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Touchless services, A new way of interaction with public devices during covid-19

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Abstract*— The COVID-19 pandemic has brought significant changes to our way of life, with a particular emphasis on prioritizing individual safety. As a result, the usage of automated systems requiring direct human interaction, such as ATMs, elevators, and public information screens, has significantly decreased due to people's fear of infection. This research aims to address this issue by proposing a safe and clever solution using touch-free technology, which combines motion detection devices, AI software, and machine learning algorithms. This technology allows users to navigate systems and perform tasks without physically touching the screens, thereby providing a safe environment for accessing information and services in public places like airports and malls during the pandemic. The research focuses on applying touchless technology to public information services, without directly modifying the existing systems. By implementing touchless features in systems such as food menus, customer service screens, and information screens, people will feel more comfortable using public services again. The study also includes a literature review on touch-free technology, an analysis of related work, and the presentation of experimental results that demonstrate user acceptance and preferences for touchless technology. Overall, touch-free technology offers advantages such as improved safety, quick processing, and ease of use, while potential challenges include the need for larger screens and proximity to the device.

***Index Terms*— COVID-19 pandemic, Touch-less technology, Motion detection devices, User acceptance**

I. INTRODUCTION

The way of life has significantly changed as an impact of COVID-19 pandemic. And no one knows when things will again run smoothly as before. This situation puts a huge pressure on governments and communities to give the highest priority for individuals' safety. They are working hard to provide safe solutions that could affect the economy positively. One of these solutions is to benefit from using technology. However, this context will work on technology in a different way that will be illustrated in the next lines. COVID-19 pandemic has made life complicated. Many automated systems that need a direct interaction from humans such as ATMs, elevators and public information screens have been affected significantly by the pandemic and the reason behind this is that people are afraid of getting the infection (Pearson et al., 2022). These systems are used by a large segment of people from different backgrounds and cultures which makes it difficult to be controlled in terms of health and safety during the pandemic(Iqbal & Campbell, 2021). Therefore, the usage of such systems has clearly decreased, and this research is trying to find a solution in making these systems as safe as possible and therefore increasing the usage again. Research aims to provide a safe and clever solution in using public electronic services by using Touch-free technology. Touch-free technology is a combination of motion detector devices, AI software and machine learning algorithms. It detects users' hands movements in mid-air and makes the suitable response on the screen. So, users can navigate systems and do their tasks without having a physical touch on screens. This solution would provide a safe environment for those who seek for information and services specially in airports and malls during the pandemic. The research is attempting to add a new technical touch to these systems without directly modifying the components of the systems. With few configurations the touch-less feature can be applied in any ready system such as food menus, customer services screens, information screens in shopping malls and airports. Eventually, people will no longer be hesitant to use public services again. In the current stage the research will focus on applying this technology for the public information services (Abe, Eguchi, Oyama, Fujio, & Kikunaga, 2023).

II. LITERATURE REVIEW AND ANALYSIS OF RELATED WORK

I. Touch-free technology

(Tao.H, Di.Y,2020) has defined the Touch-free service as "it is any service provided in a manner that spatiotemporal distance between service provider and customer is larger than zero". This means that users may interact with the device without needing to physically touch the device. The technology uses the movements of fingers in all directions. So, users can either move their fingers to navigate the system in a med-air or wave in some directions to do the desired task without actually touching the device.

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II. Usage

Touchless or touch-free technology converts hand gestures into computer commands. (ATHIRA M, 2020) in his paper has explained how the technology works. He illustrated that "The machine can track 3-dimensional gestures without ever having to put your fingertips on the screen." Touchless technology is applied using controllers such as leap motion, Kinect device, etc. that receives user hand movement and then converts them into an action on the screen. The technology can be applied on any screen with few configurations.

III. Types of touchless technologies.

1. Gesture recognition

Gesture recognition is one of the common types of touchless technology. Where users can interact with devices or systems using their gestures either hand waving or fingers pointing without touching the device itself (Carter et al., 2016).

2. Touchless sensing

Touchless sensing detects users' movements by a sensor. Automatic doors are a really good example of a touchless sensing system .

2. Voice recognition

Voice recognition gives users the option to interact with devices by speaking to them. There are some example voice recognition systems that we use in our daily bases such as Alexa for amazon, Google assistant and Siri for Apple.

4. Facial recognition

Facial recognition focuses on detecting the user's face. A best example is the new un-lock feature on some smart phones (Wibirama, Murnani, Sukowati, & Ferdiana, 2021).

IV. Used technology and devices:

Applying touchless technology requires devices that detect both human body movement and voice commands, and an artificial intelligence software. Here are some of the best used tools and devices along with AI software that supports touchless systems:

1. **Microsoft Kinect:** is a motion detector sensor that has an amazing capability of capturing huge amounts of data with immediate processing through machine learning methods and AI algorithms, thus it is the best option for gaming consoles such as Xbox.

2. **Leap Motion:** is a small, fast and accurate sensor device with infrared LEDs that recognizes hand gestures. It supports a reliable and robust skeletal model, and it is easy to use by the public.

