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Awareness and Readiness of Malaysian University Students for Emotion Recognition System

Nor Azlina Ab. Aziz[1*], Nor Hidayati Abdul Aziz[1], Sharifah Noor Masidayu Sayed Ismail [2], Chy Tawsif Khan[1], Muhammad Anas Hasnul[1], Md. Armanur Rahman[1], Tasiransurini Ab. Rahman[3], Kamarulzaman Ab. Aziz[4*]

[1]Faculty of Engineering & Technology,
Multimedia University, Jalan Ayer Keroh Lama, 75450 Bukit Beruang, Melaka, MALAYSIA

[2]Faculty of Information Science & Technology,
Multimedia University, Jalan Ayer Keroh Lama, 75450 Bukit Beruang, Melaka, MALAYSIA

[3]Department of Electronic Engineering, Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, MALAYSIA

[4]Faculty of Management,
Multimedia University, Persiaran Multimedia, 63100 Cyberjaya, Selangor, MALAYSIA

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Abstract: Emotion Recognition System (ERS) identifies human emotion like happiness, sadness, anger, disgust and fear. These emotions can be detected via various modalities such as facial expression analysis, voice intonation, and physiological signals like the brain's electroencephalogram (EEG) and heart's electrocardiogram (ECG). The emotion recognition system allows machines to recognized human emotions and reacts to it. It offers broad areas of application, from smart home automation to entertainment recommendation system to driving assistance and to automated security system. It is a promising and interesting field to be explored especially as we are moving towards industrial revolution 5.0. Therefore, a survey was conducted on the awareness and readiness of the usage of emotion recognition system among Malaysian youths, specifically among university students. The findings are presented here. Overall, positive orientation towards the technology is observed among the participants and they are ready for its adoption

Keywords: Emotion recognition, awareness, readiness, university, intention

1. Introduction

According to the American Psychological Association (APA) emotion is "complex reaction pattern, involving experiential, behavioral, and physiological elements, by which an individual attempt to deal with a personally significant matter or event." Human's decision and action are affected by emotion. Understanding human emotion not only attract the attention of psychologists but it also had attracted the attention of engineers and computer scientist. The engineers and computer scientists are interested in building emotion recognition system as it has the potential to provide a more fluid and better human computer interface. A machine with emotional intelligence can respond to human needs more intelligently and help to reduce negative emotions so that productivity can be improved.

The emotion can be detected using various modalities. Among the frequently used modality is through images such as the facial images [1], [2], thermal images [3] and movement images [4], [5]. Human's facial expression, posture and

*Corresponding author: azlina.aziz@mmu.edu.my, kamarulzaman.aziz@mmu.edu.my

movements are frequently affected by our feeling. Therefore, this had motivated researchers to use these images in development of emotion recognition system. Our voice intonation can also be used as a modality for emotion recognition system [6]. The pitch of a person's voice might be increased when feeling excited or lowered when feeling down. Other than these physical modalities, physiological signals can also be used for emotion recognition system. Among physiological signals commonly used are electroencephalogram (EEG) [7] and electrocardiogram (ECG) [7]-[10]. Some works combine multiple modalities for their emotion recognition system [11], [12].

In [13] the authors proposed an ECG based emotion recognition system with potential application for personalized driving warning system. Meanwhile, in [14] an ECG based system to identify driver's emotion is introduced to increase the driver's alertness. Another emotion recognition system for driver assistance is proposed in [15]. The system used facial images as input and based on the identified driver's current state of emotion the voice of the driver assistance system is adjusted. In the event where negative emotion is detected the voice is change to increase the driver alertness. The default voice is used for positive emotion. Emotion recognition enabled system had also been proposed to be applied in education. In [16] the output of an emotion recognition system is used to recommend suitable games including educational games. The work focused on children with Autism Spectrum Disorder. In [17], emotion recognition system is integrated to smart homes to adapt its environment settings to the preferred season of the occupant. Another application of emotion recognition in smart homes is reported in [18], [19], where it is used to control lighting and electronic devices. An emotion recognition for home care is proposed in [20]. It allows independent living for the elderly while simultaneously ensures their safety. The system used facial images to recognized any signs of distress before alerting the health care provider or next of kin.

