

# **Internship Experience at EVOMED Technology in Summer 2025**

*by*

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*Internship report (CSE4099) submitted in partial fulfillment of the  
requirements for the degree of*

**Bachelor of Science in Computer Science and Engineering**

Under the supervision of

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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**UNIVERSITY OF LIBERAL ARTS BANGLADESH**

**SUMMER 2025**

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## DECLARATION

|                              |                                                           |
|------------------------------|-----------------------------------------------------------|
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I declare that this internship report entitled *Internship Experience at EVOMED Technology in Summer 2025* is the result of my own work except as cited in the references. The internship report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## CERTIFICATE

This is to certify that the internship report entitled **Internship Experience at EVOMED Technology in Summer 2025**, submitted by **Md. Rifat Aknda** (Student ID: 212014003) is a undergraduate student of the **Department of Computer Science and Engineering** has been examined. Upon recommendation by the examination committee, we hereby accord our approval of it as the presented work and submitted report fulfill the requirements for its acceptance in partial fulfillment for the degree of *Bachelor of Science in Computer Science and Engineering*.

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**Prof. Muhammad Golam Kibria, PhD, SMIEEE,**  
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**Place:** Dhaka

**Date:** August 21, 2025

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I am greatly indebted to our honorable teachers of the Department of Computer Science and Engineering at the University of Liberal Arts Bangladesh who taught me during the course of our study. Without any doubt, their teaching and guidance have completely transformed us to the persons that we are today.

I am extremely thankful to my parents for their unconditional love, endless prayers and caring, and immense sacrifices for educating and preparing me for the future. I would like to say thanks to my friends and relatives for their kind support and care.

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*Md. Rifat Aknda*

**University of Liberal Arts Bangladesh**

**Date:** August 21, 2025

To the one I've seen,  
*who walked through fire and*  
*smiled.*

– *Md. Rifat Aknda*

## EXECUTIVE SUMMARY

The internship at EVOMED Technology provided an opportunity to gain hands-on experience in applying Artificial Intelligence (AI), Internet of Things (IoT), and healthcare technologies to real-world projects. EVOMED Technology is a forward-looking organization committed to transforming healthcare accessibility and quality by integrating IoT, Machine Learning, and TinyML into advanced Remote Patient Monitoring (RPM) solutions. Its vision is to build a world where healthcare is no longer limited by geography, complexity, or cost, and its mission emphasizes smarter, more inclusive, and human-centered healthcare solutions. The primary objective of my internship was to contribute to ongoing AI and IoT projects while developing practical skills in data acquisition, preprocessing, model development, and application integration. Over the three-month period from May 25, 2025, to August 25, 2025, I worked as an AI Engineer Intern in the Research & Development (R&D) department, undertaking tasks such as data annotation, dataset preprocessing, development and fine-tuning of deep learning models, and creation of interactive desktop and web applications. Key projects included the Energy Meter Reading system, Arduino-based real-time sEMG and IMU data acquisition, the Evo Extractor desktop application, and the adaptive hybrid model for automated wheelchair control and data analysis. These efforts resulted in high-quality datasets, robust AI models, and user-friendly software solutions that enhanced accessibility and interactivity for technical and non-technical users. Through this internship, I significantly enhanced my technical proficiency in AI, IoT, and data analysis while developing essential professional skills in teamwork, project management, and problem-solving. This experience provided substantial personal and professional growth, preparing me to contribute effectively to innovation-driven, technology-enabled healthcare solutions.

**Keywords:** AI in healthcare, IoT-based monitoring, deep learning applications, data acquisition, hybrid models, data analysis.

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# Chapter 1

## Introduction

This chapter outlines the introduction with purposes of the internship and the The objective of this internship report. These are discussed with details in the sections below.

### 1.1 Introduction

The rapid evolution of technology is reshaping the healthcare landscape, enabling smarter, faster, and more personalized solutions. Immersing in this transformative environment provides hands-on exposure to cutting-edge innovations that bridge technology and human care. This internship marks my three-month research and development experience as an AI Engineer Intern at EVOMED Technology, from May 25 to August 25, 2025. EVOMED Technology is a forward-looking organization committed to transforming healthcare through the integration of IoT, Machine Learning, and TinyML. Its mission is to make healthcare smarter, inclusive, and human-centered, while its vision aims to deliver personalized care to every individual, regardless of geography, complexity, or cost. The company focuses on creating innovative, accessible, and high-quality solutions that empower both patients and healthcare professionals [EVOMED Technology \(2025\)](#).

The purpose of this internship was to gain hands-on experience in the development of AI-driven healthcare applications, data acquisition systems, and interactive platforms. My role involved designing research methodologies, collecting and preprocessing diverse datasets, fine-tuning pretrained deep learning models, developing hybrid AI pipelines, and integrating these models into desktop and web

applications. Additionally, I participated in data visualization, interactive dashboard creation, and the development of assistive technologies such as adaptive wheelchair control using few-shot learning.

This report provides a comprehensive account of the projects undertaken, methodologies applied, tools and technologies used, and the outcomes achieved. It reflects both the technical and professional growth fostered during the internship, highlighting how my contributions supported the company's objectives and advanced practical applications of AI and IoT in healthcare.

## **1.2 Aims and Objectives of the internship**

The overall aims and objectives of my internship at EVOMED Technology was to bridge the gap between theoretical knowledge and practical application in the fields of Artificial Intelligence, IoT, and healthcare technology. Each task and project was aligned with the organization's broader mission to develop smart, inclusive, and human-centered solutions. The following aims and objectives guided the direction of my work and contributions throughout the internship period.

### **1.2.1 Aims**

- To gain hands-on experience in applying Artificial Intelligence (AI), Internet of Things (IoT), and healthcare technologies in real-world projects.
- To support EVOMED Technology's mission of delivering smart, inclusive, and human-centered healthcare solutions through AI and embedded systems.
- To develop robust, deployable AI systems for tasks such as remote patient monitoring, gesture control, image-based diagnosis, and automated utility meter reading.

### **1.2.2 Objectives**

- Design and implement research methodologies for AI-driven healthcare projects.
- Collect, annotate, and preprocess diverse medical and biomedical datasets (images, audio, video, biosignals).

- Develop and fine-tune pretrained deep learning models (YOLO, TrOCR, ViT, ResNet, etc.) for tasks like classification, detection, and OCR.
- Build hybrid model pipelines for edge AI applications like gesture recognition and smart wheelchair control.
- Create interactive desktop and web applications using tools like Python, Flask, Tkinter, and BLE-enabled devices.
- Conduct data visualization and statistical analysis using Python, R, Power BI, and Tableau to extract insights and present results.
- Enhance model usability through user-friendly interfaces and real-time interaction capabilities.

