COVID-19 and An IoT Based Protection System for Working Environment

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Abstract

As the spread of COVID-19 has widely affected the large area of the world population, this led many countries to impose complete lock-down all across the globe which is still going on and on. In such situation all the business, education, industries and organizational activities were completely stopped. In this scenario, the organizations give a policy to employees to the concept of "working from home (WFH)". However, this policy does not work for every organization. Therefore, after starting physical presence of workers and employees in organization there should be proper safety measures for identifying the symptoms and causes of the deadly virus among workers. In order to do so, in this research paper, an internet of things (IoT) based solution to protect the working environment from further spread of the disease is proposed. Suspects of COVID-19 the virus are identified through various parameters using IoT framework. The general idea is to maintain a safe and sound working environment to prevent and control the further spread of the virus. It would be more useful not only preventing and controlling the spread of COVID-19 virus but also maintaining the Standard operating procedures (SoPs) in the organizations.

Key words:
Internet of Things; COVID-19; Work from Home; Temperature detector; social distance detector

1. Introduction

COVID-19 has become a huge worry for the globe. The impact of Covid-19 on social and economic will be for reaching and devastating. In this scenario every country of the world is getting impact by the pandemic and all the avenues of life served a drastic change due to the crucial condition. When the Covid-19 outbreak started and spreading across the world, thousands of people started facing severe health issues and death rate increased. The only way to stop the spread of pandemic was stop all social and economic activities in the affected countries for indefinite period of time [1, 2].

This led many countries to impose complete lock-down all across the globe which is still going on and on. In such situation all the business, education, industries and organizational activities were completely stopped. The lockdown impacted various sectors in varied degree i.e., the hotel, travel, manufacturing industries and education and etc. this situation cause enormous disruption for worker. To overcome such situation of complete shutdown, different areas are trying to run offices and administration job through 'work from home" mode. Different organizations and companies are trying to cope the risk of economic and national turbulence caused due to COVID-19 through usage of information technology. However, it is not possible for other sectors to adopt this policy and work from home mode is helping some sectors in limited way [3].

1.1 Cases of COVID-19 in Pakistan

Our country Pakistan is the fifth most populated country all over the world. We have around 212 million people. Till 1st June 2020, we have around 72,460 cases which were reported rest were out of the consideration. The virus was first observed in a student who returned from Wuhan in China. It spread in all provinces by18th of March 2020. According to study the spread of virus is not parallel with the population but it is parallel to the norms, rules, regulations, government initiatives and effective steps taken to limit the spread [4]. We were facing the serious issue of the availability of the beds and hospitals throughout the country. Isolation wards and Quarantine facilities were filled completely with no space left for the new cases. The situation goes worst at the end of 2020 [5].

The statistics shown in Figure 1 will define the complete data till today extracted from reliable resources.

Figure-1: Comparison of 15 months statistics provided by the Government of Pakistan in April 2020 and July 2021 [6].

The current statistics are now decreasing due to affective initiatives by the concerned medical authorities of the country. Also, the good steps are preventing exponential rise in the new cases.

1.2 Working environment during COVID-19

In current situation of COVID-19 pandemic, in arrangement to keep the operation of the offices going on, various sectors are imposing the new policy for their employee to work from home mode. Though every policy has its advantages and disadvantages; similarly in this case the positive side is to helping in maintaining office work from home and proved themselves productive for organization. On the other hand this situation impacts the organizations negatively via economic loss. However, it is not all about to balancing life, but confronting all the challenges emphatically to perform and bring forward productively as the situation demands. The domestic based work mode not only saves the money of company through lower overhead but also diminished drain on energy resources. For this purpose, organizations will guarantee that workers of that company are well prepared and equipped to deal with remote working mode of operation. Some firms already do this by offering them an allowance to set up a home office where they can work uninterrupted. This allowance can cover a variety of needs [7].

