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Mobile Augmented Reality Hand Wash (MARHw): Mobile Application to Guide Community to Ameliorate Handwashing Effectiveness to Oppose Covid-19 Disease

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Abstract: The global concern about a new pandemic associated with the insufficiency of vaccines has necessitated basic practices of handwashing to get prevention in Covid-19 disease in modern health issues. At this point, due to that, the researchers develop a simple mobile application engaging augmented reality to educate the urban and rural community on a notable effect of basic infection prevention practices peculiarly on hand wash guidance to prevent Covid-19infection. A quality of a hand wash could be attained by washing hands in conformity with health standard guidelines. In this study, we analyze a sample size of 83 participants (n=83), there were categorized by age, young adult (ages 15 to 35, n=28), middle-age (36 to 55, n=28) and older adults (older than 56 years, n=27) through three main formulated hypotheses namely as a step, movement, and duration and being analyzed by SPSS version 25by using Anova. The differences in demographics and gender are not being compared amongst the group. The final result underlying a statistical significance draws two significant factors for step and movement and there was no significant effect at the time factor of utilizing this mobile application. Hence, the final result could mitigate the Malaysian government sector peculiarly to the health department to alleviate the load of educating a community about a proper hand wash that would ease the process.

Keywords: Hand wash, augmented reality and education

1. Introduction

In the modern era in line with the industrial revolution 4.0, the advancement of creating technology and education as a medium of learning the incorporation of augmented reality has become more certain than ever before. However,

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the researchers still do not know the best way to encourage the handwashing to the community that could most benefit in effective presences is unknown [1], [2]. Due to that, the internalization of augmented reality should educate the community for embodied the learning of hand washes to promote the prevention against the covid-19 plague and other pathogens. Many factors might be contributed to the current peculiarities of Covid-19 spread around the world, one of the factors is the handwashing acculturation that adding to the outbreak magnitude [3]. Notwithstanding, the handwashing activities include cleaning hands with a bar of soap and water or with alcohol-based hand rub [4]. In addition to that, this approach motivates the community to the World Health Organization handwashing guidance to ensure hygiene before eating and after using the toilet. Though, a proper handwashing activity required 20 to 30 seconds and lying in of five major steps that are imperative to be exhibited to the community [5]. Consequently, most of the people proclaim that their hand washes meet the standard, but the studies discovered that the public hand washing necessitates to be amended [4], [6], [7], and [8]. Along with the research by Von et al. [9], hand hygiene activities should comprise the synergy of many variables and factors which cannot invariably be anticipated by one behavioral theory. The result ought to advance the hand hygiene level that might save millions of lives from the covid- 19 plague but pausing the handwashing behavior might have a challenging task in social environments. Therefore, the main objective of this research is to develop a mobile application to guide a community to have proper handwashing activities for a three-difference group namely as young, middle and older. Thus, the researchers propose a different skill set for every category of ages for efficiently experiencing an application namely as MAR hand wash.

1.1 Related Work

The mobile augmented reality is the emerging technology that enabling and strengthening the process of learning from all levels of learning from preschool until the university environment [10]. Thus, nowadays the smartphone is the most usual device segment for learning peculiarly on the Augmented Reality segment [11]. In this regard, we are focusing on educational courses that guide the community to learn the accurate handwashing process throughout all learning curve ranging from teenagers until the elderly. As a result, perceiving the motivation to handwashing behaviour is vital as they may diversify from an age perspective. Moreover, a case study by Langener [12], summarizes that the motivation described by handwashing activities to be accessible, the determinants motivation and trigger should be highlighted to successfully persuade by technology aids. Differently, the handwashing process is a fundament of hand hygiene abidance that also depend upon the environment like individual cognitive social factors [13]. In addition, Seimetz [14], supported that a physical cognitive social factor also relying upon the infrastructure of the community. In addition, if the infrastructure of seemed promising, the community will adopt and practices a healthy handwashing attitude [15]. As a result, this can be observed as a consequence of social factors that are depending upon a geographical area consideration either in the urban or rural areas. Thereafter, the scrutiny conducted by Tao et al. [16], proposes that the urban area is more exercising a thoroughly handwashing behavior rather than a rural area. Individually, this adverse underpinning the factors that the education inequalities between rural and urban can have a significant effect on handwashing exercise [17]. Differently, some of the studies disapprove this theory conveyed that the education level was not significant and correlated with better handwashing exercises [18]. In short, the rural area also influenced by the absence of handwashing facilities, for instance, a hand wash station that is considered a notable factor for practicing beneficial hand wash activities [19]. Thus, the newer study has purported the improvement over the wash station will increase the frequency of handwashing and also the amount of water that is applied for the hygiene purposes [20]. As a result, this factor will intensify the ratio of handwashing activity regularity at residences.

