# Report on the outcomes of a Short-Term Scientific Mission[1]

**Action number: CA19102**

**Grantee name: Sarang Shaikh**

## Details of the STSM

Title: **Aspect-Based Opinion Mining on Student's Feedback for Faculty Teaching Performance and Course Evaluation**

Start and end date: **10/09/2022** to **25/10/2022**

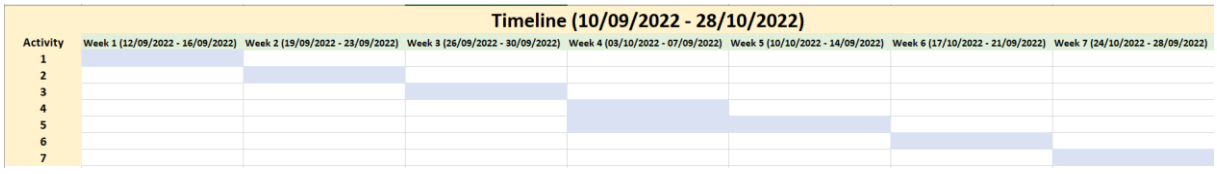
## Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

*(max. 500 words)*

The purpose of my short-term scientific mission (STSM) was to understand and gain knowledge about using AI based techniques for performing aspect-based opinion mining on student's feedback which are used to evaluate the courses and faculty teaching performance in the higher education institutions. The Dept. of Quality Enhancement Cell (QEC), headed by Prof. Dr. Sher Muhammad Daudpota, at Sukkur IBA University, Pakistan, offered me this excellent opportunity for working on the above mentioned STSM.

During my visit, I firstly met with the host's team comprising of 03 team members. These peoples are the domain experts for evaluating student's feedbacks at their department once in a semester since more than 10+ years. The department does this evaluation for each of the faculty member at the institution for each of the course he/she is teaching at all the departments. The proposed weekly-based plan is shown below which was followed during the STSM activities.




The work will be carried out as per the objectives set in the goals of this STSM research stay.

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

The week 1 was consisted of having the regular meetings with the QEC team to understand all the phases involved in the activity of collecting student's feedback for teacher performance and course evaluation. The team shared that they conduct this activity once every semester by going into each classroom and asking each student to fill an online form with open-ended comments regarding the different aspects of each individual teacher and the course. With the experience of more than 10+ years, the team has internally developed a list of aspects both for the teacher and the course for which they manually analyse the student feedbacks and assign those aspects. The team further shared that once the aspects are assigned, they further analyse the feedbacks to understand their opinions in form of sentiments. Finally, those opinions/sentiments are mapped with certain identified aspects and are then shared with individual teachers such that they can understand about what they are good at during teaching and what they need to improve. For the course, the relevant aspects and mapped sentiments give an indication to the department either to continue offering the course or not based on student's requirements. Table 1 shows the list of aspects and sentiments which they use to assess the student feedbacks, manually.

*Table 1 Teacher, Course aspects and sentiments*

| **Teacher** | **Course** |
|---|---|
| **Aspects**<br>**1. Assessment**<br>**2. Behaviour**<br>**3. Experience**<br>**4. General**<br>**5. Knowledge**<br>**6. Teaching Skills** | **Aspects**<br>**1. Content**<br>**2. General**<br>**3. Learning Material**<br>**4. Pace**<br>**5. Relevancy** |
| **Sentiments**<br>**1. Positive**<br>**2. Negative**<br>**3. Neutral** | **Sentiments**<br>**1. Positive**<br>**2. Negative**<br>**3. Neutral** |

Here, the team shared the major challenge that they are facing due to the manual process is large time and human efforts. The aim of this STSM was to automate this activity with the help of domain experts using the AI techniques.

The week 2 starts with developing the corpus of student's feedbacks with the help of the QEC team. We started with gathering raw feedbacks which the team had already collected from the students each semester. The raw feedbacks span over the duration of 10 years (from 2012 – 2021). The departments included in the feedbacks were 1) Business Administration, 2) Computer Science, 3) Electrical Engineering, 4) Education and 5) Mathematics & Social Science. The collected raw data consisted feedbacks of almost 56 faculty members and 49 courses. Before, starting of the STSM activity the QEC team already got the consent from all the faculty members to use the feedbacks data for this activity. With the discussions, we identified several cleaning steps that needs to be performed before processing the feedbacks data further. There was total 21250 comments in total used for this activity. With the help of the team, we started annotating the comments with different aspects and sentiments for both teacher and course as mentioned in the Table 1. The final distributions of those comments in the relevant annotation categories are available at: ***shorturl.at/eM789.***

In the week 3, once we had the annotated/labelled data ready, the work of the core QEC team paused for next couple of weeks as I started looking into literature along with the host Prof. Dr. Sher Muhammad Daudpota to understand existing state-of-the-art research studies used for similar kind of work. We found

couple of relevant research studies [1]–[4] which have worked on similar kind of problem the one we are targeting for this STSM activity. But there were few gaps which we identified as below:

1) Although existing studies have worked on automating the process of student's feedbacks into teacher aspects, sentiment but none of the study has worked on course aspects, sentiments.
2) Existing studies have worked on a smaller number of feedbacks as compared to the count that we have used for this STSM.
3) None of the study has made annotated dataset publicly available such that other researchers can take benefit of it.

