, the rate of transmission of viruses, and the most vulnerable population, based on health
- **Kwarantana Dommowa:** An app developed on in Poland collects personal information with selfies and images to identify where they are located. This app is a must for people with coronavirus symptoms [29].
- **Mobile Proximity App:** Netcompany, a Danish tech firm, has created a Mobile Proximity App. It's used to monitor and track the spread of the virus predicated on their input data.
- **Strict tracking and tracing:** Bahrain is developing COVID-19, GPS-tracking electronic armbands, and a coronavirus contact tracing application to warn monitoring stations when a man leaves his isolation or when the bracelet loses contact. Authorities at the Ministry of Health regularly request images of these self-isolated individuals to reveal the faces and bracelets [30].
- **Aarogya Setu:** If the person approaches someone who has tested positive for COVID-19, the Arogya Setu app, designed by the Indian government, alerts users. An individual with a positive COVID-19 moves another user nearby, and the warning message is elevated. By providing current symptoms and locating the nearest hospital facility, a person may search COVID-19 for. It usually relies on location data created by GPS and Bluetooth to track the locations the user has visited [31].
- **COVID-19 Quarantine Monitor:** The Tamil Nadu State Government, in collaboration with a private player, created the COVID-19 Quarantine Tracker to ensure that people undergoing house quarantine do not breach the standard procedures. An individual must have a mobile number logged in with Tamil Nadu to use this app. It allows monitoring of live locations via GPS and produces alerts and details [32].
- **WashKaro app: App created by IIT Delhi, aims to update Hindi knowledge in bite-sized audio daily by the layman. The app offers the government's official advice pages and has a WHO-based symptoms tracker that lets users realize whether they are healthy** [33].
- **GoCoronaGo**: A group at IISc has created the 'GoCoronaGo' software that can help to identify individuals who may have made contact with COVID-19 offenders by using Bluetooth and GPS to monitor their past interactions. In the background, it uses network analytics to determine the risk tendency even for remote contacts, know disease spread, and identify high-risk people who are most likely to contract and spread the disease [33].
- **Sampark-o-Meter**: An IIT Ropar BTech school-developed Sampark-o-Meter app to measure the potential probability of infection by COVID-19 and can show infected areas on maps with such a relative risk and warn individuals to take suitable action when necessary [27].
- **IIT Roorkee** Professor Kamal Jain has built a tracking app that can improve the monitoring system needed to include coronavirus [33].