Subsequently, the study conducted by Contzen et al. [21], contemplated that the handwashing practice for a rural area necessitated to the education flourishing the public commitment intervention to raise social norms to vary their behavior. Clearly, this will furnish a probability to practice and refine handwashing skills and conceivably progressing an effectualness hand wash learning using the mobile augmented application. Nevertheless, another scrutiny by Al-Hussami et al. [22], presumes that the major contribution of handwashing research is based on the self-reported handwashing behavior that significant to the attitude and control belief. Furthermore, the attitude could be characterized as an automatic response to a stimulus in a given context and can make up to everyday live behavior [23]. Presently, the attitude could be practiced towards the mobile augmented reality application that has been designed as guidance for handwashing activities as an easy hygiene promotion which can address a range of collateral education rather than just straight inclusion about disease transmission [24],[29]. In sum, these activities have been tailored to the community level of practices and depict a step by step approach consisting of five major steps and magnify with multimedia elements such as sound and videos. Furthermore, in this study, the researchers have formulated three main hypotheses. The hypotheses as follows:

H1: There is a significant improvement on handwashing movement before and after using MAR hand wash application based on age group (young, middle and older).

H2: There is a significant improvement on handwashing duration time before and after using MAR hand wash application based on age group (young, middle and older).

H3: There is a significant improvement on handwashing step before and after using MAR hand wash application based on age group (young, middle and older).

2. Methodology

2.1 Intervention Process

This intervention hand wash program was initiated by researchers to be distributed to several residences based on community services. The residences are categorized by the age factors by a simple questionnaire also being distributed to attain some input from the participants through online survey. Following, a simple and comprehensive guidance of Mobile Augmented Reality Hand Wash (MARHw) were distributed based on the self-reporting hand washing activities depicted on Table 1. All of these activities are demonstrated by the self-reporting criteria that have been assumed to develop an online module before downloading the MARHw application.

Table 1 - A study design of MARHw

Questionnaire	Interventions	Outcomes measure
What do you understand about hand wash activities?	Instruction based on online module	Pre-follow up
What do you know about a standard guideline for proper hand wash activities?	Instruction based on online module	Pre-follow up
When do you wash your hands before and after certain activities?	Instruction and demonstration based online module	Post-follow up
How do you wash your hands in circular or direct motion?	Instruction and demonstration based online module	Post-follow up

Table 1 depicted the study design based on MARHw on how the intervention was conducted during this research. Following, the participant will be inquired on how they wash their hand during daily activities. Thus, these activities generated many answers based on their understanding on handwashing activities. As a result, participants are being guided to a proper hand wash by researchers guided by a several steps are being shared throughout the mobile application process. Furthermore, the minimum duration of hand wash activities estimated at around 20 seconds, for instance, the participants could sing a happy birthday song twice or verbally count the number from 1 until 20 gradually [25].

Consequently, the participants are being demanded to answer and understand simple hand wash activities that have been crafted and design for several age groups. Firstly, the participants are required to login to the developed online module and try to self-reporting based on the instruction given. Afterward, the participant that has been achieved a high score or graded can be awarded a digital certificate that awarded through the portal during the pre-follow up session. Besides, the intervention session is performed for ten hours of learning time experiences.