This gave me the confidence that I am really working on solving some real-world problem which can contribute to the betterment.

The week 4 and 5 started with defining the scope of developing an intelligent/automatic solution for student's feedback analysis in terms of identifying the aspects and sentiments for both the teacher and course. With the mutual discussions with the host and the team, we finalized that I would do the two things:

1) Based on the existing annotated corpus, utilizing the recent machine learning and NLP techniques I will develop some basic supervised machine learning algorithms which will be able to predict the category of the student feedback text (either teacher or course), the aspect and its sentiment. The best performing model will be selected to use for the below point.
2) Next, I will develop a real-time small web application to which If we input student's feedbacks/comments related to any course/teacher, it could automatically identify either the comment is related to teacher or course, the aspect as well as the sentiment discussed in the comment. Also, to display all these extracted information in form of interactive charts such that it can help the dept. of QEC to get rid of the manual process and to share this information with the relevant stakeholders.

To implement all this technical stuff, I used the Python programming language. For pre-processing the data and training machine learning algorithms I used several Python packages such as: scikit-learn, NLTK, genism, etc. For developing the web application, I used the Flask and Plotly libraries.

Once, I implemented all the work in the week 4 and 5, the week 6 started with evaluation of the developed machine learning algorithms and testing of the web application with the help of domain experts to see if the predictions are going in right direction or not?

Finally, at the end of the week 6 with the feedback from the domain experts and discussing computational metrics such as precision, recall, f1-score values of the developed algorithms it was decided that the initial developed work is good enough to be used at the department of QEC for performing the task.

The week 7 which was the last week I presented the whole work to the host, and we started discussing the possible options to report all the work in form of publishing some peer-reviewed scientific papers. Information about this is given in the next section below.

References

[1] I. Sindhu, S. M. Daudpota, K. Badar, M. Bakhtyar, J. Baber, and M. Nurunnabi, "Aspect-based opinion mining on student's feedback for faculty teaching performance evaluation," *IEEE Access*, vol. 7, pp. 108729–108741, 2019.
[2] M. Herath, K. Chamindu, H. Maduwantha, and S. Ranathunga, "Dataset and Baseline for Automatic Student Feedback Analysis," in *Proceedings of the Thirteenth Language Resources and Evaluation Conference*, 2022, pp. 2042–2049.
[3] R. Faizi and S. El Fkihi, "A Sentiment Analysis Based Approach for Exploring Student Feedback," in *International Conference on Innovative Technologies and Learning*, 2022, pp. 52–59.
[4] P. Ren, L. Yang, and F. Luo, "Automatic scoring of student feedback for teaching evaluation based on aspect-level sentiment analysis," *Educ. Inf. Technol.*, pp. 1–18, 2022.

## Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

*(max. 500 words)*

As discussed in the weekly based details in the above section, one can see that all the planned goals and expected outcomes of the proposed STSM are achieved.

Specifically, the planned goals and outcomes were:

1. Understanding of the overall process of student's feedback analysis – **this was achieved with the activities conducted in the week 1.**
2. Corpus development of manual student's feedback into different aspects (e.g., teaching skills, behavior, knowledge, assessment, experience) and opinions (e.g., positive, negative, and neutral) - **this was achieved with the activities conducted in the week 2.**
3. Building automatic/intelligent machine/deep learning and NLP based solution to automate the extraction of aspects and opinions from student's feedbacks. – this was achieved with the activities conducted in the week 3, 4, 5 and 6. The codes used for training algorithms are available at: **https://github.com/sarangs-ntnu/STSM_LITHME.git**
4. The solution will be in form of a web-based application representing the extracted results in form of a report. - **this was achieved with the activities conducted in the week 4, 5 and 6.** The developed application is available at: **https://lithme-stsm-qec-app.herokuapp.com/**
5. Discussion and future plan for minimum two paper publications from the overall activities of the proposed STSM - **this was achieved with the activities conducted in the week 7.**
6. We identified two possible options for now:
    i) A scientific paper to report all the steps related to the preparing the annotated corpus (Tentative venue: Data in Brief Journal – Elsevier) – Status: Under writing
    ii) A scientific paper to report all the experiments performed on the developed dataset along with the details on the web application (Tentative Venue: IEEE Access) – Status: Planned after the first paper

The whole activity and expected results will contribute towards below specific Action objectives.

1. Research coordination objectives
    a) Develop: (i) methods, (ii) theory to study language in the human-machine era.
    b) Generate substantive guidelines for equitable development of emerging technologies.
    c) Advance understanding of emerging technologies likely to influence language.
2. Capacity building objectives
    a) Create a collaborative network with critical mass to drive scientific progress
    b) Achieve breakthroughs by building much-needed bridges between computational linguists and a range of other linguists, alongside developers and stakeholders.