Although the applications discussed above are mostly lab scale and prototype, this technology is not far away. Towards the end of 2019, the Financial Times reported that in the controversial district on Xinjiang, China, security system equipped with emotion recognition had been installed at public places to predict any signs of terrorism such as aggressiveness and nervousness [21]. In Sept 2020, Forbes reported that NtechLab from Russia is going to introduce a similar security system that scans human faces to detect their emotions and any sign of aggressive behavior [22]. Smyle, a United Kingdom based company launched their "Return of Emotion" solution in Oct 2020 [23]. The "Return of Emotion" is an emotion recognition system based on facial images, pulse sensors and neurological signal. The solution aims to measure the genuine emotional impact of event to the attendees.

The applications discussed above prove that emotion recognition system is an interesting technology that promises a broad application spectrum. The advancement of artificial intelligence that is seen as the backbone for industrial revolution 5.0 (IR 5.0), is the catalyst behind the field of emotion recognition system. Emotion recognition system will be commonplace in the near future, giving rise to new generations of smart technologies able to deliver up to the minute customized solutions needed or desired by the users. Therefore, this study aims to investigate the awareness and readiness of Malaysian university students towards the adoption and deployment of such systems. They are of the generations that will be riding and driving the IR 5.0 and beyond. Thus, understanding their attitude, awareness and readiness will provide insights to better drive this technological sector.

The paper is organized as follows. The next section discusses ERS in education sector. The research method is discussed in section 3. In section 4, the results are presented and discussed. Finally this paper is concluded in section 5.

2. Emotion Recognition System in Education

The outbreak of Covid19 pandemic brings new challenges to education system. The new normal of social distancing and no large gathering, sees the migration of education system from traditional classroom to online and e-learning system. This migration involves all level, from kindergartens to primary schools to secondary schools and even tertiary education institutions. Online and e-learning encourages independent learning among students, however, often in this setting due to the spatial and temporal difference between the learners and the educators, the exchange of emotion is lacking [24]. Additionally, communication between the two parties is also limited [25]. Emotion is important in learning. A positive emotion helps in improving learner's cognitive and understanding [26]. Research also found that students with healthy emotions tend to perform better in university in comparison to their peers with unhealthy emotional state [27].

Many works had proposed the integration of ERS with e-learning. The adoption of ERS benefits not only the learners but also the instructors [27]. Specifically, an education module integrated with ERS is able to identify the learner's emotion towards a learning activities which can work as an automated feedback taker, allowing the education provider to react and adapt accordingly. This contributes to an efficient, personalized and inclusive educational model [28]. The instructors are also able to benefit through ERS, where the system could reduce the chances of the instructors to overlook some of the students' responds especially in big group and ensure more active learning sessions [29].

ERS has been implemented for e-learning to improve learner's experience and to improve the delivery. In [30], a facial based ERS developed using open database is used to detect emotion of students participated in educational game. In their experiment 4 young students including 2 of students with learning difficulties participated. The students' emotion was recorded throughout the session. The emotion detected varies from one students to another, especially when the comparing the emotion of the students with learning difficulties with their peers without the difficulties. An architecture of emotion aware online learning is proposed in [25]. In the study the proposed architecture is implemented

during an online course of Python for beginners to a group of 30 university students. The students' emotion is recorded via self-reporting and facial expression. The findings show that the emotion aware system is able to provide feedback to the instructors that allows them to change their delivery and overcome the communication barrier between instructors and learners in online learning. Additionally, the emotion aware system provides report to learners on the relation of their state of emotion with their learning performance. This report can be used to help them improve themselves. The researchers also used the emotion detected for automation of mood regulator, attention improvement and report generation to provide a more efficient learning environment. Delivery of classes using online platform has been popular since the Covid19. In [31], facial expression based ERS is used to measure the students' reaction towards the end of an online meeting to overcome the lack of communication between the students and instructor.