After reviewing some of the feedback from the participants that are complying with the module and instruction, there are two ways to enhance their engagement and apprehension to comprehend hand wash activities. Foremost, the participants are doing well after they discover a step by step instructions in an online module but demanded to do some practical ways. Lastly, the participants are using amiss ways of handwashing activities and required a simple guidance [26]. Thus, this mobile application mixed with augmented reality education element should be a simple guidance to a participant to lead them in three domain factors namely as hand movement, timely duration and proper steps as depicted in Fig.1.

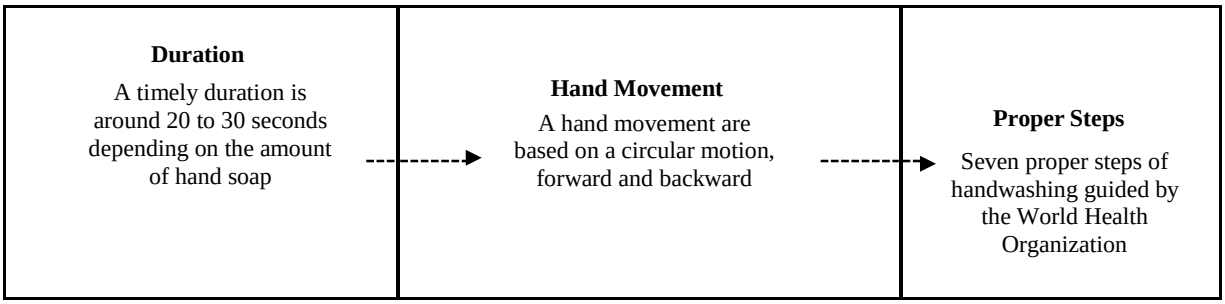

Fig. 1 - A Mobile Augmented Reality Hand Wash (MARHw) guidance

2.2 System Overview

This research will be focusing on hand gestures based on the hand interaction in front of the camera as depicted in Fig. 2. Whilst, this approach allows the researchers to deal with the smooth integration between real object gesture namely as a hand gesture and the hand tracking marker in mobile application. Thus, this will offer real-life experience when using mobile augmented reality application. Our main objective is to detect a gesture and interaction between hands in front of the camera. Moreover, this research will also classify a real-life usage of handwashing scenarios as well as figuring the potential limitation and investigating a practicable implementation to educate the community. Fig. 2 depicts the specified standard hand gesture to guide the users about the proper step guidance by the World Health Organization. Thus, the handwashing is ordered sequential by number and the user must comply step by step according to the instructions. As a result, this application will monitor a hand gesture for only the character of hand movement activities. Therefore, this monitoring is restricted to follow a step given by application instructions.