8.5 Technology

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- **COVIDWatch:** COVIDWatch Bluetooth allowed the mobile application established in collaboration with Stanford University to maintain privacy and monitor contacts during COVID-19 **[29].**
- VR for stress: Limbix Italia, located in Italy, brought a virtual reality headset device to the hospital to improve the psychological-emotional feelings of the employees. It works with the visualization of the VR hardware and directed breathing exercises to cope with anxiety when dealing with corona patients.
- **Stress Reducer**: The Singapore-based MindFi Mobile tech firm launched a revamped version of mindfulness applications to minimize levels of stress among health workers and first respond with one year of free subscription. Such a mobile app, available on iOS and Android, has been developed jointly with HSEU, e2i, and LHUB [34].
- Apple **health check**: A new platform and related app introduced by Apple acts as an information platform to get user-led answers to the questions regarding risk factors, signs, and exposure to disease, as well as surveys to continue with the next possible step toward the COVID 19 solutions [35].
- **Clean payment**: Luxury lifestyle consulting company developed antibacterial and antiviral payment cards to deter surface pathogens. A specially coated metal coat eliminates 99.9% of the germs and serves as a debit and credit card [36].
- **Zero contact payment**: Ins for Renascence has started paying the hospitals zero contacts. Using QR code, advance payment is made once users have their official WeChat account approved by their health records and insurance policies. The insurers then reimburse the actual medical bills directly to the company.
- **Haola Tech**: COVID-19 Digital self-assessment software introduced by Haola Tech to evaluate the general public's risk of infection. The AI-driven instrument was also used during COVID-19 to evaluate physical as well as psychological health [37].
- **AirBin**: The IIT Madras start-up called Antariksh Waste Ventures launches IoT-enabled smart bin branded AirBin to monitor waste accumulation and clearance. This Smart bin can intelligently observe and act on residues produced in hospitals, clinics, quarantine zones, and public bins. Smart bin is retro installed on existing containers, walls, or bin lids and reminds local rural and urban bodies to clear the bin until it floods otherwise COVID-19 would spread [32].
- IoT built by Pink Tech Design makes Sanitation possible. It is programmed to include automatic sanitization using IoT sensors and AI to calculate the amount of sanitization by hand. The green light is shown to show the one that is used when properly sanitized, and if not, red light. This AI-based system also features a camera and image processing algorithms to identify human wearing gloves and masks.
- A screening system developed by SenseSemi Technology is used in public places such as community centers, public transports, parks, malls, parks, etc. to screen people with a non-touch thermometer.
- BillionLives has launched a website titled Coraonacare.life to provide online advice and consult with experts to get accurate virus advice. This helps patients interact with physicians, social workers including psychologists [26].
- The COVID 19 Feedback app: Information technology has been developed a survey app to obtain sensitive data on any procedures and tests that may have been exposed to recently. In this way, the very worst affected area can be defined to improve the test facilities.
- **COVA:** The Corona Virus Alert App was built and designed by the Government of Punjab's aim of providing information on preventive medicine and other government advice to people. As well as other essential information, this detailed app lets the user create a curfew pass. It offers a forum for the government to exchange orders and travel guidelines. There is also a list of reported deaths, predicted outcomes, unfavorable outcomes, and quarantine at homes and isolation at the hospital. Users will verify their state of health to see just how far they seem to be from the closest patient [32].
- **Asimov Robotics**, a Kerala-based start-up, also deployed robots at the entrance to office buildings as well as other public places to carry sanitizers and information about the virus to the people. Robots are now being used to carry food and medications to hospitals in isolation, helping to relieve the burden on medical staff [38].
- **Robots from IIT-Guwahati:** The Branches of Mechanical and Electronic Engineering & Electrical Engineering have built robotic medication/food transport units for isolation ward as well as robotic screening units. They even work on the production of handheld temperature control devices, ICU beds and ventilators, isolation areas for hazardous waste disposal, disinfection baths, and hand sanitizers including protective masks that comply with the guidelines provided by the World Health Organization (WHO) [39].

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▪ **onAir feature:** The onAir app created by IIT Delhi uses Artificial Intelligence to cross-refer to WHO documents. This means that people are safe from false information and pranks. It also acts as a medium for checked knowledge relative to other social media sites [33].

Table 2 below details the list of Digital Technologies used to implement 5T policy along with their advantages and disadvantages.

Table 2: Digital Technologies used to implement 5T policy along with their advantages and disadvantages [40-41].

Functions	Digital Technology Used	Advantages	Disadvantages
TEST			
Tests individuals and populations for the disease.	▪ Artificial intelligence ▪ Automated thermometers ▪ Smartphone apps ▪ Thermal cameras ▪ Toolkits on the Web	▪ Provides details about the prevalence and anatomy of diseases ▪ Distinguishes persons for research ▪ Contact tracing and isolation	▪ Might violate privacy ▪ Fails to diagnose asymptomatic individuals based on self-reported symptoms or vital sign monitoring ▪ Includes high costs ▪ Needs supervision and regulation ▪ Needs screening methods to be validated
TRACE			
Recognizes and records people who may have come into contact with an infected individual	▪ Global positioning systems ▪ Phone applications ▪ Tracking of mobile devices in real-time ▪ Wearable technology [42]	▪ Describes people subject to testing and containment ▪ Monitors the spread of viruses	▪ Might infringe privacy ▪ Might detect individuals who were not exposed but had contact ▪ Could not detect individuals who are exposed if the application is deactivated, the mobile device is missing or Wi-Fi or cell access is inadequate
TREAT			
▪ Diagnosis and treatment of sick persons ▪ Tracks the health status ▪ Forecasts clinical outcomes ▪ Offers telemedicine and virtual care capacities	▪ Artificial predictive intelligence ▪ machine learning ▪ virtual health care or telemedicine applications [43]	▪ Aid in clinical decision making, diagnosis, and risk prediction ▪ promotes effective delivery of services ▪ encourages patient-centered, remote care ▪ Enhances infection control [44]	▪ Might violate privacy ▪ Fails to diagnose patients accurately ▪ Requires high costs ▪ Equipment may not work properly
TRACK			
Tracks real-time sick activity	▪ Data dashboards ▪ Maps for migration	▪ Allows visual representation of the	▪ Can infringe privacy ▪ Includes high costs