A student ERS (SERS) for e-learning is introduced in [32]. The SERS system proposed is also based on images, however, instead of the facial features, the system only focuses on the eyes and head movement. These inputs are used to measure the negative emotions of students throughout an e-learning session using video. Based on the emotion detected the frames with high number of boredom are able to be identified and revision can be made accordingly. A large scale experiment involving various age groups is conducted in [33] to study the suitability and challenges of facial and body movement based ERS in educational setting. Various limitations and recommendations are outlined by the researchers for future works.

Intelligent tutoring system (ITS) provides computerized self-paced and personalized learning module. Several studies have shown that ITS can benefits from ERS [34], [35]. Facial expression and self-assessment manikin are applied in [34]. On the other hand, the learners' state of emotion is identified via text data mining in [35]. The textual comments of leaners on the lesson and activities conducted are analyzed and the emotions are classified.

ERS is integrated to a virtual learning environment in [26]. The ERS identified learner's emotion via his/hers facial expression. Based on the identified emotion the virtual teacher's reaction is adjusted accordingly. This allow a more realistic learning session. The ERS has also been adopted in traditional class. In both [28] and [29], the students facial expressions during class are recorded and their emotions are identified. This helps the instructor to monitor the students, especially in large class. The students' reaction also assists the instructor in improving their teaching method and preparation of a more engaging session.

In this age of Covid19, most of Malaysian's universities are adopting hybrid educational system where online face to face classes and e-learning play major role in supporting lessons delivery. Based on the literature reviewed here, it can be seen that ERS has the potential to ensure online and e-learning can be as effective or even better than traditional class. ERS can transform online learning platforms to be aware and attentive to the emotional state of the learners. It can mitigate the lack of emotional connection and interaction between learners and instructors, and allow for smart interventions in the lessons to cater and suit the learners. This can increase the dynamism of online learning. Additionally, students especially engineering students should be exposed to the technology. Assignments of projects based on ERS can be incorporated into their curriculum syllabus, so that these students upon graduation are ready to be the players in the related fields. Following sections present and discuss the results of survey on Malaysian's university students focusing on engineering students' awareness and readiness of ERS.

3. Methodology

A survey was conducted at Universiti Tun Hussein Onn Malaysia, which is a public university in the southern state of Malaysia. The survey was done during a knowledge transfer session in early 2020, just few weeks before the first movement control order was enforced in Malaysia. The session was divided to several parts where the general concept of emotion recognition, potential fields of application and issues related to emotion recognition system were presented and discussed by speakers from the research team.

The students were asked to fill up the survey form to study their level of awareness of emotion recognition system prior to the session and after the session. The students who answered aware of the existence of the technology were asked for their source of knowledge.

Based on the information discussed during the knowledge transfer session the participants' readiness towards mass adoption of the technology is surveyed. Their preference of the modalities to extract the emotions are also studied to give a better insight for ERS developer.

Furthermore, the students were also asked to gauge their readiness towards adoption of emotion recognition system in everyday life. The study used the Theory of Planned Behaviour [36], to survey the students' intention towards being ready for emotion recognition technology.

Initially there was plan of conducting similar knowledge transfer session by touring other Malaysian's universities. However, the worsening outbreak of Covid19 pandemic and the movement control order enforced by Malaysian government had halted this plan which was later cancelled. However, given the collected sample size and geographical spread according to place of origin, the sample to a certain extent is able to reliably represent the targeted population, i.e. Malaysian university students.

4. Results & Discussion

4.1 Demographics

The participants of this survey were 177 students of which 106 are male and 71 are female, as shown in Fig. 1. The students are from Faculty of Electrical & Electronics Engineering with 97.7% (173) of them are from first year while 2 are from second year of their studies and 2 are final year students. The participants' age range is shown in Fig. 2, where majority of the students (99%) are within 20 to 25 years old while the remaining (1%) are younger.