Fig. 2 - A Mobile Augmented Reality Hand Wash (MARHw) interfaces

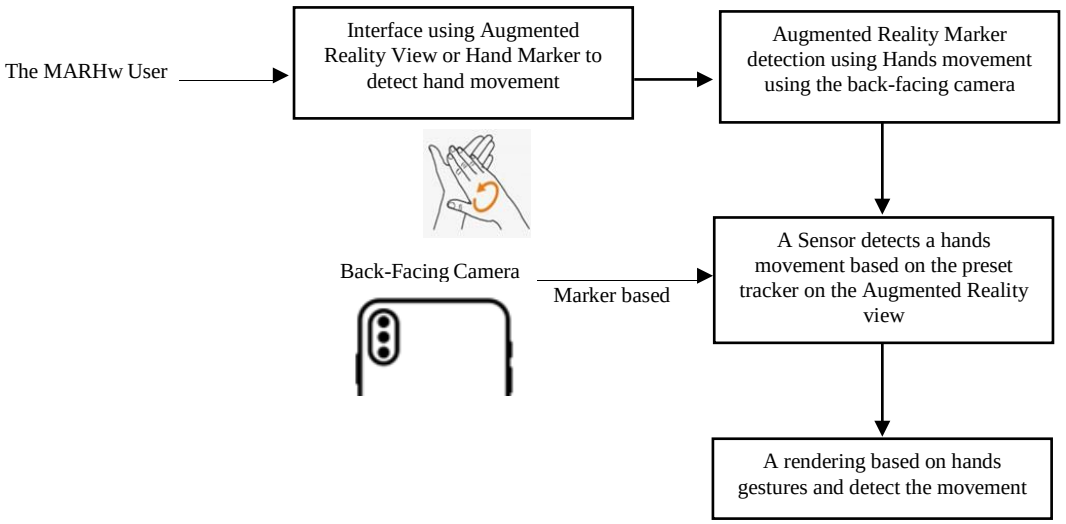

Fig. 3 - A proposed Mobile Augmented Reality Hand Wash (MARHw) a system overview

Fig. 3 depicts the overview content of the proposed MARHw system that will discern the hand's movement from the left and right-hand movements or gestures. The proposed system is segregated into two main criteria, the first one is to detect the movement and finally the identification section for the images to detect the hand washing process.

3. Result

The final results depicted that the mean average of age was 38.5 years and the differences of age were not statistically significant by the value of p=0.35. All of the participants are using this mobile application before washing their hands and the result of the user acceptance test for this mobile application is depicted in Table 1. Table 1 also present the participant of MARHw mobile application observed data that the mobile application is easy to be used for a young adult that is defined by (M=59.57, SD=.84), whereas the middle age (M=45.20, SD=.78) follow by the older adults (M=25.64, SD=.65). Thus, this result approves that the young adult is easy to be using a mobile device rather than middle age and older adults [27]. The second and third characteristic namely as easy to understand and application is interesting didn't explicate so much significance by $SD\pm$=0.02. Besides, this explication is also affected by the reason of the self-reporting manual that has been given beforehand in this research.

Table 2 - The user acceptance test for MARHw mobile application

	Young adult			Middle-age			Older adults		
Characteristic	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**
Easy to be used	6	59.57	.84	6	45.20	.78	7	25.64	.65
Easy to understand	13	48.33	.94	10	65.41	.75	8	36.75	.67
Application is interesting	9	41.85	.72	12	42.67	.73	12	43.82	.71
Total (n)	28			28			27		

Overall, seventy percent of the respondents acknowledged and found the characteristic of using MARHw easy to be understood. Thus 65% of participants also acknowledged that the MARHw mobile application is interactive and interesting to be practiced. In sum, there are also dislike respond included as the hand's recognition is not precise during a dark condition and the internet connection are too slow depending on the research area. Furthermore, the ANOVA with multivariate evaluation was measured in this research. The main inference is to capture the task completion time to washing the hand using MAR hand wash application. First, the intervention took time around 20-30 seconds and capturing the handwashing activities and secondly, this research also regulates the time for the hands' rotation and demonstrate the final result as the right sign.

For the first hypothesis, the improvement of handwashing movement by p=0.028 and p<0.001. This will infer that in this regards the improvement was statistically significant by scaling of F (4, 23) = 43.21; p=0.0002; p<0.001). We can deduce that the participant has made accurate ways of washing a hand. Secondly, the second hypothesis for the handwashing duration time by p=0.032 and p>0.001. This will infer that the time improvement was statistically considered not significant by scaling of F (4, 20) =40.11, p=0.034; p>0.001) for the duration (t) by the value of (p=0.07). We can assume that there are not many different times of handwashing activities before and after treatment. Finally, for the last hypothesis, Pillai's trace and Wilk's lambda test revealed that the difference for the handwashing step was significant for F (5, 27) = 32.21; p=0.0002; p<0.001). We can conclude that the user can have sufficient precautious during hand wash activities after treatment.

4. Discussion

Overall, the testing of three hypotheses portrayed that the participant of a proposed Mobile Augmented Reality Hand Wash gains improvement of three criteria that have been discussed namely as handwashing improvement duration, movement and step after using this mobile application. Thus, the result also demonstrates the participants are likely to make a sufficient time of handwashing after they are utilizing this mobile application. In short, watching guidance in this mobile application using a real-life guided hand's movement should reinforce the proper ways of handwashing education and enhancing the real-life practice using an accurate hand gesture and movement [28]. Specifically, the study limitation using this mobile application also being discussed and more plausibly these disliked factors are not determined by the physical factor rather than unexampled factor. Besides this proposed mobile augmented reality could be also be implemented using a neural network for future development and be able to classify the hand images by image classification [30].

