

# Automated Customer Complaint Processing for Business Development Based on Natural Language Processing and Federated Learning - Case Study of Laptops.

*Md Ulfat Tahsin<sup>1,\*</sup>, Md Saeem Hossain Shanto<sup>2,\*</sup>, M Rashedur Rahman<sup>3,\*</sup>*

\* - Department of Electrical and Computer Engineering, North South University, Dhaka, Bangladesh.

1 - email: [ulfat.tahsin@northsouth.edu](mailto:ulfat.tahsin@northsouth.edu); ORCID: 0000-0002-2810-2821

2 - email: [saeem.shanto@northsouth.edu](mailto:saeem.shanto@northsouth.edu)

3 - email: [rashedur.rahman@northsouth.edu](mailto:rashedur.rahman@northsouth.edu)

## **Abstract**

Empathy is considered one of the key elements while developing a better version of any product or service. Recent developments in online shopping, business analytics, and business intelligence are taking organizations to sky-high profit margins. Many big and small organizations invest huge capital in collecting and analyzing customer feedback and market information. It is often a tedious process as it takes a long time to reach the manufacturers as they think of developing a better version of their products. Whereas companies performing no market research often fail to promote and increase the sales of their products due to a lack of empathy and failure to understand customer satisfaction and demands. Keeping that in mind, we put forward a complete system to generate product summaries, customer dissatisfaction reports, and graphical illustrations of the product based on customer reviews, complaints, and feedback, depending on their usage history. We employ Natural Language Processing to classify and analyze customer reviews and feedback and extract issues that customers face while using that product. Federated learning is utilized to ensure the data privacy of the participating clients, deal with non-uniform data distribution, and reduce the stress on the central server. With federated training rounds, the NLP models are updated after each round of federated computation using the FedAvg algorithm. We also analyzed the impact of federated training on the three BERT variants (BERT, DistillBERT, and RoBERTa) for performing the classification task, which is later managed by our web application system to generate an overall product complaint report and graphical illustration. The best result was obtained by the RoBERTa variant during our experiments. On our web application, the best-performing model variant is deployed and tested. The simulation and web application show that our suggested system can be implemented successfully.

**Keywords** - *Business Development, Business Intelligence, Empathy, Natural Language Processing, Federated Learning, Interactive Web Application.*