Development of an E-Survey Application to deal with Complexities Involved in Electronic Surveys with Emotions in Higher Education Institutes

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Summary
Electronic surveys nowadays play an important role for data collection as they are cost-effective and convenient. In Academic organization and Higher Education Institutions (HEIs), these surveys are considered a popular tool for the collection of information or feedback from students. The results of such surveys are used for key decision making as well. However, while conducting surveys emotions are generally not considered. This may lead to ineffective or biased results. In this paper, we have developed an E-Survey application which integrates Electronic Surveys with emotions and provides valuable data for further analysis. Standard data set from a leading Engineering University has been obtained. Results have been analysed using standard statistical methods. It has been shown that there is wide scope for using this E-survey application for development of frame works do deal with complexities of this kind of data.

Key words:
E-survey, Likert scale, Emotions, Affectiva.

1. Introduction

Higher Educational Institutions (HEIs) rely on electronic surveys to record feedback of students and take different measures to improve the quality of teaching in HEIs. Surveys are crucial in a Higher education institution, as some of the significant decision are taken based on student's feedback such as monitoring and review of quality and standards, teacher performance evaluation for appraisals and promotions, ensuring the effectiveness of course design and delivery etc.[1].

Normally as noticed, due to possible lack of motivation and interest, students do not take interest in attempting the surveys and are forced to respond that result in careless and falsified responses [1].

Psychologists pertaining to the cognitive domain have identified factors such as temporary mood state, fatigue, emotions and careless responses that may influence the respondent's evaluations [2].

For this purpose, we have developed an Electronic-survey (E-survey) application in combination with emotion recognition and categorization based on the Affectiva SDK. The whole process has been tested and implemented using HEC Questionnaire at Balochistan University of Engineering and Technology Khuzdar (BUETK). Finally, the results are analyzed to investigate the effect of emotions on responses.

The paper is distributed in the manner that Section-II describes Electronic Surveys, Section III discusses development of e-survey application followed by detailed discussion on results. Conclusion has been provided in Section IV.

2. Electronic Surveys

Electronic surveys are commonly used techniques for collecting data. Most, not all, of the questions in any questionnaire in surveys are generally described using four to five-point Likert scale. The Likert method is considered a standard psychometric scale for measurement of responses [2]. This method was introduced by Rensis Likert in 1932 and is considered a benchmark method. It works by asking respondents to specify their levels of agreement with the help of a declarative statement. For this, consider an example: For a 5-point Likert scale, each scale point could be labeled according to its agreement level. Numerical values can be used to indicate the agreement or disagreement or having no impact or neutral. Number 5, in that case, can indicate Strong Agreement whereas number 3 can be used as neither agree or disagree and 1 for strong disagreement. The scale label can be interpreted differently based on the requirement of measurement. For example, if the frequency is measured then, labels like ''never-always'' can be used; whereas while measuring attitude or belief of the respondent, labels like ''not very much-very much'' are more appropriate. [2].

The measurement of survey responses has all the time been an issue of highest significance in social sciences and for this reason; several rating scales have been developed. However, only a limited number of studies suggests that ratings obtained from surveys such as visual analog scales (VAS) Likert-like scales (numbered labels or quantitative symbols) and Likert scales are comparable. [3]

Rose et al., [4] endorsed that the use of fuzzy rating scale-based (free response) survey questionnaire is statistically

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more advantageous as compared to the fuzzy linguistic representations (closed response) based format. Based on the comparative study, Rose [5] concludes that the fuzzy rating is better than by using fuzzy conversion scales or a Likert scale.

Symeonaki et al. [6] suggested that the Likert scale is the most commonly used rating scale, developed in 1932 by Rensis Likert. The Likert scale rates respondents to select more than a few response categories, demonstrating various degree of strengths of disagreement or agreement. As shown in Figure 1.

Fig. 1 Likert Scale.

3. Development Of E-Survey Application

We have developed an Electronic Survey (E-Survey application using Microsoft Visual Studio ™ 2017 (VB.NET) for data acquisition. The data acquisition has two stages:

i. User performs survey
ii. Emotions are detected using a webcam

The snapshot of E-Survey application is depicted in Figure 2, the software records a total of 6 parameters. Five out of six are emotion parameters and one is the response of any questions out of 20. The emotions of respondents are recorded, using five parameters i.e., Happiness, Sadness, Disgust, Fear, Anger, and the Response is recorded using one parameter based on the 5-point Likert Scale. The emotion parameters range from 0-100% while the response parameter ranges from 1-5 where 1 shows Strongly Disagree and 5 shows Strongly Agree. Finally, the data is exported automatically in an excel sheet.