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	▪ Machine learning ▪ Mobile real-time data and wearable technology [45-46]	spread ▪ Guides border constraints ▪ Directs the allocation of resources ▪ Advises forecasts [47]	▪ Needs supervision and regulation
TECHNOLOGY			
Overall approaches that are used by the public to fight disease.	▪ Artificial Intelligence ▪ Machine Learning ▪ Sensor based - IoT applications [42,48].	▪ Enables the public to remain safe and prevent disease spread ▪ Preserves mental balance	▪ High cost and maintenance ▪ Facilities may not operate properly [49]

9. TRIPLE-R APPROACH ADOPTED BY GOVERNMENT TO COMBAT WITH COIVID-19 :

During this pandemic era, the government faced the most difficult lifespan. The data analytics and insights are used by government sectors to adopt a triple-R approach to take effective policy decisions and operational activities to provide people with the best possible results during this pandemic emergency. That is, how people respond (acquire a better knowledge of the situation), recover (support the needy), and reimagine (transform the data into digital form) [50].

- **Respond** (acquire a better knowledge of the situation): The implementation of data analytics enables the government and its representatives to consider things in the past, present, and future to respond to the crisis. Analytics provide the data by analyzing the current situation data with visualization to improve situational awareness. This helps to forecast the future. It involves optimizing limited medical resources and supplying the right people with the right materials at the right time. Even advanced analytics are used to empower monitoring and tracing, spread rate, risk rate, and variables, finding missing links in the community.
- **Recover** (support the needy): Analytics will help public sector organizations and their work as people start to recover and step beyond urgent circumstances. Data analytics are used to determine the assistance needed by the agencies and also determine fraud operations. Government agencies may also take evident decisions based on projects implemented with minimal funds in this recovery process. By applying analytics, this is feasible and would have the greatest effect on the next specific periods.
- **Reimagine** (transform the data into digital form): In the emergency pandemic era, the use of analytics can assist government agencies to implement digital transformation. The reimagination or transformation would unlock the ability of enormous data to prevent the effects of the global virus. Innovative decisions are made by leaders based on knowledge provided by analytics. This will encourage successful measures in the use of money and public trust. To improve efficiency and efficacy, artificial intelligence and machine learning are used with data to enhance predictive decision-making by agencies and sister agencies [50].

10. NPI APPROACH:

Apart from taking medicines and getting vaccinated, people can prevent the spread of the pandemic by following the nonpharmaceutical intervention (NPI) strategy [51]. It is a set of guidelines to be followed to flatten the curve and avoid community spread. There are certain etiquettes to be followed by an individual at residence, at the workplace, at a gathering. Children are to be educated to follow NPIs when in school. Also, there are personal, community, and workplace guidelines. These are the policies made by individuals and the government to avoid community spread (Table 3).

Personal NPIs are to be followed by people when they are sick. These are the preventive measures that are to be observed by individuals every day. Actions taken by an individual for the prevention of the spread of disease among the close contacts makes a lot of difference during the outbreak of the pandemic. Staying at home when he/she is sick, avoiding close contact with the members of the family, following respiratory

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etiquettes even when at home, maintaining personal hygiene can prevent the spreading of the disease among the primary contacts.

Workplace NPIs are the policies of responsible organizations to avoid the infection among the workforce. The policies include creating awareness, providing training sessions, updating sick-leave policies, medical allowances, taking preventive measures to disinfect the areas, implementing work-from-home policy, online training sessions, flexible workplace settings, conducting virtual meetings, etc. Employees are to be restricted from sharing personal items. Community NPIs are the policies of organizations and the government to avoid face-to-face interactions. They include temporary suspension of schools, canceling of public events, maintaining physical distance, the compulsion of masks, imposing travel restrictions, organizing virtual meetings, promoting online education, implementing lockdown, and seal-down if necessary. Environmental NPIs include the disinfection of places and objects, creating awareness among the public, and arranging services during emergencies.