### **1.3 Motivation**

My motivation for pursuing this internship at EVOMED Technology stemmed from a strong desire to apply my academic knowledge of Data Science, Artificial Intelligence and Internet of Things to real-world healthcare challenges. I have consistently been inspired by the transformative power of technology to improve people's lives in meaningful ways, especially in critical sectors like health. EVOMED's mission to develop inclusive, intelligent, and human-centered solutions resonated deeply with my own values. The opportunity to contribute to projects involving medical imaging, assistive devices, and real-time physiological monitoring offered a meaningful platform to explore how advanced AI models and embedded systems can be leveraged to solve accessibility and automation problems. This internship also provided a unique environment to work at the intersection of innovation and empathy, where engineering meets care, which further fueled my interest in building technology that not only functions well but also serves a greater social purpose.

### **1.4 Objective of the internship report**

The objective of this internship report is to provide a structured overview of my work, learning, and contributions during the internship at EVOMED Technology. It aims to document the methodologies, tools, and technologies applied across various

projects, highlight the skills developed, and reflect on the impact of the work on both personal growth and organizational goals. Additionally, the report serves to summarize the results, findings, and insights gained from hands-on experience in AI, IoT, and healthcare technology applications, providing a comprehensive account of the internship journey.

## 1.5 Internship Timeline

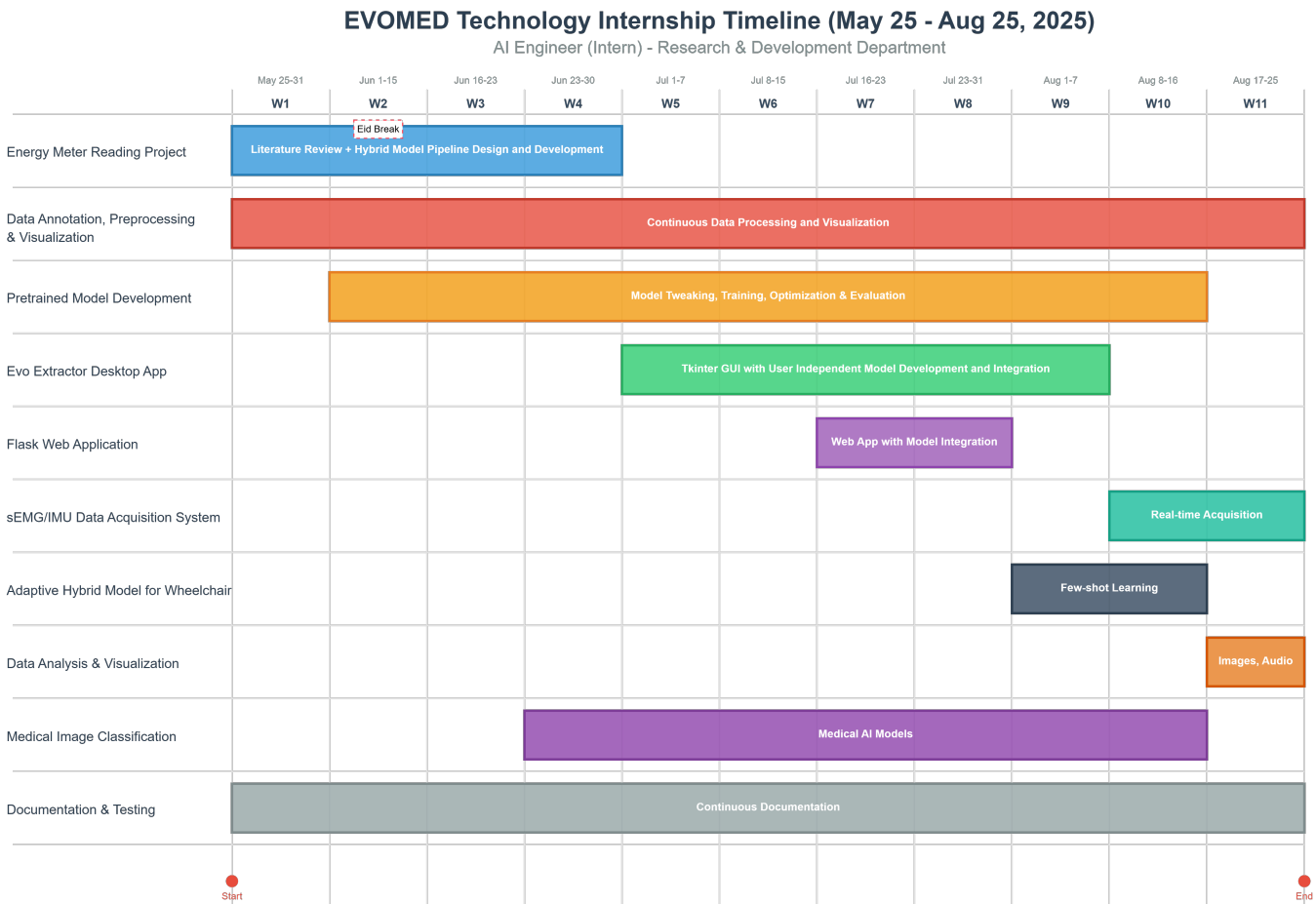


Figure 1.1: Internship Timeline

# Chapter 2

## Background

This chapter provides background information such as an overview of EVOMED Technology, its vision, mission, and industry context, industry values, as well as the purpose of the internship and my role in the organization.

### 2.1 Organization Overview

EVOMED Technology, established in 2024, is an innovative healthcare technology company dedicated to shaping a smarter, more connected future for healthcare. Leveraging the power of the Fourth Industrial Revolution, the organization develops advanced Remote Patient Monitoring (RPM) devices that integrate IoT, Machine Learning, and TinyML. These solutions aim to deliver faster, personalized, and high-quality healthcare to people everywhere, eliminating barriers such as distance, cost, and complexity. By empowering patients to take control of their health and equipping healthcare providers with advanced tools, EVOMED focuses on creating smart, user-friendly solutions that strengthen healthcare systems globally [EVOMED Technology \(2025\)](#).

### 2.2 Vision and Mission

The vision and mission of EVOMED Technology are:

### **2.2.1 Vision**

To build a world where healthcare is no longer limited by geography, complexity, or cost—where intelligent technology brings personalized care to every person, in every place.

We envision a future where healthcare is proactive, connected, and deeply empowering. Through innovation rooted in empathy and impact, EVOMED will help lead the way [EVOMED Technology \(2025\)](#).

### **2.2.2 Mission:**

We exist to make healthcare smarter, more inclusive, and truly human-centered. By combining cutting-edge technologies like IoT, Machine Learning, and TinyML, we create affordable, accurate, and accessible solutions that empower individuals, support healthcare professionals, and close the care gap—everywhere.

We are driven by values: innovation with purpose, accessibility without compromise, and care that connects [EVOMED Technology \(2025\)](#).

## **2.3 Industry Context**

EVOMED Technology operates in the healthcare technology and remote patient monitoring industry, which focuses on leveraging digital and AI-driven tools to enhance healthcare delivery. Its solutions address critical challenges in patient accessibility, real-time monitoring, and proactive care, contributing to the global movement toward more connected, data-driven, and efficient healthcare systems [EVOMED Technology \(2025\)](#).