For emotion recognition and categorization, the Affectiva SDK is embedded with E-Survey application [7]. The SDK is used because of its free availability and widespread usage. Secondly, Affectiva claims to have the world's largest emotion database with 5.3 Million faces and global diversity of data [8].

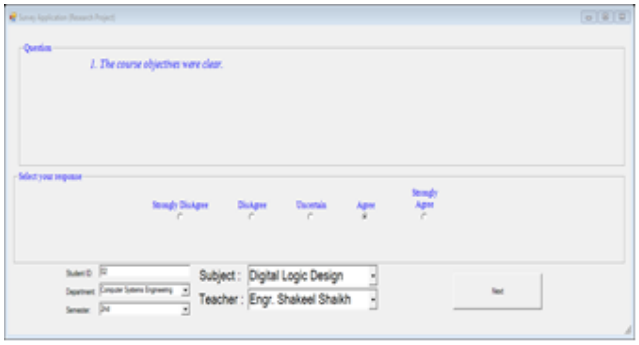

Fig. 2 E-Survey GUI.

The survey questionnaire used in the application for data collection were obtained from Quality Enhancement Cell (QEC), BUET Khuzdar which has been designed by Quality Assurance (QA) division of Higher Education Commission (HEC) Government of Pakistan. Questionnaires' list is shown in Figure 3. There are 20 Questions, each of which has five responses that are Strongly Disagree, Disagree, Uncertain, Agree and Strongly Agree. The confidentiality and anonymity of data has been assured.

Student Course Evaluation Questionnaire

(To be filled by each Student at the time of Course Completion)

Questionnaire	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. The course objectives were clear	□	□	□	□	□
2. The Course workload was manageable	□	□	□	□	□
3. The Course was well organized (e.g. timely access to materials, notification of changes, etc.)	□	□	□	□	□
4. I think the Course was well structured to achieve the learning outcomes (there was a good balance of lectures, tutorials, practical etc.)	□	□	□	□	□
5. The learning and teaching methods encouraged participation.	□	□	□	□	□
6. The overall environment in the class was conducive to learning.	□	□	□	□	□
7. Classrooms were satisfactory	□	□	□	□	□
8. The Course stimulated my interest and thought on the subject area	□	□	□	□	□
9. The pace of the Course was appropriate	□	□	□	□	□
10. Ideas and concepts were presented clearly	□	□	□	□	□
11. The method of assessment were reasonable	□	□	□	□	□
12. Feedback on assessment was timely	□	□	□	□	□
13. Feedback on assessment was helpful	□	□	□	□	□
14. I understood the lectures	□	□	□	□	□
15. The material was well organized and presented	□	□	□	□	□
16. The instructor was responsive to student needs and problems	□	□	□	□	□
17. Had the instructor been regular throughout the course?	□	□	□	□	□
18. The material in the tutorials was useful	□	□	□	□	□
19. I was happy with the amount of work needed for tutorials	□	□	□	□	□
20. The tutor dealt effectively with my problems	□	□	□	□	□

Fig. 3 HEC Survey Questionnaire [9]

Table 1: Descriptive Statistics

	Survey	Emotions				
	Response	Happiness	Sadness	Disgust	Fear	Anger
Mean	3.953094	3.872583	1.416446	1.727197	0.648920	0.989204
Median	4.000000	0.001828	0.024418	0.426611	0.004553	0.002055
Maximum	5.000000	99.93061	99.87614	99.97469	99.35780	99.56856
Minimum	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Std. Dev.	0.949489	19.01282	6.929977	9.093383	5.294232	6.869682
Skewness	-0.674957	4.775132	7.511853	9.051947	10.72223	10.19724
Kurtosis	2.837915	23.91303	75.18717	88.91137	135.9494	119.1873
Jarque-Bera	472.9185	135223.9	13908889.	19729095.	4639641.	3560032.
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	24272.00	23777.66	8696.976	10604.99	3984.368	6073.715
Sum Sq. Dev.	5534.491	2219170.	29482.29	50763.16	17206.94	28971.49
Observations	6140	6140	6140	6140	6140	6140

The results and analysis of primary data collected from students of BUETK using E-Survey application are provided in the result's section.

4. Results and Discussion

We have collected primary data from students of BUET Khuzdar using E-Survey application. The sample used in this study is 307 students responding to 20 questions, which provide a total number of 6140 observations.

The sample size of 307 students is based on research carried out by Saadatian et al. [10] who also used Roasoft.inc [11] a freely available online tool to determine the sample size. The tool indicates that a sample of 278 students is the best representative of a total of 1000 student in the university. Whereas, we have surveyed 307 students as a sample which is more than the required number of students.

