# Sabbir Hossain Ujjal

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## Education

**Bangladesh University of Engineering and Technology (BUET)**
Bachelor of Science (B.Sc.) in Electrical and Electronic Engineering (EEE) March 2018 - May 2023
Major in Communication & Signal Processing (CSP)
**CGPA - 3.75/4.00**

**Relevant Coursework:** Probability and Statistics | Digital Signal Processing I | Continuous Signals and Linear Systems | Random Signals and Processes | Computer Programming | Computer Networks | Control Systems | Microprocessors and Embedded Systems | Biomedical Signals Instrumentation and Measurement

## Research Interest

Applied Machine Learning | Natural Language Processing | Audio & Speech Processing | Multimodal Large Language Models | Conversational Agents | Human Computer Interaction | Robust & Trustworthy AI

## Publications

**mTOVA: A Multilingual Task Oriented Virtual Assistant for Human-Computer Communication**
**Sabbir Hossain Ujjal**, A F M Mahfuzul Kabir, Mohammad Ariful Haque, 5th IEEE International Conference on Telecommunications and Photonics (ICTP), 2023, DOI: 10.1109/ICTP60248.2023.10490454

## Research Experience

**Development of a Voice-Controlled Multilingual Conversational Agent Using Deep Learning and Natural Language Processing** [Undergraduate Thesis] May 2022 - May 2023
Supervisor: Dr. Mohammad Ariful Haque

- Developed a virtual assistant that handles both Bengali and English commands integrating automatic speech recognition (ASR), natural language processing, and a dialogue management system with the RASA framework. Our designed system achieved 93% user intent recognition and 99.4% task completion accuracy, making voice technology more accessible for Bengali speakers.

**Development of Bengali Large Language Model** (Ongoing) September 2023 - Present

- Leading the development of novel Bengali large language model through custom **BPE** tokenizer implementation, large-scale data collection and generation, and instruction-tuned model development - aiming to release the first open-source Bengali large language model with extensive benchmarking.

## Work Experience

**Advanced Chemical Industries (ACI) Limited** Dhaka, Bangladesh
Team Lead, Machine Learning Team Aug 2024 - Present

Leading a cross-functional team of **12** talented engineers in developing and deploying machine learning solutions that serve **34 internal businesses**. Managing the full ML system design process and optimization while ensuring best practices in ML system and model maintenance.

**Projects under my supervision:**

- **Information Extraction System**: Utilizes multimodal large language model to extract key information from business PI/PO documents.
- **Prescription OCR:** Extracts medicine names from handwritten prescriptions using YOLO and TrOCR models for accurate interpretation. [Demo Video]
- **Insight Generation:** Utilizes large language models (LLMs) to analyze tabular data, uncover patterns, and generate meaningful insights. [Link]
- **Vehicle Number Plate Detection:** Employs a YOLO model-based system to identify license plates and extract numbers from live camera feeds during entry, exit, and weighbridge operations. [Demo Video]
- **Customer Auto-Identification:** Integrated facial recognition system at YAMAHA service centers to identify registered customers and access their service history for personalized assistance.
- **Merchandising Visibility:** Uses a mobile camera to identify and count products on store shelves, ensuring visibility and monitoring during market visits. [Project Page]

- **Theft Detection:** Implements action detection in retail shops to identify suspicious behaviors and prevent theft using computer vision techniques.

Machine Learning Engineer — Oct 2023 - Aug 2024

A short list of projects implemented during this role:

- **Virtual Assistant** [Demo Video]: Developed a sophisticated bilingual virtual assistant handling Bengali and English voice queries through Whisper-based **ASR** integration. The system leverages advanced **LLMs with RAG** architecture and specialized vector databases **(Qdrant)** for accurate information retrieval while employing TTS for natural voice responses. The assistant efficiently handles customer inquiries across multiple domains, including product information, technical support, and service requests.

- **ACI SpeechHub** [Demo Video]: Implemented an enterprise audio processing platform, integrating ASR for Bengali and English transcription, with **T5** and **BERT** models for automated summarization and keyword extraction. Platform reduced manual transcription time by 70% across customer service, compliance, and meeting documentation workflows.
  **Impact:** More than **70** employees are using this utility for automated meeting transcription and feedback analysis.

- **Voice Based Ordering System:** Engineered a voice-command ordering system utilizing ASR that **reduced order processing time by 50%**, streamlining sales representatives' interactions with retailers.
  **Impact:** Around **3000** sales representatives are using it to take orders from retail outlets.

- **Writing Assistant**: Designed a bilingual writing assistant handling Bengali and English that streamlines enterprise documentation, leveraging LLM and langchain for context-aware report generation. The system guides employees through structured templates, automates formatting, and ensures compliance with company standards, reducing report creation time significantly and maintaining accurate document structure and content requirements.
  **Impact:** More than **70** employees are using this utility for automated report generation.

**AIEdgeInside** – AI Startup — Tokyo, Japan

Machine Learning Engineer [Remote] — Aug 2023 - Oct 2023

- Experiemented and developed computer vision solutions for business process automation, such as a **document error detection** system. Extended research into generative AI by implementing a video frame generation system using **diffusion** models and **ControlNet**, focusing on improving frame consistency and video processing capabilities.