## **2.4 Industry Values**

The healthcare technology industry operates at the intersection of innovation, accessibility, and impact. At its core, the industry prioritizes the development of solutions that enhance patient outcomes, streamline clinical workflows, and democratize access to quality care, especially in under-resourced or remote areas. EVOMED Technology, as a participant in this space, upholds these industry values through its

commitment to delivering affordable, intelligent, and human-centered healthcare technologies.

A key value in this industry is “innovation with purpose”, which drives organizations to design systems that are not only technologically advanced but also solve practical, real-world healthcare challenges. Another fundamental value is “accessibility without compromise”, ensuring that quality medical solutions are not limited by geography, socio-economic status, or technical complexity. Finally, “human-centered design” is at the heart of healthcare technology, emphasizing systems designed with a deep understanding of patient needs, clinical workflows, and accessibility for all users, including non-technical stakeholders.

EVOMED reflects these values by integrating AI, IoT, and TinyML to create solutions such as Remote Patient Monitoring (RPM) devices, smart diagnostic tools, and assistive technologies. These offerings are aligned with broader global efforts to transform healthcare into a proactive, connected, and inclusive system that empowers individuals and strengthens communities.

## **2.5 Internship Purpose and Role**

The purposes of this internship is to provide hands-on experience in applying AI, computer vision, IoT, and data analytics in real-world healthcare projects. My role as a Research & Development Intern – AI Engineer involved designing research frameworks, collecting and preprocessing datasets ethically, developing and fine-tuning AI models, and contributing to desktop and web application development for healthcare use cases. I also collaborated closely with the team to ensure timely execution of project milestones, enabling practical application of theoretical knowledge while supporting EVOMED Technology’s mission of delivering inclusive, smart, and human-centered healthcare solutions.

# Chapter 3

## Scope of Work

This chapter presents the scope, tasks, and applications of the work carried out during my internship at EVOMED Technology. It outlines the technical domains explored, the specific responsibilities undertaken, and the practical systems developed as part of the Research & Development team. By documenting both the processes and their real-world applications, this chapter highlights how the internship contributed to advancing AI-driven healthcare and assistive technologies while aligning with the organization's broader mission.

### 3.1 Scope of Work

The scope of this internship was centered around the application of Artificial Intelligence (AI), Internet of Things (IoT), and embedded systems in the development of healthcare and assistive technologies. As an AI Engineer Intern in the Research & Development department at EVOMED Technology, my work involved contributing to projects that required both theoretical understanding and practical implementation of intelligent systems. The internship was designed to provide exposure to a wide array of tasks including data acquisition, annotation, preprocessing, model development, system integration, and deployment.

The scope covered various domains such as medical image analysis, biomedical signal processing, real-time monitoring systems, and human-computer interaction through wearable devices. Specific technical areas included computer vision, optical character recognition (OCR), deep learning model training and fine-tuning, data visualization, and few-shot learning techniques for adaptive systems. Additionally, the internship encompassed the development of desktop and web-based

applications integrated with AI models to ensure usability for both technical and non-technical stakeholders.

Through these multidisciplinary tasks, the scope of work ensured a well-rounded experience that emphasized both innovation and usability in AI-driven healthcare solutions. The projects undertaken were designed to address real-world challenges in healthcare accessibility, patient monitoring, and assistive technologies, aligning with EVOMED Technology's broader mission of making healthcare smarter, inclusive, and human-centered.

## **3.2 Assigned Tasks and Projects**

Throughout the internship attachment period, I was assigned a variety of tasks, projects, and responsibilities. These includes:

- Image and video data annotation, labeling, ground truth generation, and visualization.
- Data preprocessing for various datasets using a range of techniques.
- Pretrained detector and classifier models development through model tweaking on diverse datasets.
- Data analysis and visualization of audio, video, and image data using Python, R, Power BI, and Tableau on several datasets.
- Hybrid deep learning model development for the Energy Meter Project.
- Flask-based enhanced interactive web application with deep learning model integration.
- CLI-based real-time sEMG and IMU data acquisition system using a wearable armband.
- Evo Extractor: Desktop application with integrated user-independent AI model.
- Adaptive hybrid model development for automated wheelchair based on few-shot learning.

### **3.3 Applications of the Tasks and Projects**

The projects and systems developed during my internship at EVOMED Technology have practical implications in various areas of smart healthcare, assistive technology, and real-time monitoring systems. Each component of the work was designed to solve real-world problems with a focus on in-device integration, accessibility, automation, and user-centric design.

#### **3.3.1 Data Annotation and Preprocessing**

Comprehensive annotation and preprocessing of image, video, and biosignal datasets were carried out to ensure high-quality, structured inputs for supervised learning and deep model training. Tools such as Roboflow and CVAT were used to generate consistent ground truths, while techniques like normalization, resizing, filtering, and feature scaling were applied to enhance data integrity and model readiness. This annotated and preprocessed datasets can be used to:

- Forms the foundational step for building reliable and accurate AI models in healthcare and other data-driven domains.
- Supports the creation of reusable, high-quality datasets that facilitate model training, benchmarking, and validation.
- Can be extended to domains such as autonomous driving, industrial defect detection, or agricultural monitoring where annotated data is critical for machine learning applications.

#### **3.3.2 Data Analysis and Visualization**

Comprehensive analysis was performed on various image, video, and signal datasets using Python, R, Power BI, and Tableau to extract meaningful insights and visualize trends. These can be used to:

- Enables clinicians and data scientists to explore patterns in medical imaging and biosignal data for diagnostic decision-making.
- Supports healthcare administrators in understanding disease distributions, system performance, and model accuracy through interactive dashboards.

- Promotes evidence-based AI model development by uncovering dataset imbalances and correlations.

### **3.3.3 Evo Extractor Desktop Application**

The Evo Extractor is a desktop application integrated with a user-independent gesture recognition model, powered by the Myo armband. It captures real-time sEMG and IMU signals to recognize hand gestures. Some real time applications of the EVO Extractor are:

- Can be used in assistive technology for individuals with physical impairments to control computers, home appliances, or wheelchairs using hand gestures.
- Offers hands-free interaction for industrial or hazardous environments where touchless control is essential.
- Useful for rehabilitation training and muscle movement monitoring in physiotherapy.
- Visualize the Live sEMG and IMU data in real time and record in a CSV file.

### **3.3.4 Energy Meter Reading Project**

A hybrid deep learning pipeline was developed using YOLOv11s for region detection and TrOCR for optical character recognition (OCR) to automatically extract readings from analog energy meter images. The system was integrated into a web-based interface to enable real-time prediction and user-friendly interaction. Some real time application of this project:

- Can automate energy meter reading in both residential and industrial settings, reducing reliance on manual inspection and minimizing human error.
- Supports remote monitoring and digitization of utility infrastructure, contributing to the development of smart utility management systems.
- Enables utility providers to streamline billing, improve operational efficiency, and offer real-time usage insights to consumers.

### **3.3.5 Pretrained Model Development**

Fine-tuned CNN and Transformer models were used to classify various medical imaging datasets, including brain tumors, skin cancer, retinal scans, and ECG signals. These can be integrated to:

- Enables development of automated diagnosis tools for use in telemedicine and low-resource clinics.
- Can assist radiologists and clinicians in early detection of critical diseases like cancer, potentially improving patient outcomes.
- Facilitates screening tools in mobile or embedded diagnostic devices.