Subsequently, a step by step guidance is accessible to be followed by the participant that is required to be a significant way to complete a proper handwashing activity. Furthermore, the participant also described being positive during using this mobile application experience with the future iteration of handwashing activities to be adapted on a large scale of the community.

5. Conclusion and future work

In conclusion, this proposed handwash using mobile augmented reality presented that the participant is required much more time to likely familiar with the steps in this approach. The result depicted that the participant positively enjoys the application and also be able to follow the simple steps in the MARHw mobile application in movement and steps guidance but necessitated more time to be able to familiarize the application. In the next study or research, the researcher should include more images based on image tracking on hand movement during real-time handwash activities. This approach will enhance augmented reality experiences in education capabilities to attract more participants to participate in this research. We are only proposing a suggested framework that is not connecting cloud interference. The next research should require more participants to acquire positive feedback experiences from a targeted young participant in handwash activities like primary or secondary students.

References

[1] Brewis, A., Wutich, A., du Bray, M. V., Maupin, J., Schuster, R. C., & Gervais, M. M. (2019). Community hygiene norm violators are consistently stigmatized: Evidence from four global sites and implications for sanitation interventions. Social Science & Medicine, 220, 12-21.

[2] Luby, S. P., Davis, J., Brown, R. R., Gorelick, S. M., & Wong, T. H. (2020). Broad approaches to cholera control in Asia: Water, sanitation and handwashing. Vaccine, 38, A110-A117
[3] Pogrebna, G., & Kharlamov, A. (2020). The Impact of Cross-Cultural Differences in Handwashing Patterns on the COVID-19 Outbreak Magnitude.
[4] World Health Organization. (2020). Considerations for quarantine of individuals in the context of containment for coronavirus disease (COVID-19): interim guidance, 19 March 2020 (No. WHO/2019-nCoV/IHR_Quarantine/2020.2). World Health Organization.
[5] Wang, C., Sarsenbayeva, Z., Chen, X., Dingler, T., Goncalves, J., & Kostakos, V. (2020). Accurate Measurement of Handwash Quality Using Sensor Armbands: Instrument Validation Study. JMIR mHealth and uHealth, 8(3), e17001.
[6] Bloomfield, S. F., Aiello, A. E., Cookson, B., O'Boyle, C., & Larson, E. L. (2007). The effectiveness of hand hygiene procedures in reducing the risks of infections in home and community settings including handwashing and alcohol-based hand sanitizers. American journal of infection control, 35(10), S27-S64.
[7] Borchgrevink, C. P., Cha, J., & Kim, S. (2013). Hand washing practices in a college town environment. Journal of environmental health, 75(8), 18-25.
[8] Weinbren, M. J. (2018). The handwash station: friend or fiend. Journal of Hospital Infection, 100(2), 159-164.
[9] Von Lengerke, T., Ebadi, E., Schock, B., Krauth, C., Lange, K., Stahmeyer, J. T., & Chaberny, I. F. (2019). Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE. Antimicrobial Resistance & Infection Control, 8(1), 56.
[10] Loureiro, S. M. C., Guerreiro, J., & Ali, F. (2020). 20 years of research on virtual reality and augmented reality in tourism context: A text-mining approach. Tourism Management, 77, 104028.
[11] Crofton, E. C., Botinestean, C., Fenelon, M., & Gallagher, E. (2019). Potential applications for virtual and augmented reality technologies in sensory science. Innovative Food Science & Emerging Technologies, 102178.
[12] Langener, S. (2019). Elementary school children's motivation and experience toward digital hand hygiene gamification: a mixed methods approach (Master's thesis, University of Twente)
[13] Contzen, N., & Inauen, J. (2015). Social-cognitive factors mediating intervention effects on handwashing: a longitudinal study. Journal of behavioral medicine, 38(6), 956-969
[14] Seimetz, E. (2015). Behaviour, cognitions, and the environment: the influence of contextual factors and social-cognitive determinants on handwashing practices in infrastructure-restricted settings (Doctoral dissertation, University of Zurich).
[15] Devine, J., & Koita, S. N. (2010). Senegal: A hand-washing behavior change journey. Water and sanitation program: Learning note. Washington, DC: Water and Sanitation Program.
[16] Tao, S. Y., Cheng, Y. L., Lu, Y., Hu, Y. H., & Chen, D. F. (2013). Handwashing behaviour among Chinese adults: a cross-sectional study in five provinces. Public health, 127(7), 620-628
[17] Nkurunungi, G., Lubyayi, L., Versteeg, S. A., Sanya, R. E., Nassuuna, J., Kabagenyi, J., ... & Niwagaba, E. (2019). Do helminth infections underpin urban- rural differences in risk factors for allergy- related outcomes? Clinical & Experimental Allergy, 49(5), 663-676.
[18] Odu, O. O., Emmanuel, E. E., Amu, E. O., Deji, S., Dada, S. A., & Marcus, O. (2017). Practice of effective hand washing and associated factors among caregivers of infants attending infant welfare clinics in Ado-Ekiti, Ekiti State, Nigeria. Journal of Advances in Medicine and Medical Research, 1-8.
[19] Luby, S. P., Davis, J., Brown, R. R., Gorelick, S. M., & Wong, T. H. (2020). Broad approaches to cholera control in Asia: Water, sanitation and handwashing. Vaccine, 38, A110-A117.
[20] Nery, S. V., Clarke, N. E., Richardson, A., Traub, R., McCarthy, J. S., Gray, D. J., ... & Clements, A. C. (2019). Risk factors for infection with soil-transmitted helminths during an integrated community level water, sanitation, and hygiene and deworming intervention in Timor-Leste. International journal for parasitology, 49(5), 389-396.
[21] Contzen, N., Meili, I. H., & Mosler, H. J. (2015). Changing handwashing behaviour in southern Ethiopia: a longitudinal study on infrastructural and commitment interventions. Social science & medicine, 124, 103-114.
[22] Al-Hussami, M., Darawad, M., & Almhairat, I. I. (2011). Predictors of compliance handwashing practice among healthcare professionals. Healthcare Infection, 16(2), 79-84.
[23] Wood, W., Quinn, J. M., & Kashy, D. A. (2002). Habits in everyday life: Thought, emotion, and action. Journal of personality and social psychology, 83(6), 1281.
[24] White, S., Thorseth, A. H., Dreibelbis, R., & Curtis, V. (2020). The determinants of handwashing behaviour in domestic settings: An integrative systematic review. International Journal of Hygiene and Environmental Health, 227, 113512.
[25] Lacey, G., Zhou, J., Li, X., Craven, C., & Gush, C. (2020). The impact of automatic video auditing with real-time feedback on the quality and quantity of handwash events in a hospital setting. American Journal of Infection Control, 48(2), 162-166.