The one of the biggest challenges faced by companies beside other challenges is the collaboration in the situation when company allow workers to work from home. The main idea of collaboration goes much beyond just ensuring that when they supposed to meet, individuals log in for gatherings, meetings and calls. There is a need to provide a great collaborative system by companies, comprising of assembly instruments, chat apps and information sharing software and meeting tools. Empowering video calls and advancing casual interactions can go a long way in decreasing the sense of isolation that worker report when they work from home mode operation [8].

1.3 Role of IoT in pandemic situation

The consistent association of incredible integration with advances has empowered the IoT to be one of the promising method that will alter our lives [9]. The applications of IoT in combating this worldwide widespread in several sectors which can play a major role in diminishing the hazard of corona virus outbreak [10]. Figure 2 shows potential applications in which IoT advances can be valuable and successful into combating the COVID-19. IoT has gotten to be a necessarily portion in today's advance era of communication where millions of gadgets are associated through IOT and the number is developing quickly. IoT has the potential to play a imperative part in different areas of the life, such as health systems [11], autonomous vehicles [12], home and industrial automation [13], intelligent transportation [14], smart grids [15] and so on. A diagram of IoT is given in Figure 2 in which IoT is implemented in health sector, homes, power sector and various infrastructures. The various kind of sensors are deployed to gather the data of related application from the surrounding of environment or body and used a cloud as a medium of delivery to source body or an organization [16, 17].
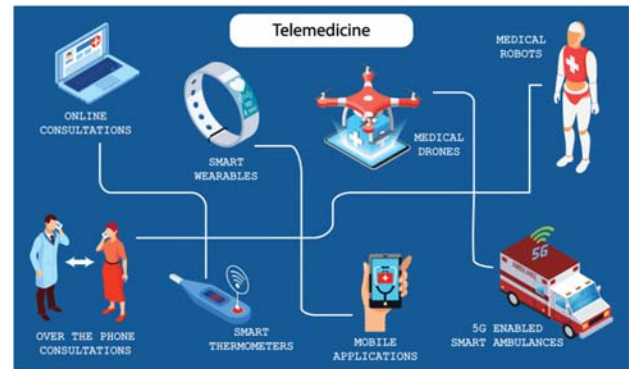

Figure-2: Applications of IoT technologies for COVID-19 Pandemic [17].

2. Background

Now a days, COVID-19 is not only a worldwide a biggest health crisis but also a big threat for international economic. Across the world, to avoid the spread of COVID-19 that were mandatory to stop business and industries which bring the chain of variety of unique challenges for both employees and employers [18]. At the individual level, populations of shutdown-affected employees were turned overnight into (a) "work from home"(WFH) employees, (b) "essential" or "life-sustaining" workers (e.g., emergency room medical personnel and supermarket staff), or (c) furloughed or laid-off employees seeking the nation-specific equivalent of unemployment benefits. Given the uncertainty and breadth of the COVID-19 shock, work and organizational psychologists urgently need to apply the field's current knowledge for the purpose of sense making to help individuals and organizations manage risks while simultaneously developing and applying solutions. The series of guidelines has been provided by WHO for both, health and non-health workers [19]. There are six themes that were suggested to make sure the workplace safety in COVID-19 situation which includes: on demand cleaning, frequently handwashing, hygiene maintenance, national and international travel consultancy and last but not least promoting the message and communicating the individual to stay at home even they just feel mild flu or like symptoms of low-grade fever. The meetings and event arrangements should be followed the proper SoPs.

Simultaneously, the European Agency for Safety and Health at Work has announced the updated workplace guidance for preventing the spread of COVID-19 according to the WHO and the International Labour Organization, as well as the Canadian Centre for Occupational Health and Safety, practical information is available. The information on corona virus, cleaning infrastructure, face masks, management of confirmed COVID-19 cases, travelling and meetings, and certifying absence is also included in this workplace guidance [20].

Different Researchers have proposed multiple ideas and applications for limiting the spread of the disease. Therefore, these solutions-based devices have a larger impact in healthcare as well. Also, the IoT based devices plays a great role in restraining the spread of the deadly virus all over the world.