These students came from all over Malaysia as shown in Fig. 3 while 2 of them are international students. Each of the Malaysian state has at least 5 representatives. They have various economic backgrounds and household income ranging from bottom 40 to top 20 household. All of the students involved can be considered as tech savvy since they each own at least one smart device, with majority have more than one devices. Being tech savvy is important as ERS requires high technology acumen. The devices include smart phones, tablet, smart watch, fitness tracker, smart TV, laptop, desktop, and camera including in car camera and CCTV.

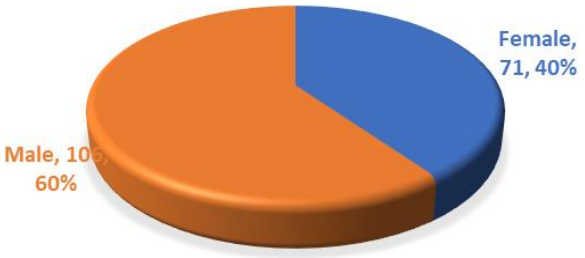

Fig. 1 - Participants' gender

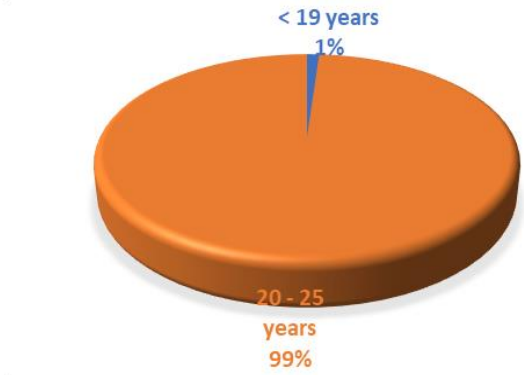

Fig. 2 - Participants' age group

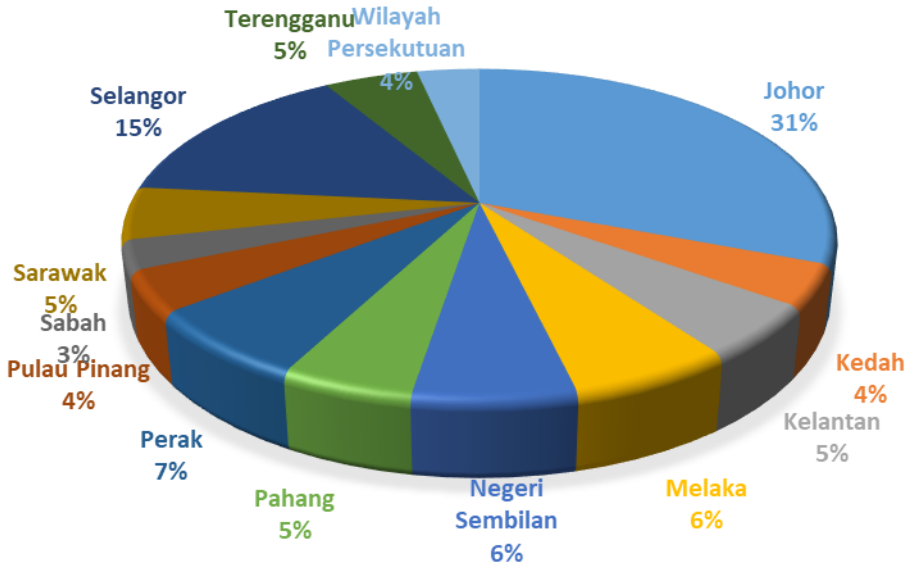

Fig. 3 - Malaysian participants' home state

4.2 Awareness

In the survey the participants were enquired on their awareness of emotion recognition system prior to the exposure during the knowledge transfer program. The results obtained shows that 90 out of the 177 students (51%) were first introduced to the technology through the knowledge transfer session conducted on the day of the survey, while 87 (49%) were already aware of the existence of such technology. This finding is visualized in Fig. 4.