[26] Boyce, J., Chartier, Y., Chraiti, M., Cookson, B., Damani, N., & Dharan, S. (2009). WHO guidelines on hand hygiene in health care. Geneva: World Health Organization.
[27] Zou, B., Yan, X., & Li, H. (2020). Students' Perspectives on Using Online Sources and Apps for EFL Learning in the Mobile-Assisted Language Learning Context. In Language Learning and Literacy: Breakthroughs in Research and Practice (pp. 515-531). IGI Global.
[28] Gupta, S., Bagga, S., & Sharma, D. K. (2020). Hand Gesture Recognition for Human Computer Interaction and Its Applications in Virtual Reality. In Advanced Computational Intelligence Techniques for Virtual Reality in Healthcare (pp. 85-105). Springer, Cham.
[29] Kasinathan, V., Mustapha, A., Hasibuan, M. A., & Abidin, A. Z. Z. (2018). First Discovery: Augmented Reality for Learning Solar Systems. International Journal of Integrated Engineering, 10(6).
[30] Ismail, A., Ahmad, S. A., Soh, A. C., Hassan, K., & Harith, H. H. (2019). Improving Convolutional Neural Network (CNN) architecture (miniVGGNet) with Batch Normalization and Learning Rate Decay Factor for Image Classification. International Journal of Integrated Engineering, 11(4).