3. Tobii Rex: is a device that tracks eye motion and uses an embedded software linked with a computer. Technically, it uses the user's eyes as a pointing device where they can select options, read texts, and scroll easily.

III. Advantages and Disadvantages:

There are many reasonable advantages of touchless systems that would definitely change the way of our living, starting with that it ensures user's safety since there is no direct physical contact with the device and that is what matters with the increase of viruses and diseases around the world (Emmanuel, Reber, & Blankenbach, 2021). Usually, such systems have quick processing units and come with a friendly and simple user interface with a limited number of needed buttons that makes it easy to use by the public, hence it can be considered as one of the best solutions to provide self-services in the public places.

Despite the advantages, there are some disadvantages too. Using this technology usually requires big screens and must be placed away from the sun to avoid reflections and disturbed vision. Moreover, users must stay near and close to the screen to be able to capture their motion.

IV. Details of Experiment

a. **Materials and Procedures**

To make the experiment successfully work some materials were provided such as , Smart tv, laptop and motion detecting device(leap motion). picture 1 below shows the configuration part of the experiment:

Respondents were given a short explanation on how the

touch-less technology works. Then, participants were given a chance to try the technology by themselves. Finally, they have been asked to participate in a survey. The survey consisted of three parts. Pre-experiment questions , during experiment question and post-experiment questions outcomes were analyzed and discussed. This design was mainly applied to measure the effectiveness of touch-less technology and user satisfaction .

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V. RESULTS AND DISCUSSION

The upcoming sections are demonstrating the discussion of the experiment survey results.

IX.1. Question 1

Data for question one was descriptive through statistics as described in Table1. The respondents' age ranged between 18 and 64. The highest percentage was for ages between 18-24 which is 76.92% and 10.77% for the range 35-44.

Answer Choices	Responses	
18-24	76.92%	50
25-34	9.23%	6
35-44	10.77%	7
45-54	3.08%	2
55-64	0.00%	

IX.2. Question 2

Question 2 described the gender of respondents as mentioned below in figure 2. Almost the number of female participants is equal to male participants.

IX.3. Question 3

Question3 mainly focused on the professional background of the respondents and as shown in figure () the majority of respondents was from students with almost 80% of the total number of respondents. Then Academic with 14.06%. And administrative employees came with the least percentage 7.81%.

IX.4. Question 4

One of the objectives of the survey was to measure respondents' acceptance to use touchless technology despite their culture and background diversity. Table 3 below illustrated the diversity of respondents.

Answer Choices	Responses
White	3.13%
Black or African American	3.13%
Asian or Asian American	7.81%
American Indian or Alaska Native	0.00%
Native Hawaiian or another Pacific Islander	0.00%
Arab	85.94%

IX.5. Question 5

Question 5 illustrated that touch screens are widely used by almost all respondents. 70.77% chosen very likely, 26.15% chosen likely, 1.54% Neither likely nor unlikely and 1.54% unlikely. This shows that touch screens are widely utilized.

IX.6. Question 6

The survey revealed that most respondents use mobile phones (75.38%), laptops/PCs (76.92%), and tablets (35.38%). A smaller percentage mentioned TV smart screens (29.23%), X-Box (15.38%), and smartwatches (26.15%). Only a few participants reported using VR devices (3.08%) and self-payment machines (12.31%). These findings provide insights into device preferences and can inform the assessment of touchless technology like Leap Motion.

IX.7. Question 7

The participants provided their input on the extent to which they use the mentioned devices or machines, considering their willingness to adopt touchless technology. The analysis revealed that a majority of 64.62% responded with a high likelihood, expressing their strong inclination to use these devices. Additionally, 27.69% indicated a moderate likelihood, stating their willingness to adopt. A small percentage of 4.62% remained neutral, neither leaning towards nor against usage. On the contrary, only 1.54% responded with a low likelihood or strong aversion to using such technology.

IX.8. Question 8

The survey investigated the impact of touch devices on timesaving, and the results were promising. The majority of participants (53.85%) showed a strong belief in the time-saving benefits of touch devices. Additionally, 40.00% expressed a moderate likelihood, indicating a positive perception of touch devices' efficiency in saving time. A small proportion (4.62%) remained neutral, neither favoring nor opposing the idea. Only a few respondents (1.54%) expressed skepticism about the time-saving potential of touch devices. Notably, none of the participants considered touch devices as highly unlikely to save time. These findings underscore the overall positive perspective on the role of touchless technology in optimizing time.

IX.9. Question 9

One of the objectives of the survey was to assess individuals' willingness to adopt touchless technology in their daily routines. The question explored the impact of

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touch devices on productivity. Valuable insights were gained from the responses, with a majority (50.77%) expressing a strong belief in the significant positive effect of touch devices on productivity. Additionally, a considerable percentage (40.00%) held a moderate belief, indicating the potential for touch devices to enhance work efficiency. Interestingly, none of the respondents expressed skepticism or strong skepticism about the ability of touch devices to increase productivity. These results support the notion that touchless technology can increase efficiency in routine operations.