### **3.3.6 Real-Time sEMG & IMU Data Acquisition System**

Developed a command-line interface (CLI)-based real-time data acquisition system using BLE-enabled wearable armband to capture physiological signals. Applications of this system are:

- Useful in biomedical research for capturing biosignals for gesture recognition, rehabilitation, and fatigue analysis.
- Can be deployed in wearable health monitoring systems for continuous movement and muscle tracking.
- Acts as a training dataset generator for personalized gesture or posture recognition models.

### **3.3.7 Adaptive Hybrid Model for Automated Wheelchair**

Designed and developed a deep learning model combining CNN and RNN layers using few-shot learning to control a smart wheelchair based on sEMG and IMU signals. Some real time application of this model are:

- Empowers mobility-impaired users to control a wheelchair with personalized gestures, enabling greater independence.

- Can be integrated into smart assistive devices that adapt to individual user patterns with minimal data.
- Applicable in personalized rehabilitation robotics, especially where conventional joystick control is infeasible.

### **3.3.8 Overall Integration**

Across all projects, hybrid models, real-time systems, and interactive platforms were developed to bridge the gap between AI theory and practical healthcare application. Some of them are:

- Demonstrates a comprehensive workflow for AI-driven healthcare solution development.
- Encourages interdisciplinary collaboration between engineers, medical professionals, and designers for user-centric innovation.
- Can be adapted for domains like medical, utility automation, industrial safety, and education where sensor-based intelligent systems are relevant.

# Chapter 4

## Internship Activities

This chapter provides an overview of the organization, details of weekly work accomplishments, and the challenges faced along with the solutions applied during the internship. The following sections describe each aspect in detail.

### 4.1 Introduction of the Organization/Institution

EVOMED Technology is an innovative health-tech company dedicated to transforming the way healthcare is delivered by integrating cutting-edge technologies into practical, real-world solutions. At the heart of its mission lies a commitment to harnessing the power of the Fourth Industrial Revolution, specifically, the convergence of Internet of Things (IoT), Machine Learning, and TinyML, to develop intelligent Remote Patient Monitoring (RPM) systems that support proactive and personalized healthcare.

The company's focus is on building high-quality, affordable, and precise medical technologies that are accessible to individuals regardless of geographic or economic barriers. Through its advanced diagnostic devices with interconnected apps, EVOMED enables real-time monitoring of patients' health conditions from remote locations, reducing the need for frequent hospital visits and allowing for earlier detection and intervention.

By removing traditional obstacles such as distance, cost, and technological complexity, EVOMED empowers patients to take charge of their own health while also equipping healthcare providers with tools to enhance diagnosis, treatment, and long-term care. These smart systems are designed to be user-friendly, scalable, and

adaptable across diverse healthcare environments, from urban hospitals to rural communities.

Through its vision of a proactive, connected, and empowering healthcare future, EVOMED Technology is transforming healthcare by making it smarter, more inclusive, and human-centered. By leveraging IoT, Machine Learning, and TinyML, the company delivers affordable and accessible solutions that bring personalized care to every individual, support healthcare professionals, and help close the global care gap [EVOMED Technology \(2025\)](#).

## 4.2 Responsibilities

As an AI Engineer in the R&D team at EVOMED Technology, my key responsibilities included:

- Design research frameworks, objectives, and methodologies for ongoing and new projects.
- Collect, organize, and manage data using ethical and standardized procedures.
- Analyze datasets and apply ML/ AI tools to extract meaningful insights.
- Interpret and present findings in alignment with project goals and stakeholder expectations.
- Contribute to the development of mobile or embedded applications for healthcare use-cases.
- Collaborate with the team, delegate tasks when necessary, and ensure timely execution of project milestones.

## 4.3 Work Accomplishment

This section presents a weekly basis diary-like description of activities undertaken in the internship organisation such as what I have observed, experienced, performed, learned, and understood in my attachment period in the internship organization.

**Week 01: Orientation, Literature review, Pipeline design and documentation of Energy Meter Reading Project ( May 25 - 31, 2025)**

In the first week, following the orientation, I focused on understanding the core project I was initially assigned to, the development of an automated Energy Meter Reading system using YOLO v11 for detection and TrOCR for text recognition. I have started with an in-depth literature review covering image recognition, object detection techniques, and transformer-based OCR models relevant to the project's objectives. Based on my findings on literature, I proposed a finalized model pipeline and prepared detailed documentation outlining its structure. I also annotated a set of self-collected energy meter images in Computer Vision Annotation Tool (CVAT) [CVAT.ai Corporation \(2025\)](#), did model testing and initial experimentation with the manually annotated data to validate the proposed approach.

Gained hands-on experience in annotating energy meter images; performed initial testing of YOLO v11 and TrOCR models; observed the importance of integrating detection and OCR for automation; learned to design and document an effective model pipeline; understood the workflow from data collection to model validation.

**Week 02: Data annotation, preprocessing, pretrained model development, and documentation (June 01 - 15, 2025 (including Eid vacation: June 06 - 13, 2025))**

This week was primarily focused on data preparation and model exploration for the Energy Meter Reading project. I began by acquiring energy meter image datasets from various online sources, followed by organizing, cleaning, and processing their annotations. Several preprocessing techniques were applied to enhance the data quality, including resizing, normalization, and format adjustments. I tested the proposed model pipeline on these datasets to evaluate its effectiveness and identify potential improvements. In parallel, I manually annotated a self-collected dataset of energy meter images using Roboflow [Roboflow, Inc. \(2025\)](#) to ensure high-quality ground truths for model validation. I then explored, trained, and evaluated several pretrained YOLO models for Region of Interest (ROI) detection and segmentation, as well as OCR models such as TrOCR, EasyOCR, PaddleOCR, and Donut for accurate text extraction. Through experimentation, YOLO v11s emerged as the most suitable detector for ROI segmentation based on speed and precision. After testing the full pipeline on the manually labeled data, I finalized the architecture and proceeded to

implement the proposed deep learning-based hybrid model, integrating YOLO v11s for detection and TrOCR for OCR, to automate the energy meter reading process.

Gained experience in data preprocessing and annotation; evaluated YOLO and OCR models; learned to integrate YOLO v11s with TrOCR into a hybrid pipeline for automated energy meter reading.

### **Week 03: Proposed hybrid model development for Energy meter reading project (June 16 - 23, 2025)**

This week, my primary work was on model development for the automated Energy Meter Reading system. I implemented the region detection pipeline using YOLOv11s and integrated the TrOCR architecture for text extraction. A significant amount of time was dedicated to debugging and refining the model training scripts to ensure stability and optimal performance across both components. The hybrid model pipeline I developed consists of multiple sequential steps: initial data preprocessing tailored for YOLO, followed by training the YOLOv11s detector with architecture and hyperparameter tuning. The detected regions were then preprocessed and passed into the TrOCR model. I applied several filters and performed model-level tweaks to improve text extraction accuracy. The TrOCR output was further post-processed to map extracted values to their respective units, yielding a final structured output containing the meter reading, unit type, meter number, timestamp, and other relevant metadata. Additionally, I prepared detailed documentation of the entire pipeline, including setup, model configurations, and processing steps, to ensure future reproducibility and ease of deployment.