A set of different symptoms namely fever, cough, Electrocardiogram, Oxygen Saturation, Speech detection etc. linked to the virus is analyzed using edge computing devices. The term of Internet Medical of Things (IoMT) was coined by Md. Abdur Rahman for their solution [21]. The node devices use state of the art edge Graphical Processing Units (GPUs)for alert generation based on the collected data.

A humanoid robot is developed based on Artificial Intelligence for medical applications which can diagnose a COVID-19 suspect using a set of sensors and machine learning algorithms on the collected data. For the safety of doctors and assisting nurses the list of sensors including Contact Temperature Sensor (CTS), Air flow Breathing Sensor (ABS), Galvanic Skin Response Sensor (GRS) with the facility of monitoring chest X-rays and Blood Testing through samples. The Medical Diagnosis Humanoid (MTH) is free of human interference until the bug arrives. They suggest that moving from database to cloud in the future will help in improving neural network and ML algorithms [22].

3. Proposed IoT based Framework for COVID-19 suspect detection

As in current scenario, corona virus continues its onslaught across the world and most of the organizations adopted the policy of "Work from Home" WFH. However, this policy is not applicable in few companies or organizations because they need to run their business from field or through customer physical contact basis. In the same way, some of the organizations can get very limited benefit via adopting this mode. In order to overcome the loss of economics and run proper business, gradually organizations started to change the working policy and turn on office work mode. As a gradual change already occurs in the different area via adopting IoT based various applications. In this paper, we have adopted the IoT in the workplace to identify the

suspected case prior to enter in workplace to secure the working environment. The block diagram is given in Figure 3.
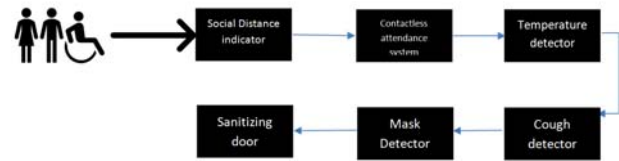

Figure-3: Block diagram of proposed Framework

In our research we have developed a framework to protect the working environment from the risk of corona virus from the suspected employees. We have utilized the various IoT techniques to identify the suspect and maintain the basic SoPs in the organization. The proposed framework is shown in the Figure 4 below.
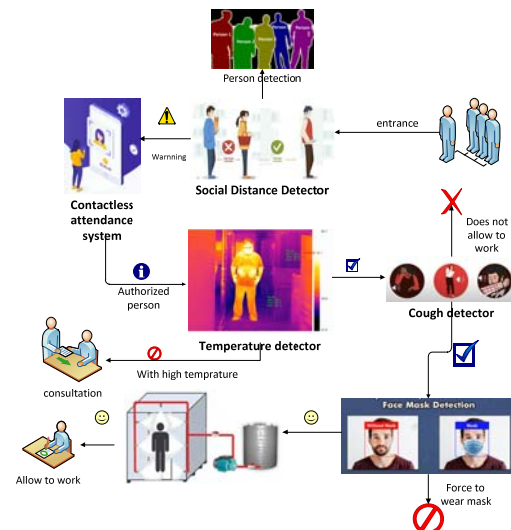

Figure-4: Proposed IoT based framework to detect COVID-19 Suspect at workplace.