Table 3: Types of NPI with reasons and policies [51]

Type of NPI	Policies	Reason
Personal	• Quarantine • Isolation • Frequent Sanitization	• Avoid spreading among the primary contacts
Workplace	• Remote work • Virtual Conferences/Webinars • Sanitization of areas of contact • Physical distancing • Restrict Sharing of personal items • Flexible work policies • Revise sick-leave and medical allowance policies	• Avoid spreading among the employees • Provide extra care to the employees
Community	• Virtual meetings • Cancellation of public events • Disinfecting public places • Temporary closure of schools • Travel restrictions	• Avoid direct interaction • Avoid community spread • Avoid spreading the disease among vulnerable • Avoid community spread

10. DISCUSSION AND RECOMMENDATION:

The optimal utilization of adaptive technologies of the time can contain COVID-19 and related pandemic diseases. Hundreds of developments and improvements that occurred during the COVID-19 outbreak to fight the pandemic are direct testimony to this. Using technology encourages human activity, results faster, improves protection, reduces infection rate, and enhances efficacy. An integrated approach involving various process issues related to combating pandemic situations — including virus transmission, secure and effective disease treatment, and ongoing business order can help the administration handle and control COVID-19 like pandemics [52]. The entire solution can be divided into three processes – combating the spread of the virus, managing and tracking diseased, and streamlining business order. Under each process, Figure-3 highlights various elements involved.
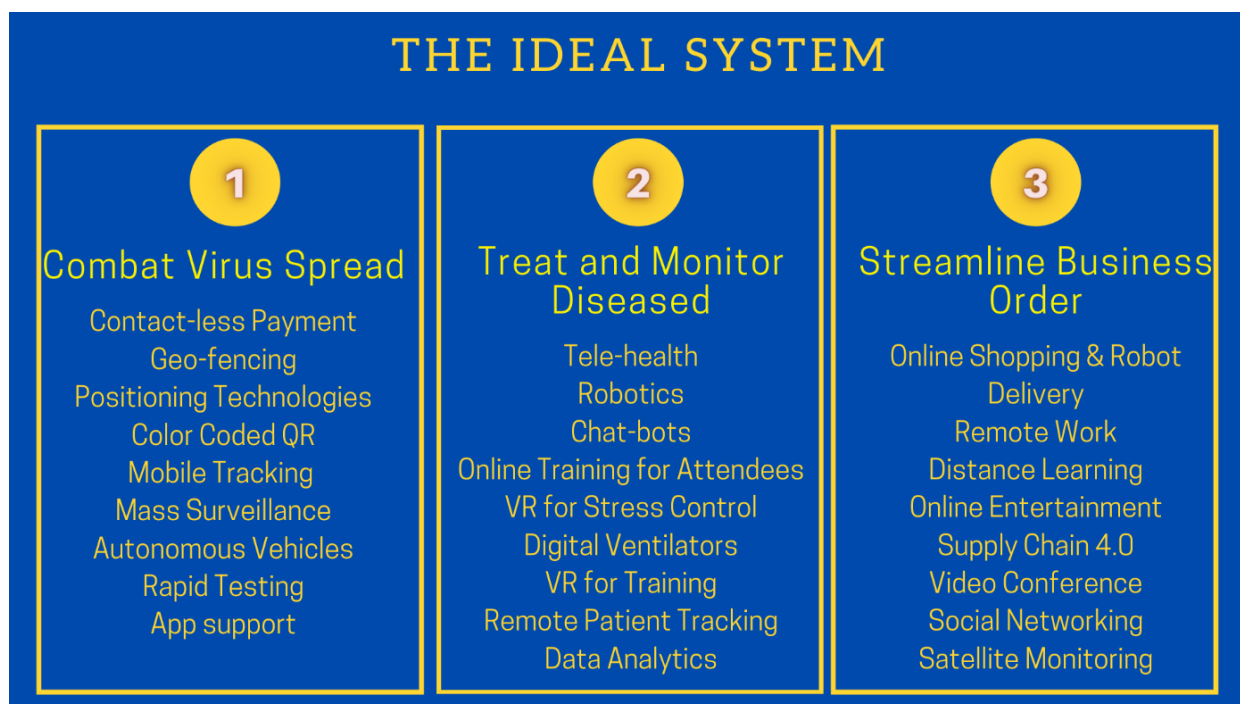
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THE IDEAL SYSTEM