Gained hands-on experience in developing and debugging a hybrid model pipeline; performed data preprocessing, model tuning, and post-processing for accurate meter reading extraction; learned to document the full pipeline for reproducibility and deployment.

### **Week 04: Data annotation, ground truth labeling, pretrained detector model development with tweaking (June 23 - 30, 2025)**

This week, I focused extensively on energy meter data annotation, labeling, and ground truth generation for a range of self-collected datasets, which was later merged with the previously annotated data. Using Roboflow [Roboflow, Inc. \(2025\)](#), I efficiently annotated images, assigned class labels, and generated accurate ground

truth files to support model training and evaluation. In addition, I worked on pretrained YOLO detectors and classifier models (v8–v12) by architecture modifications and hyperparameter tuning, along with learning rate scheduling and early stopping, to optimize performance on the Brain Tumor dataset. Also, I performed medical image annotation using Roboflow and conducted data visualization in Python for the Brain Tumor and HAM10000 skin cancer datasets. Later this week, I was assigned to the Evo Extractor project, a Myo armband based desktop app development with Integrated User-Independent AI Model.

Gained experience in annotating and generating ground truth of image datasets using Roboflow; performed model tuning and optimization of YOLO detectors for both Energy Meter Reading and Brain Tumor datasets; learned data management techniques and began exploring AI integration in the Evo Extractor Myo armband project.

#### **Week 05: Model and Desktop app development for Evo Extractor Project, Energy meter data annotations and labeling (July 01 - 07, 2025)**

This week, I began working on the Evo Extractor project, which involves the development of a desktop application based on the Myo armband, featuring an integrated user-independent hybrid AI model for gesture recognition. My initial focus was on building the AI model component, which included sEMG and IMU data collection, followed by cleaning and preprocessing the biomedical signals. I designed the hybrid model pipeline, performed training and evaluation, and prepared the model for integration into the application. For the offline desktop app, at first, I developed a standalone Python script that established a BLE connection with the Myo armband, logged real-time EMG data into CSV files, and was tested for portability. The graphical user interface of the desktop application was built on Tinker GUI library. On the backend, I implemented real-time plotting functionalities for eight EMG channels and six IMU data streams. After creating a basic frontend GUI, I integrated it with the backend, resolved multiple GUI bugs, and began implementing advanced features like continuous real-time visualization of live sEMG and IMU signals. Asynchronous Python was used to develop and handle the backend functionalities. To enhance signal clarity and visualization, I explored and applied several filtering and noise reduction techniques, including exponential smoothing and bandpass filtering. Also, I did self collected energy meter data

annotations and labeling in Roboflow [Roboflow, Inc. \(2025\)](#) for the energy meter reading project.

Gained hands-on experience in sEMG and IMU data collection, preprocessing, and hybrid AI model development; performed real-time signal logging and visualization; learned to build and integrate a Python-based desktop app with BLE connectivity, GUI, and backend functionalities; understood signal filtering and noise reduction techniques for biomedical data.

**Week 06: Pretrained classification models development with tweaking on various datasets, Exploration of several features integration methods for desktop application (July 08 - 15, 2025)**

This week, I focused on the development of pretrained classifier models, covering both CNN and Transformer-based architectures. For the Brain Tumor dataset, I implemented and fine-tuned models such as ResNet-50, InceptionNet v3, DenseNet-121, MobileNet v2, VGG16, Vision Transformer (ViT), CaiT, and Swin Transformer. The workflow involved data preprocessing, architecture adjustments, hyperparameter tuning, and applying techniques like learning rate scheduling and early stopping to optimize model performance. I also conducted similar model development for the HAM10000 skin cancer, OCT2017 and other medical images, using pretrained architectures such as ResNet (18, 50, 152), InceptionNet (v3, v4), VGG (16, 19), DenseNet (121, 201, 264), EfficientNet (B0–B7), MobileNet (v3, v4), ViT, iGPT, DeiT, and Swin Transformer. These models were also refined through various preprocessing and parameter tuning to enhance classification accuracy and generalization across the dataset. In parallel, throughout the week, I further explored the ideas to expand the “Evo Extractor” desktop application by adding features such as dynamic connection management with armband gesture profile classification and management using the pre-evaluated AI model.

Gained experience in fine-tuning CNN and Transformer-based pretrained models for Brain Tumor and HAM10000 datasets; performed data preprocessing, hyperparameter tuning, and optimization techniques; learned to enhance model generalization and classification accuracy; explored feature integration methods for desktop application.

**Week 07: Flask based web app development with AI model integration, medical image data annotation (July 16 - 23, 2025)**

This week, I was assigned to work on the development of a Flask-based interactive web application designed to integrate an already developed deep learning model. The primary goal was to create an intuitive, responsive, and user-friendly platform where users could interact with the model and visualize predictions in real-time. I have started by developing the project using Flask as the backend framework, enabling efficient routing, server-side logic handling, and seamless integration with the pretrained model. The model was designed for energy meter reading and was already trained and evaluated; my task was to wrap this model in a clean, accessible interface. On the frontend, I utilized HTML, CSS to design the user interface. This included building basic layouts, form inputs for image upload, and dynamic result displays. I ensured the UI was lightweight, clean, and focused on usability for both technical and non-technical users. The backend logic included loading the trained model, handling user-uploaded image files, running inference on those inputs, and returning the outputs including meter reading with unit and meter number to the frontend in real-time. I implemented input validation, error handling, and file management to make the system robust and reliable. After building the core functionality, I focused on improving interactivity adding features such as loading animations, and basic result visualization. I also ensured smooth communication between frontend and backend for a better user experience. Additionally, I did self collected skin cancer images annotations in Roboflow [Roboflow, Inc. \(2025\)](#) throughout the week.

Gained experience in developing a Flask-based interactive web application; performed backend integration of a pretrained deep learning model; learned to build a user-friendly frontend with HTML/CSS; implemented real-time inference, input validation, error handling, and basic result visualization for enhanced interactivity and usability.

**Week 08: New features integration in desktop application, JavaScript integration in Web Application (July 23 - 31, 2025)**

This week, I've expanded the Evo Extractor desktop application by incorporating several key features to enhance functionality, user interaction, and overall usability. I implemented a gesture profile module that allows users to customize and manage

recognized gestures for different control commands. I've integrated a trained hybrid model for gesture classification and management. A dynamic connection status indicator was added to provide real-time connection state of the armband, ensuring users are always informed about the device's operational state. To improve hardware integration and monitoring, I included a battery icon with real-time battery level tracking with battery level percentage, enabling users to keep track of the armband's power status during use. A keymapper feature was introduced, allowing users to map specific gestures to keyboard inputs or application functions, adding flexibility for various use cases. Also, added functionalities for armband vibration control. Lastly, an "About" section was added to provide users with version details, developer credits, and a short overview of the app's functionalities and capabilities. Finalized Evo Extractor by generating a portable .exe file using pyinstaller. In parallelly, I've finalized the Flask based AI model integrated web application by adding JavaScript to make the UI interactive.