It is shown in the Figure 5 the workflow of the IoT based framework for COVID-19 suspect. Initially the employees are scan through surveillance or fixed mounted camera for detecting the safe social distance among them. If the employees follow the rules and maintained the proper distance then they are allowed to go further otherwise before going forward employees have to maintain the safe distance. In the next step, contactless attendance system is implemented in to the framework for avoiding physical touch of employees. After getting authentication, thermal or infrared camera is equipped for temperature monitoring system. The temperature of any employee indicates the possible chance of suspect with corona virus. If the reading of temperature appears high for any person, then system will generate the alarm and send the information to authorities. And the employee will send to the doctor or
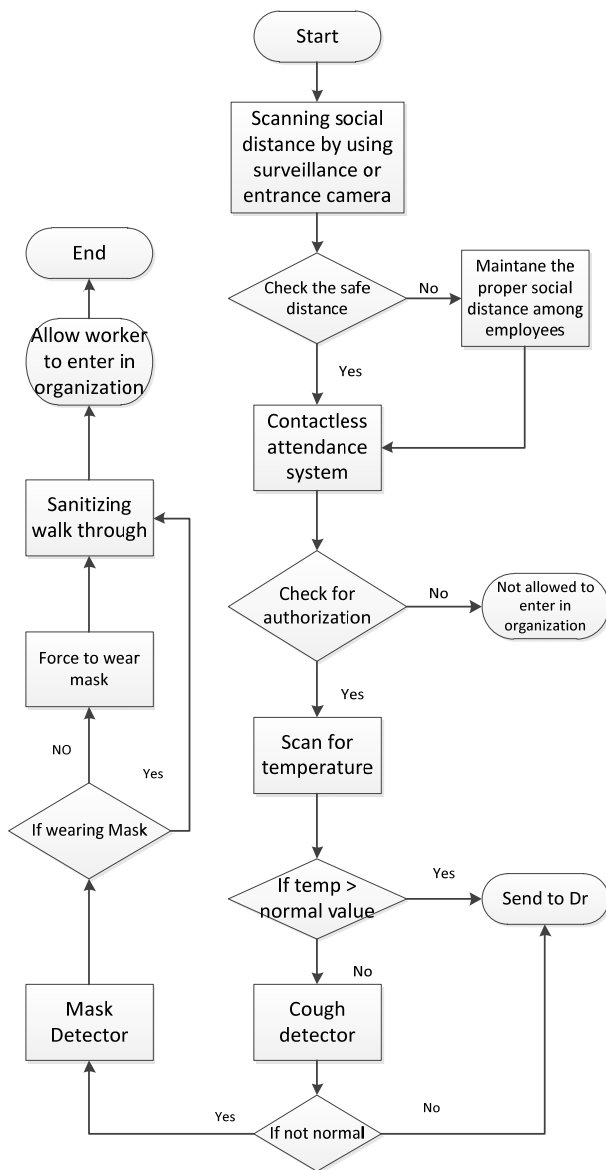
dispensary for further checkup.

Figure-5: Workflow of proposed IoT based model.

4. Results and Discussion

To ensure the working experience under the current COVID-19 situation in any organization via applying our proposed IoT framework for corona virus suspect were conducted through survey in Nawabshah city. The questionnaire was given to employees and workers of different organizations to understand IoT based framework and respond to words implementation. A survey was conducted from the employees and employers of different organizations. Online and paper-based questionnaire was designed English. To validate the proposed model, the questionnaire was distributed to measure the five constructs i.e., Perceived ease-of-use (PEOU), Perceived usefulness (PU), Subjective norm (SN) and Perceived Behavioral Control (PBC). A structured questionnaire captured employees of organizations and institute's perceptions of IoT based framework in terms of usefulness, ease of use and overall employees' confidence in using new IoT technology in organization under COVID situation. The descriptive demographic of sampling data is shown in Table 1. The result of technology acceptance model constructs in our study shown in Figure 6.

Table 1: Demographic characteristics of the participants in this study (n = 198).

Demographic characteristics		Number of participants
Gender	Male	113
	Female	85
Age group	18-27 years old	50
	28-37 years old	78
	38-47 years old	50
	Above 47 years	20
Educational level	Secondary and below	8
	Diploma	20
	Bachelor	40
	Master and PhD	130
Organization	Bank	75
	University	123
Geographical regions	Nawabshah city	--