IX.10. Question 10

This question focused on evaluating the ease of the experiment. The responses provided valuable insights from participants with different backgrounds and ages. A majority of respondents (47.69%) expressed that the experiment was very easy, indicating a high level of user-friendliness. Additionally, 36.92% reported it as easy, further supporting its accessibility. A small percentage (13.85%) remained neutral in their response, while only 1.54% found it not easy. Notably, none of the respondents considered it to be very difficult. These findings highlight the overall positive perception of the experiment's ease, suggesting that touchless technology is user-friendly for individuals with diverse backgrounds.

IX.11. Question 11

The aim of this question was to assess the impact of using touchless technology on the pace of decision-making. A significant percentage (35.38%) considered this technology extremely helpful, indicating its strong influence on accelerating decision-making processes. Additionally, 36.92% found it very helpful, further emphasizing its positive impact. A considerable portion (26.15%) perceived it as somewhat helpful, suggesting a moderate level of effectiveness. Only a negligible percentage (1.54%) reported it as not so helpful. Remarkably, none of the participants found the technology to be +at all helpful. These findings underscore the overall positive perception of touchless technology's contribution to faster decision-making.

IX.12. Question 12

Understanding user preferences for touch or touchless technologies is crucial for their adoption. In this survey, a significant percentage (27.69%) strongly preferred touchless technology over touch screens, while 43.08% had a moderate preference. Notably, 13.85% remained neutral, warranting further investigation. Only a small percentage (13.85%) showed an unlikely preference, and just 1.54% considered touchless technology as very unlikely. These findings highlight the positive attitude towards touchless technology as a preferred choice, indicating its potential for widespread adoption.

IX.13. Question 13

The survey participants were asked about their recommendation for using touchless technology like leap motion. The responses indicate a high level of desirability for this technology, with 57.81% considering it extremely desirable and 34.38% finding it very desirable. A smaller percentage, 6.25%, expressed somewhat desirability. Only a negligible percentage of respondents, 1.56%, found it not so desirable, and none considered it not at all desirable. These findings highlight the overall positive perception and recommendation of touchless technology, indicating its potential for widespread adoption in daily lives.

IX.14. Question 14

The participants were asked about their perception of the effort required for touchless technology to work effectively. The responses indicate that a majority (44.62%) agree that touchless technology requires some effort to function well. Additionally, 36.92% strongly agree with this statement, further emphasizing the belief in the need for effort. A smaller percentage (10.77%) remained neutral, neither agreeing or disagreeing, while only 6.15% disagreed with the notion of effort. Interestingly, a negligible percentage (1.54%) strongly disagreed. These findings highlight the general consensus that touchless technology does require some level of effort for optimal performance.

IX.15. Question 15

One of the survey's objectives was to measure the ease of using touchless technology. 73.85% of respondents confirmed the ease of using touchless technology while 26.15% disagreed. This gave us a sign that using touchless devices is generally easy to be used by individuals with different cultures and backgrounds.

IX.16. Question 16

The survey participants were asked about their willingness to shift to touch-less technology, regardless of the price. And surprisingly 84.62% were happy to shift to such technology and only 15.38% of them showed that shifting to touchless technology is undesirable.

IX.17. Question 17

One of the measures that the survey focused on was the confidence of participants while using the leap motion device. Table 5 below shows their response to this question:

Answer Choices	Responses
Extremely confident	29.69%
Very confident	43.75%
Somewhat confident	21.88%
Not so confident	1.56%
Not at all confident	3.13%

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Based on their responses we clearly can see how confident they were when using leap motion.

IX.18. Question 18

Question 18 measured how painful it is using the leap motion for a long time and 29.23% of respondents strongly agreed that it is painful to use the device for a long time while 33.85% agree , 24.62% Neither agree nor disagree , 9.23% disagree and 3.08% strongly disagree. This shows that leap motion can effectively be used to accomplish short tasks, and this achieves one of the research projects' aims which is using public screens with harmless and effortless tasks.

IX.19. Question 19

The survey also focused on measuring the effectiveness of touchless technology in translating user gestures into actions on screen. The responses show how accurate and valid leap motion was with 90.77%. However, only 9.23% of responses showed the opposite.

IX.20. Question 20

At the end respondents were asked whether they are interested in repeating the experiment in future and 70.77% showed their interest to live the experiment again. while none of the responses showed the opposite.

VI. CONCLUSION

This paper examines the impact of the COVID-19 pandemic on the usage of interactive systems and proposes the implementation of touch-free technology as a solution. Touchless technology, utilizing motion detectors, AI software, and machine learning algorithms, allows users to interact with public systems without physical contact. Various touchless technologies, including gesture recognition and facial recognition, are reviewed, along with supporting devices and software. The benefits of touchless systems include user safety, fast processing, and user-friendly interfaces. However, drawbacks such as screen size requirements and proximity limitations are noted. The survey results indicate a positive attitude towards touchless technology, with a willingness to adopt it and a preference for touchless over touch screens. The research concludes that touch-free technology has the potential to increase the usage of public electronic services while ensuring safety and efficiency.

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