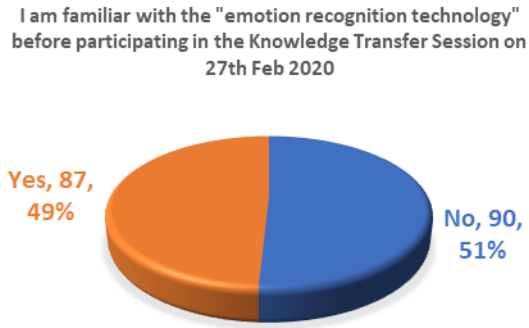

Fig. 4 - Participants awareness prior to the knowledge transfer session

Among the source of knowledge listed by the participants that already aware of the emotion recognition system are via introduction by their lecturers in class, technology review articles, movies and dramas, final year project of their colleagues and YouTube.

The students were also asked on their awareness of technologies utilizing emotion recognition system in the scale of 1 to 7, where 1 is the lease aware while 7 is highly aware. Most of the students had moderate to advance awareness as shown in Fig. 5.

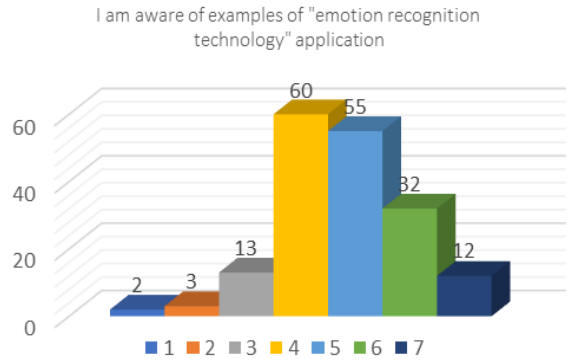

Fig. 5 - Participants awareness on the type of applications for emotion recognition system

4.3 Readiness

The students' readiness on the adoption of emotion recognition system in everyday life were measured in a scale of 1 to 7, and the findings (Fig. 6) show that majority of the students (162 out of 177) rated their readiness between moderate to advance (scale 4 to 7). However, when asked of their opinion on the readiness of the country for emotion recognition system, the students rated it relatively lower where 159 students rated it between the scale of 3 to 6. This can be observed in Fig. 7.

Most of the students are of the opinion that the industry and government should encourage application of emotion recognition system, this is shown in Fig. 8 & 9. They also believed that the government need to upgrade and improve public technological infrastructure for adoption of emotion recognition system, Fig. 10.