Gained experience in enhancing a desktop application with gesture profile management, real-time device monitoring, keymapping, and haptic feedback; performed integration of a hybrid AI model for gesture classification; learned to improve usability, interactivity, standalone exe conversion, and user experience through dynamic indicators and informative UI elements.

**Week 09: Adaptive hybrid model development, python errors debugging.  
(August 01 - 07, 2025)**

This week, I was involved in the development of an adaptive hybrid deep learning model designed to control an automated wheelchair system using a wearable armband. The objective of the project was to build a smart, user-adaptive model that can interpret biomedical signals and environmental context to drive the wheelchair autonomously. To address the challenge of limited training data per user, I've implemented the model using a few-shot learning approach that allows rapid personalization with minimal input samples. In the design and development stage, I've designed a hybrid model architecture, combining convolutional layers for spatial feature extraction from EMG/IMU signals and recurrent layers for temporal pattern recognition. I implemented few-shot learning techniques, such as prototypical networks and metric-based comparison strategies, to enable the model to generalize well across different users with minimal retraining. This ensured that

new users could quickly calibrate the system with only a few samples, making it more practical for real-world deployment in healthcare and assistive technology scenarios. In parallel, I debugged Python script errors for the Brain tumor project.

Gained experience in designing a hybrid deep learning model for adaptive wheelchair control; performed few-shot learning implementation for rapid user personalization; learned to combine spatial and temporal feature extraction from EMG/IMU signals, errors handling in python model pipeline; understood techniques for generalization across users with minimal training data.

**Week 10: CLI based sEMG and IMU data acquisition system development, Video data annotation (August 08 - 16, 2025)**

This week, I was assigned to work on the development of a real-time sEMG and IMU data acquisition system designed for data collection to support Arduino-based hybrid deep learning model training. The goal was to build a reliable data collection setup using a wearable armband that could continuously capture physiological signals, specifically surface electromyography (sEMG) and motion data from an inertial measurement unit (IMU), and transmit them in real time for downstream AI processing. I designed and developed a CLI based real-time sEMG and IMU data acquisition system using a single Arduino script. The system was designed to structure, timestamp, and stream synchronized data packets over Bluetooth Low Energy (BLE), ensuring efficient and lossless transmission. Special attention was given to optimizing sampling rate, memory management, and signal stability to ensure compatibility with hybrid model training requirements. The acquired real-time data recorded in csv file for user given time limits and later used for training a hybrid deep learning model combining both spatial (CNN) and temporal (BiLSTM) layers for gesture recognition. In parallel, I did video data annotation and labeling on Roboflow [Roboflow, Inc. \(2025\)](#).

Gained hands-on experience in real-time sEMG and IMU data acquisition using Arduino and BLE; performed data structuring, synchronization, and optimization for hybrid model training; learned to capture reliable physiological signals for CNN-BiLSTM-based gesture recognition. Also, I've learned how to annotate and label the video data.

### **Week 11: Data Analysis on image, audio, and video datasets using Python, R, Power BI, and Tableau (August 17 - 25, 2025)**

This week, I focused on data analysis and visualization on image, audio and video data. Used multiple tools and platforms, including Python, R, Power BI, and Tableau, across several medical and biomedical datasets. The goal was to extract meaningful insights, perform statistical evaluations, and create intuitive visual dashboards that could support decision-making and model development. The datasets I worked on included Chest X-Ray images for Pneumonia detection, a combined skin cancer dataset (HAM10000 + ISIC 2018), OCT 2017 retinal scans, the PTB-XL electrocardiography dataset, self-collected sEMG and IMU biosignals, and horn audio analysis data. Using Python and R, I performed tasks such as data cleaning, statistical testing, correlation analysis, dimensionality reduction, and feature distribution analysis. I scripted automated pipelines to preprocess large volumes of data and export processed outputs to CSVs, which were then used in dashboard tools. In Power BI and Tableau, I developed interactive dashboards to visualize trends, class imbalances, prediction outcomes, and signal variations, making the results more interpretable for both technical and non-technical stakeholders. I've performed analysis for each dataset using basic and advanced feature engineering, did various tests and visualizations from unstructured medical images to time-series biosignals and audio data. I tailored my analysis techniques to fit the data type using heatmaps, bar plots, ROC curves, and time-domain signal overlays to highlight key patterns.

Gained experience in data analysis and visualization of image, audio, and time-series biosignal datasets; performed data cleaning, statistical testing, feature engineering, and dimensionality reduction using Python and R; learned to create interactive dashboards in Power BI and Tableau for interpretable insights across medical and biomedical datasets.

## **4.4 Challenges Faced & Solutions**

Throughout the internship, I encountered various challenges across several tasks. This section represents the challenges I've encountered and solutions to overcome them.

I faced several challenges in the first week in understanding model integration, conducting a focused literature review, and using CVAT for annotation. I overcame these by organizing research, improving annotation skills through practice, and enhancing data quality with preprocessing, which led to a validated and documented model pipeline. In the second week, the main challenges were managing diverse datasets, ensuring annotation consistency, and selecting the most effective OCR and detection models. I addressed these by organizing and preprocessing data systematically, using Roboflow for accurate annotations, and experimenting with multiple models to finalize a reliable YOLOv11s–TrOCR hybrid pipeline. I faced challenges in the third week in debugging the hybrid model pipeline and ensuring smooth integration between YOLOv11s and TrOCR. I resolved these by carefully tuning model parameters, refining preprocessing and post-processing steps, and systematically documenting the entire workflow to ensure stability, accuracy, and reproducibility. I faced challenges in managing large-scale annotations and optimizing pretrained YOLO models for different datasets in the fourth week. I overcame these by using Roboflow for efficient labeling, applying systematic tuning techniques, and balancing tasks across projects, which enabled accurate ground truth generation and performance improvement in both energy meter and medical image models.

During the fifth week, I faced several challenges in building a real-time desktop app with BLE connectivity and integrating a hybrid AI model for gesture recognition. I overcame these by modularizing the development process, using asynchronous Python for smooth backend operations, resolving GUI bugs through iterative testing, and applying signal filtering techniques to enhance data quality. In the sixth week, I have faced challenges in optimizing diverse pretrained CNN and Transformer models across multiple medical datasets and ensuring their generalization. I addressed these by applying systematic preprocessing, architecture tuning, and optimization techniques, while also exploring practical feature integration methods to enhance the Evo Extractor desktop application's functionality. I faced challenges in integrating a pretrained deep learning model into a user-friendly Flask web application while ensuring real-time inference and smooth frontend-backend communication in the seventh week. I overcame these by systematically implementing backend logic, designing an intuitive HTML/CSS interface, adding input validation and error handling, and enhancing interactivity with dynamic

result visualization. During the eighth week, I faced challenges in adding multiple interactive features to the Evo Extractor desktop app and enhancing the web app UI with JavaScript. I overcame these by implementing gesture profile management, real-time device monitoring, keymapping, and haptic feedback, while finalizing the web interface for interactivity and generating a portable standalone .exe file.