## Achievements

- **RISE Student Research Grant Award** — 2023
  Research grant for outstanding undergraduate thesis by Research and Innovation Centre for Science and Engineering (RISE), BUET.
- **Dean's List Award** — 2021, 2022
  Academic honor by BUET for attaining a CGPA of 3.75 for two consecutive terms.
- **University Merit Stipend** — Jan 2018, July 2018, July 2021
  Academic honor by BUET for ranking among the top 20 students.
- **President's Scout Award** — 2013
  The highest award of Bangladesh Scouts
- **Government Scholarship in Secondary School Certificate (SSC) Examination** — 2015
  Scholarship awarded by Ministry of Education, Bangladesh.

## Competitions

- **Champion, Robi Datathon 3.0** - Bangladesh's largest data science competition [Media cover]
- $1^{st}$ **Runner-up, IUT National ICT Fest 2024 Datathon:ASR for Bengali Regional Dialects** [Leaderboard]
- **Bronze Medalist** [$59^{th}$ internationally, $4^{th}$ in Bangladesh], **Bengali.AI Speech Recognition** [Leaderboard]
- $2^{nd}$ **Runner-up, 2nd AVA Challenge@IEEE MIPR 2024** [Leaderboard]

## Open Source Contributions

- **Awesome Bangla Datasets** [Repository] - Established the first centralized repository for Bengali language datasets, enabling accessible data resources for Bengali deep learning research and development.
- **banglanlptoolkit** [PyPi Package] [≈ 35,000 downloads] - A comprehensive Bengali NLP toolkit, featuring text normalization, tokenization, punctuation generation, and text augmentation capabilities.
- **faster-translate** [PyPi Package] [≈ 7,000 downloads] - A fast and efficient Bengali translation tool using ctranslate2, enabling rapid text translation with pre-trained translation models.

## Leadership and Volunteering Activities

- **Team Lead**, Machine Learning Team, ACI Limited — Aug 2024 - Present
- **Senior Patrol Leader (SPL)**, SHKSC Scout Group — Feb 2014 - Nov 2014
  Shamsul Hoque Khan School & College, Dhaka.
- **Advisor**, Shopno Sarothi [Activities] — Feb 2019 - May 2023
  **Shopno Sarothi** is a charitable foundation that successfully raised funds and provided essential support to underprivileged communities.

## Highlighted Projects

- **AI Generated Text Detection** [Project Page] - Developed a robust deep learning model to accurately distinguish between AI-generated and human-written text, which can help various evaluation processes.
  - Language/Framework/Model: Python, Pytorch, DeBERTa, Feature engineering
- **Bengali Name Extractor** [Project Page] [Code] - Implemented a robust NLP-based system for accurate person name extraction from Bengali text which can be used in any call center and online voice-based transaction systems.
  - Language/Framework/Model: Python, Pytorch, BanglaBERT
- **Resume Classification and Sorting** [Project Page] [Code] - Engineered a deep learning-based end-to-end system for automated resume classification and sorting, streamlining and enhancing recruitment processes.
  - Language/Framework/Model: Python, Pytorch, BERT, DeBERTa
- **Real Time Covid Patient Monitoring** [Project Page] [Code] - Designed an IoT-based COVID-19 patient monitoring system integrating a sound event detection (SED) model and sensors, providing real-time emergency notifications to concerned people.
  - Language/platform/Model: Python, C++, Arduino, YAMNet
- **Drowsiness Detection by PPG signal Analysis** [Project Page] - Engineered a wearable device, analyzing PPG signals to detect drowsiness, alerting users to prevent potential road accidents.
  - Language/platform: Matlab, C++, Arduino
- **Real Time Object Detection for Blind People** [Project Page] [Code] - Developed an end-to-end system for detecting objects from images and converting them to audible messages to guide blind individuals.
  - Language/platform/Model: Python, YOLO, Faster-RCNN
- **Bangla Calendar Clock** [Project Page] [Code] - Implemented a microprocessor-based multilingual, multi-calendar clock displaying Gregorian, Bengali, and Arabic dates. Our developed clock was later selected among 6 participating teams and hung in the microprocessor lab of the BUET EEE department.
  - Language/platform: C++, Arduino

## Technical Skills

- **Programming Languages:** Python, C, C++, MATLAB
- **Frameworks & Libraries:** PyTorch, TensorFlow, Keras, RASA, Langchain, LlamaIndex, AutoGen
- **DevOps Services:** Git, GitHub, Bash, RESTApi, FastAPI, Flask, Uvicorn, Qdrant, Weaviate
- **Circuit Simulation:** Proteus, PSpice
- **Embedded Systems:** Verilog, STM32, Arduino
- **Other Tools:** LaTeX, Office suite Softwares

## MOOC Courseworks

- Deep Learning Specialization by DeepLearning.AI [Certificate]
- Machine Learning by Stanford University [Certificate]
- Fine-tuning Large Language Models by DeepLearning.AI [Certificate]
- Python for Everyone by University of Michigan [Certificate]
- Mathematics for Machine Learning Specialization by Imperial College London [Certificate]