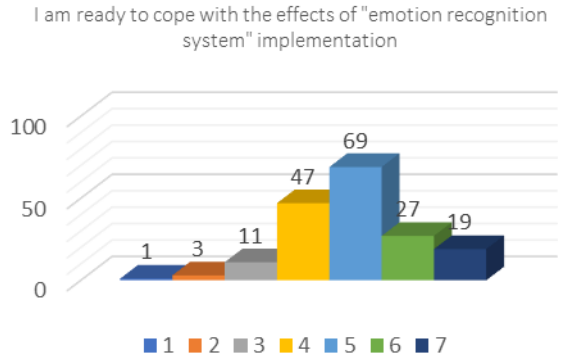

Fig. 6 - Participants' readiness for emotion recognition system

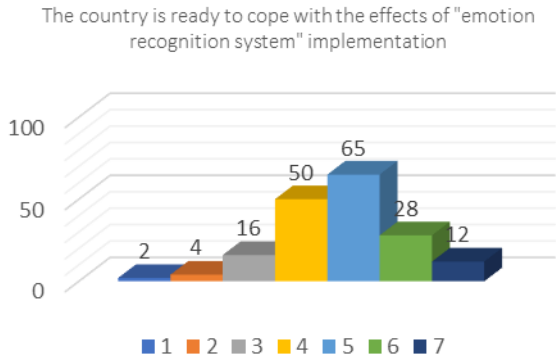

Fig. 7 - Malaysia's readiness for emotion recognition system

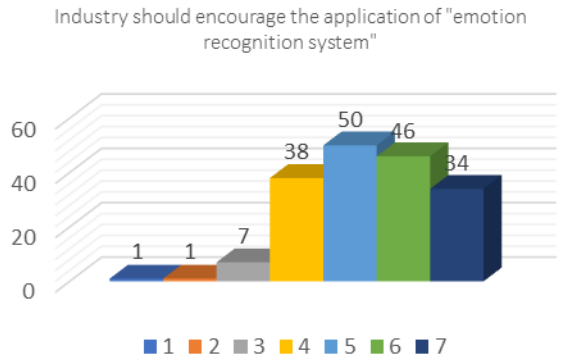

Fig. 8 - Adoption of emotion recognition system by industry

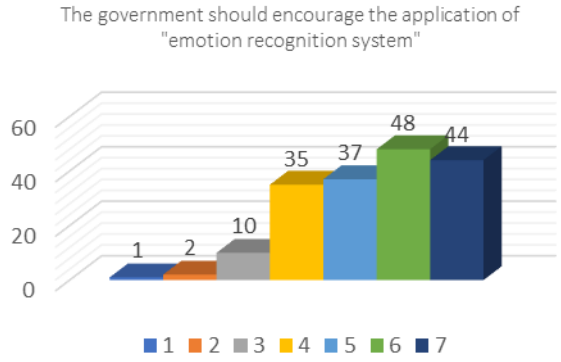

Fig. 9 - Adoption of emotion recognition system by government

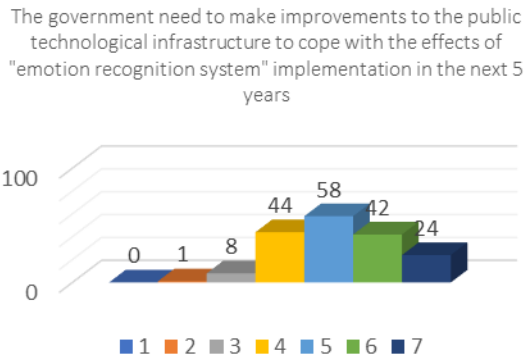

Fig. 10 - Improvement of public infrastructure for emotion recognition system

4.4 Modalities

We also surveyed the students' opinion on what type of modalities for emotion recognition system that they preferred. From the findings as visualized in Fig. 11, 52% of the students preferred physiological signal, followed by 20% multimodal signal, 17% visual, 8% text and audio is the lease with 3%. The factors that strongly motivates their selection is the accuracy and authenticity of the data (40%) followed by the conveniences of the data collection (33%). The importance of these factors are displayed in Fig. 12.

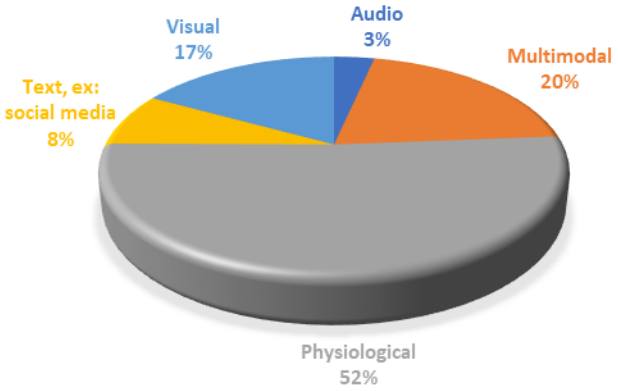

Fig. 11 - Participant's preference towards modality of emotion recognition system