In week nine, I faced challenges in developing a user-adaptive hybrid model for wheelchair control with limited training data and in debugging Python scripts. I overcame these by implementing few-shot learning for rapid personalization, combining spatial and temporal feature extraction, and systematically handling code errors to ensure robust model performance across different users. During the tenth week, I faced challenges in developing a reliable real-time sEMG and IMU data acquisition system and in managing video data annotation. I overcame these by designing a CLI-based Arduino setup with BLE streaming, optimizing sampling and memory management for stable signal capture, and systematically annotating video data to support hybrid model training. In the last week of my internship attachment period, I faced challenges in analyzing and visualizing diverse datasets, including images, audio, and biosignals, across multiple platforms. I overcame these by applying tailored preprocessing, statistical analysis, and feature engineering in Python and R, and by creating interactive dashboards in Power BI and Tableau to generate clear, interpretable insights for decision-making and model development.

# Chapter 5

## Methodology

This chapter depicted the methodologies applied throughout several projects and tasks during my internship at EVOMED Technology, detailing the approaches, research, and data collection techniques employed for various projects and tasks illustrated in Table 5.1. The table summarizes the structured workflow for each key activity, including data annotation and preprocessing, development and fine-tuning of pretrained detector and classifier models, hybrid deep learning model design, and deployment of interactive desktop and web applications. Additionally, it highlights the real-time acquisition of sEMG and IMU signals, adaptive model development using few-shot learning, and comprehensive data analysis and visualization across multiple platforms. These methodologies ensured systematic model development, reliable data handling, and robust integration of AI solutions into practical healthcare and assistive technology applications, consistent with best practices in applied machine learning and biomedical signal processing.

Table 5.1: Methodology Overview of Internship Activities

| Task / Project                                                                  | Methodology / Approach                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Image & Video Data Annotation, Labeling, Ground Truth Generation, Visualization | Used CVAT and Roboflow to annotate images/videos, assign classes, and generate ground truth files; applied visualization to validate annotations and ensure dataset quality for supervised learning.                            |
| Data Preprocessing for Various Datasets                                         | Applied resizing, normalization, format conversion, noise filtering, signal smoothing, temporal alignment, missing value handling, class balancing, and feature scaling to prepare image, video, audio, and biosignal datasets. |

Continued on next page

**Table 5.1 – continued from previous page**

| <b>Task / Project</b>                                              | <b>Methodology / Approach</b>                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pretrained Detector & Classifier Model Development                 | Fine-tuned CNN and Transformer models (YOLO, ResNet, InceptionNet, DenseNet, MobileNet, VGG, EfficientNet, ViT, CaiT, DeiT, iGPT, Swin Transformer) on custom datasets; performed hyperparameter tuning, architecture adjustments, learning rate scheduling, and early stopping.         |
| Data Analysis & Visualization (Python, R, Power BI, Tableau)       | Conducted statistical evaluation, correlation analysis, feature engineering, dimensionality reduction, and automated preprocessing; created interactive dashboards and visualizations (heatmaps, bar plots, ROC curves, signal overlays) for interpretable insights.                     |
| Hybrid Deep Learning Model for Energy Meter Project                | Developed YOLOv11s–TrOCR pipeline: preprocessing → ROI detection → text recognition → post-processing; tuned models, refined preprocessing/post-processing, and documented workflow for reproducibility.                                                                                 |
| Flask-Based Interactive Web Application with AI Model Integration  | Developed backend with Flask for routing, inference, and file handling; frontend designed with HTML/CSS/JS for responsive UI; implemented input validation, error handling, real-time prediction display, and dynamic result visualization.                                              |
| Arduino-Based Real-Time sEMG & IMU Data Acquisition System         | Built CLI-based system using Arduino and Myo arm-band; streamed synchronized EMG/IMU data over BLE, timestamped and stored CSV files; optimized sampling, memory, and signal quality for hybrid model training.                                                                          |
| Evo Extractor Desktop App with Integrated AI Model                 | Developed Python/Tkinter GUI; integrated hybrid AI model for gesture recognition; implemented BLE connectivity, real-time signal logging, keymapping, vibration control, dynamic status indicators; converted to standalone executable using PyInstaller.                                |
| Adaptive Hybrid Model for Automated Wheelchair (Few-Shot Learning) | Designed hybrid model with convolutional layers for spatial features and recurrent layers for temporal patterns; implemented few-shot learning with prototypical networks and metric-based strategies for rapid personalization; tuned and debugged for robust performance across users. |

# Chapter 6

## Analysis and Findings

### 6.1 Results/Findings

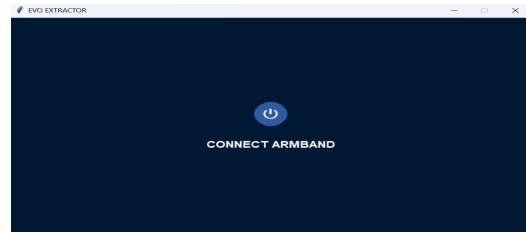
During the internship at EVOMED Technology, several tangible outcomes and findings were achieved across multiple projects, reflecting both technical progress and practical contributions to the organization's objectives. **According to the confidentiality condition of the agreement, I cannot disclose proprietary or sensitive information of the company.** However, **with the company's permission**, I am including Graphical user interface of Evo Extractor desktop app and some data analysis visualization along with some user guidelines as examples from several final deliverable applications and tasks completed during the internship.

#### 6.1.1 Evo Extractor Desktop Application

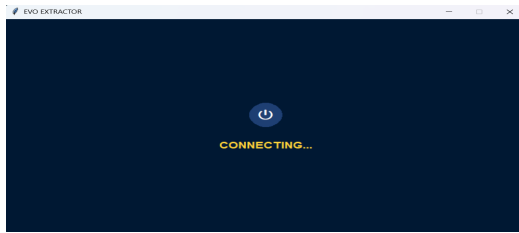
The Myo armband-based desktop application enabled real-time sEMG and IMU signal acquisition, preprocessing, and visualization. The hybrid AI model integrated into the app provided reliable gesture recognition, while additional features such as gesture profile management, keymapping, data collection and data visualization improved user experience. The standalone executable file of the app allows seamless user access in real time. The GUI of the desktop app is illustrated in Figure 6.1 below [EVOMED Technology \(2025\)](#).