The detailed description of data is provided in Table 1. The mean for the response of 307 students with 6140 observations is 3.95, which indicates that on average students are inclined towards Agree and Strongly Agree. While the mean for the Emotion variable Happiness, Sadness, Disgust, Fear, and Anger is 3.87, 1.42, 1.73, 0.65 and 0.99 respectively which shows inclination of emotions towards the natural or normal level.

The variable response has the median of 4 indicating that agree is the option for the variable response that split the data into two equal halves. The table also provides information on maximum and minimum values in the data set.

The negative value of skewness shows that the data on the variable response is negatively skewed; while all emotions variables are skewed positively, as shown in Table 1 and Figure 4. Whereas, Jarque-Bera (JB) test of normality postulates that all of the variables are not normally distributed as their probability values are less than 0.05.

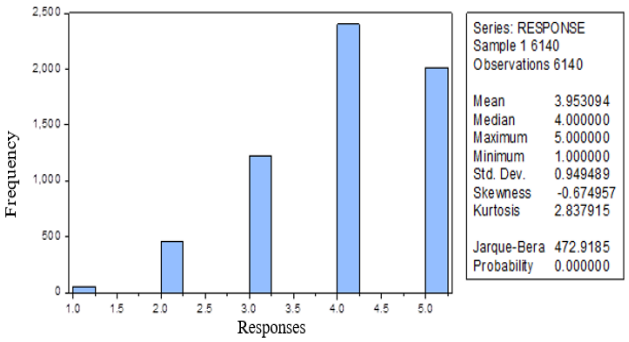

Fig. 4 Histogram of response in primary data

The information on the correlation coefficient is postulated in Table 2. The correlation between two variable ranges from -1 to +1. The -1 value of correlation indicates that there exists a perfect negative correlation between the two variables while +1 value indicates that two variables are perfectly positively related with each other. The value zero indicates that two variables have no relationship.

Table 2: Correlation

	Survey	Emotions				
	Response	Sadness	Happiness	Fear	Disgust	Anger
Response	1.000000	-0.065188	0.021279	0.028453	-0.049532	-0.041850
Sadness		1.000000	0.057985	0.166047	0.191063	0.463273
Happiness			1.000000	0.002729	0.110887	0.069155
Fear				1.000000	0.078021	0.128599
Disgust					1.000000	0.265747
Anger						1.000000

The table shows that response is negatively correlated with sadness, disgust and anger; while it is positively correlated with Happiness and fear. According to The Ekmans' Atlas of Emotions, the response of fear is to avoid the situation

which means either physically stay away from the threat or keep oneself from thinking about it [12]. The statistical analysis shows that data is not Gaussian, which indicates the complexity of data.

The question wise average response of all the students for the survey is represented in Figure 5 which indicate the average response of student per question. The Figure 5 shows that student are inclined toward strongly agree for Question No. 2 on average while the inclination of students for Question No. 1 is toward neutral point

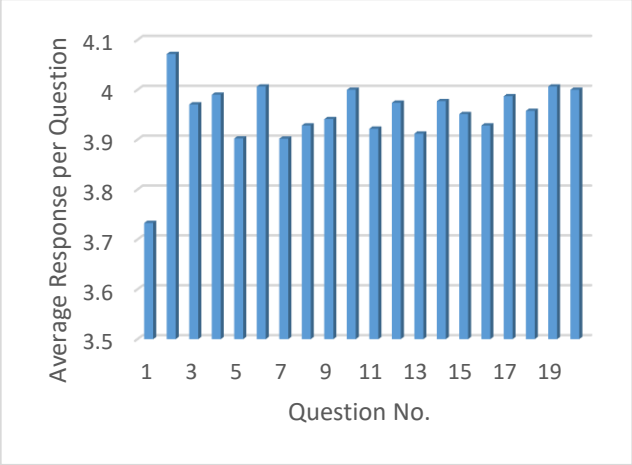

Fig. 5 Question wise Average Response of Students.

5. Conclusion and Future Work

In the current research work, we have been able to develop an Electronic-survey (E-survey) application in combination with emotion recognition and categorization based on the Affectiva SDK. The application primary testing has been done on the data set obtained from Balochistan University of Engineering and Technology Khuzdar Pakistan while keeping the confidentiality. The results obtained from the software application have been analysed using standard statistical tools. In future, we aim to develop a comprehensive framework based on advanced computational methods with a focus on fuzzy logic to capture the ambiguities found in analysis of data obtained from the Electronic Survey obtained from our E-survey application.

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