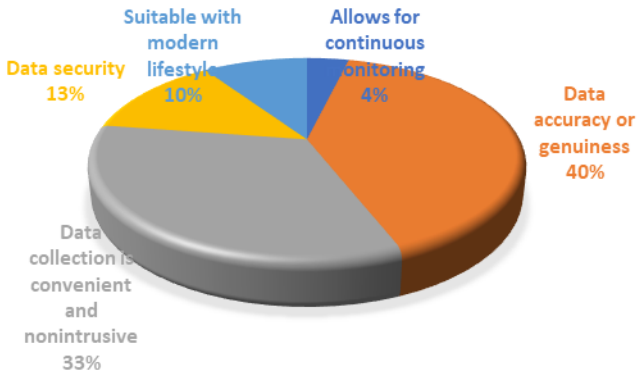

Fig. 12 - Factors influencing participant's preference towards modality of emotion recognition system

4.5 Behavioral Intention

We also surveyed the students' intention towards being ready for the technology using the Theory of Planned Behaviour [36], [37]. Reliability analysis was conducted to determine the internal reliability of the items used to measure the constructs tested in this study. All of the constructs were considered as reliable and good as the Cronbach's Alpha were above 0.90 (see Table 1). A total of 38 items were used to measure the main constructs of the study, namely Intention (Int) (5 items), Attitude (Att) (9 items), Subjective Norms (SN) (10 items), and Perceived Behavioural Control (PBC) (14 items). The items were measured by itemized rating scale with seven scale categories.

Table 1 - Reliability analysis

Construct	N	Items Mean	Cronbach's Alpha	No. of Items
Att	177	5.348	0.947	9
SN	177	5.023	0.918	10
PBC	177	5.105	0.960	14
Int	177	5.125	0.926	5

Mean analysis shows that generally, the respondents agreed with all the items measuring the constructs with Att achieved the highest level of agreement with an average of 5.348; while SN scored the lowest with an average of 5.023. Meanwhile, PBC achieved the mean of 5.105. The scores also suggest that in general the respondents have moderately positive attitude towards ERS; believe that their social networks also have moderately positive outlook towards ERS; plus, they also have moderately positive perspective on their ability to adopt or act on the technology. The Int mean being 5.125 gives a good indication of the students' intention to further familiarize themselves with the technology and being ready to adopt emotion recognition technologies when such applications become more widely implemented. It can be said that the students' orientation towards ERS are quite positive but at the same time still cautious. This is consistent with the earlier findings on their levels of awareness and readiness towards ERS.

5. Conclusion

Emotion recognition system is an interesting area with wide spectrum for application which include security, education, health care, entertainment and transportation. The technology is no longer merely exist in labs and as prototypes. This study surveyed the awareness and readiness of Malaysian university student towards mass adoption of such technology. The finding shows that the students has positive orientation towards the technology and ready for its adoption albeit with realistic cautious orientation given their perception on the readiness levels of the ecosystem. However, from this study it shows that the awareness is still relatively low since more than 50% of the sample were not aware of the technology prior to the study even though nearly 98% of the sample were of the same cohort. This suggest introduction to this particular technology is not part of the standard programme content.

The students' attitude can be deemed as being positive towards the technology given Att's mean being the highest as seen earlier. Plus, more the moderate levels of the means for SN and PBC also indicate the students' have the perception of relatively conducive environment towards the technology as well as their ability in utilising the technology. This may serve as a good motivation for the inclusion of emotion recognition functions into various learning technologies and solutions. Thus, it is highly encouraged for the inclusion of the technology into part of the range of technologies that such students are introduced to. In fact, introduction to range of current emerging technologies should be a standard component of university programmes. This may lead to the possibility of homegrown innovative solutions being produced and establishing the country into one the region's if not global hub for ERS technological innovations.

However, the sophistication and readiness of the national ecosystem to enable a widespread implementation and adoption of ERS need to be ensured first. This include the enhancement of national infrastructure and infostructure. Next, the ecosystem is nothing without clear policy framework in place to guide the sector. Furthermore, the framework must encompass not only the technological but also the soft aspects such as privacy and ethical issues which often arise from the adoption of ERS. This arguably can be a catalyst that spur the country's transformation into a technological powerhouse.

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