We looked into user behaviour when it came to using IoT technologies in the workplace. An empirical questionnaire survey method was used to collect data by personal delivery and e-mail to evaluate the research goals. The data from the questionnaires was analysed using quantitative statistics. The survey instrument contains two sections. Personal and demographic data are presented in the first section. Second Section of the survey questionnaire developed based on the relevant studies. The variables for the current study are;

perceived usefulness (6 items); perceived ease of use (6 items); behaviour Intention (3 items); and usage behavior (2 items). The items for the constructs of TAM were adapted from past studies [23, 24, 25]. This section obtains the questions related without using IoT model and the behavior towards adopting proper SOPs of organization. And the remaining section based on the willingness to use IoT technologies in the future. The questionnaires measured how much percentage can be cover after adoption of IoT model in organization by using the respondents asked to select their opinions on the items. In this study, the sample target was employees, employer and lower staff who work in different organization. About 200questioners distributed among respondents. The questionnaires given along with the introduction to make sure that respondent's responses are confidential and will use for research purpose only.
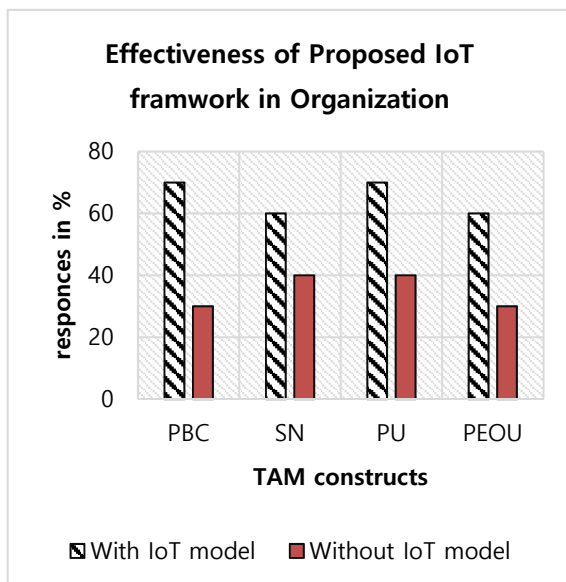

Figure-6: Bar chart of TAM constructs on the effectiveness of proposed IoT framework.

The percentage for all the variables is shown in Figure 6. This indicates that the majority of respondents agreed with all of the questions in general. Perceived usefulness, subjective norm, PBC, and perceived ease of use all contribute more than 70% to behaviour intention to use IoT technology, according to this study.

The results of proposed IoT based framework solution for working environment confirm the robustness of the proposed model, explaining technology acceptance behavior for users in the context of IoT technologies in Table 2.

Table 2. Proposed IoT based solution for COVID-19 Prevention and control in Working Environment.

Covid-19 solution for working environment	Proposed frame work of IoT based applications	Responses in %
Less physical contact	Touchless attendance system	92
Virus Symptoms diagnoses	Body temperature detection and cough monitoring system	95
Contact tracing	Social distancing monitor	85
Avoid spreading covid 19	Mask detection and sanitizing walk through	92

From the analysis of TAM model dimensions the study finding that a consumer's perceptions of usefulness, perceived ease of use, and subject behaviors and predictive of user's intention to use IoT technology are prominently increases. Also, found the impact on the organization to use of IoT model to prevent the employees from COVID-19 and controlling the spread of virus under working environment. Hence it is extremely productive and fruitful for the organization to compete with the challenges linked to the spread of deadly virus. Maintenance of safe environment and surroundings will ultimately help each and every individual working at the organization.

5. Conclusion and Future Work

Due to various losses such as economic and social, gradually organizations of the world now back to "work form office" mode policy. In order to prevent the employees from COVID-19 and controlling the spread of COVID-19 in working environment in this paper, an IoT based framework solution for COVID-19 suspect detection in working environment were proposed. This includes COVID-19 symptom Diagnosis, Contactless attendance system, social distance and mask detection and disinfecting the environment. According to the results collected through questionnaire, the TAM model constructs show the user's intention towards the usage of proposed model is highly appreciated. From the achieved responses we can conclude that via implementing our proposed model will not only identify the COVID -19 suspect in organization before entering in organization but also it is useful to forcefully implement the SoPs in organization. Moreover, the proposed framework also controls the spreading of COVID-19 through proper measures taking at the time of detection.

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