1

Combat Virus Spread

Contact-less Payment
Geo-fencing
Positioning Technologies
Color Coded QR
Mobile Tracking
Mass Surveillance
Autonomous Vehicles
Rapid Testing
App support

2

Treat and Monitor Diseased

Tele-health
Robotics
Chat-bots
Online Training for Attendees
VR for Stress Control
Digital Ventilators
VR for Training
Remote Patient Tracking
Data Analytics

3

Streamline Business Order

Online Shopping & Robot Delivery
Remote Work
Distance Learning
Online Entertainment
Supply Chain 4.0
Video Conference
Social Networking
Satellite Monitoring

Fig. 3: An Integrated System with Processes

▪ **Combat Virus Spread:** The most common way COVID-19 disease spreads are by being in close contact with someone who has the infection. Near touch is approximately 6 meters. When a person's symptoms are at their highest, the illness is most infectious. It is also possible for anyone to transmit the virus without symptoms. Droplets that contain the virus can often land on surfaces or objects close by. By touching certain surfaces or objects, other people will pick up the virus. So, the best way to stop the spread of COVID-19 spreading from human to human is to minimize contacts and increase social distances. The system includes contactless payment, geo-fencing, positioning systems, color-coded QR codes, mobile monitoring & mass surveillance, and autonomous vehicles to maintain social distance and prevent direct contacts [53].

▪ **Treat and Monitor Diseased:**
 Continuous monitoring of COVID-19 patients with clinical-grade sensors and obtaining data on various physiological signals can improve clinical decision-making by health care providers. Digital technologies such as telehealth, remote patient monitoring, data analytics, and even consumer-facing AI-based chatbots can play a key role in managing the COVID-19 outbreak and helping people who think they have been exposed to the novel coronavirus. There are a few elements that fall under this phase-telehealth, robots, chatbots, online attendance training, stress control virtual reality, automated ventilators, and educating using virtual reality [54].

▪ **Streamline Business Order:** Because of the pandemic epidemic, daily business operations must not be disrupted, so the economy and supply chain must be kept intact. One cannot contain virus spread or reduce its risks by simply closing off the business. By following the protocols, the business has to continue as normal [55]. To do this, the framework proposes online shopping & robot distribution, remote work or work from home, distance learning, online entertainment, digital supply chain, video conferencing, social networking, and satellite monitoring.

11. CONCLUSION:

The downpour of change would be to reduce, even with difficulty, reliance on portability for business progression. Not because, as of now, the world hadn't been progressing and developing out there, the perspective would in any case change at the moment. A change from cost-saving, sustainability, practice, and so forth to coherence would take place. The congruity possibility is amazing and will increase the pace of growth. To get started, think of a similar industrial facility that can be run remotely via a cloud-based comfort

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that takes care of sensors and similar machines. An administrator sitting in the help logs-in home gives the machines and robots important directions for development. Items could be manufactured and shipped continuously. Consequently, an online request can be prepared with the aid of the RFID and sensor-based transport line, which will direct the items to the stacking dock where independent tracks can be placed and mechanical robots will stack the items. The item could then be dispatched to customers by automated GPS-using automatons. In transit, the cost extension based on RFID can auto deduct the cost fee, and the related trucks can also achieve cross-docking to increase conveyance. In this situation, we perceive how a broad group of new inclination developments, such as IoT, RPA, AI / ML, Robotics, Cloud, Edge Computing, Drones, and self-sufficient vehicles, will disrupt the way we operate today and probably dis-middle human physical closeness, whenever the right push is issued. These technological intercessions will be in the crosshair of the Industries this year, and sooner rather than later, as never before. While at the rush of a magic wand, the above-mentioned condition may not become reality, the front-line developments may eventually arrive at a level where the human dependency on flexibility might not be quite as simple. In the post-COVID world, innovation work in the fight against COVID-19 will be crucial.

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