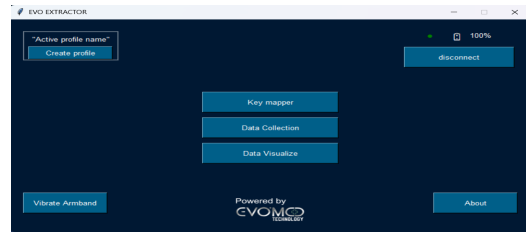
(a) Start window



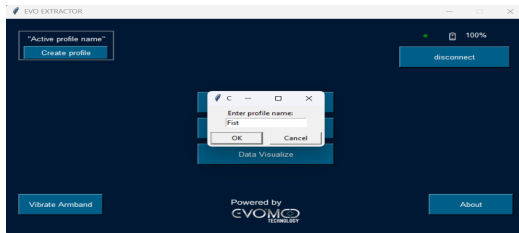
(b) Connect armband



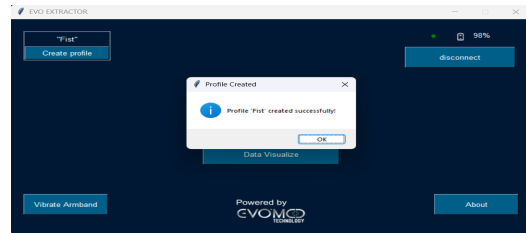
(c) Connection Status



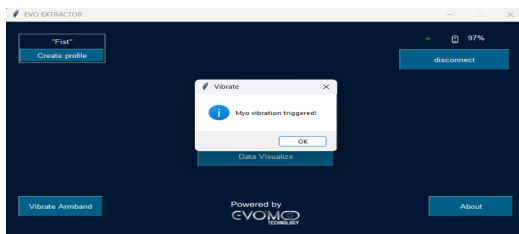
(d) Main Interface



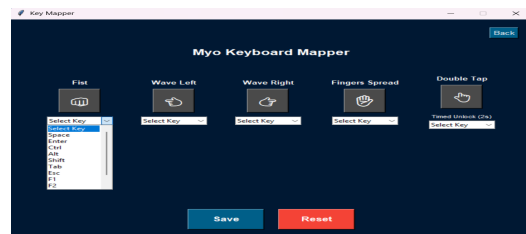
(e) Gesture Profile Creation



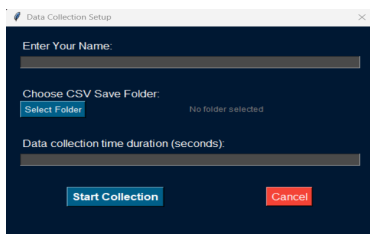
(f) Gesture Profile Creation



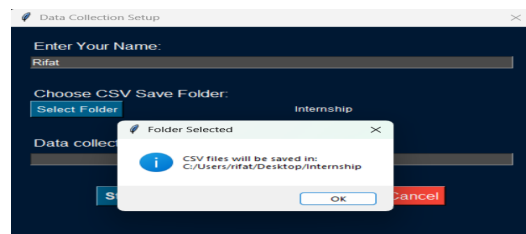
(g) Vibrate Armband



(h) Key Mapper

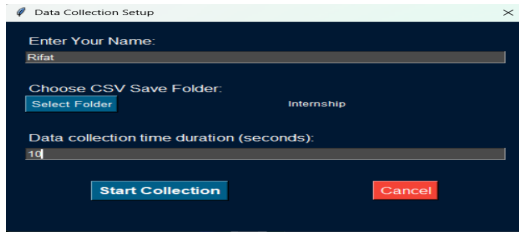


(i) Data Collection

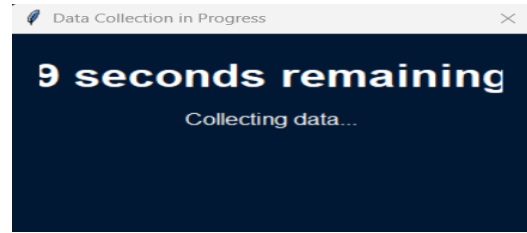


(j) Data Collection

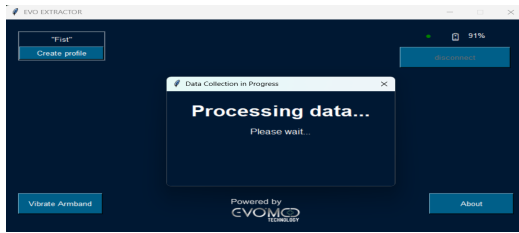
Figure 6.1: Evo Extractor Desktop Application



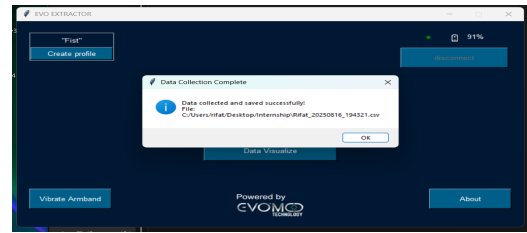
(k) Data Collection



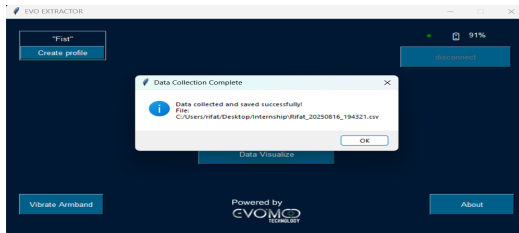
(l) Data Collection



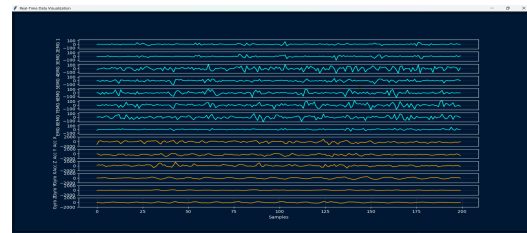
(m) Data Collection



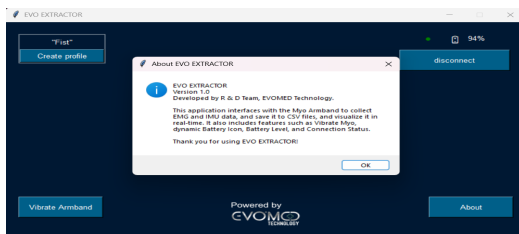
(n) Data Collection



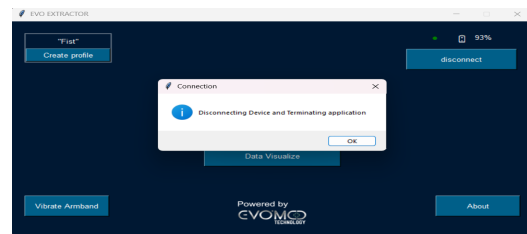
(o) Data Collection



(p) Live Data Visualization



(q) About



(r) Disconnect Armband

Figure 6.1: Evo Extractor Desktop Application (continued)

### 6.1.2 Data Analysis and Visualization

Comprehensive analysis of image, video, audio, and biosignal datasets using Python, R, Power BI, and Tableau yielded actionable insights. Techniques including statistical evaluation, correlation analysis, feature engineering, and dimensionality reduction supported model development, while interactive dashboards facilitated

intuitive interpretation of trends, class distributions, and predictive outcomes. Some of the dashboard is depicted in Figures 6.2, 6.3, 6.4, and 6.5 below **EVOMED Technology (2025)**.

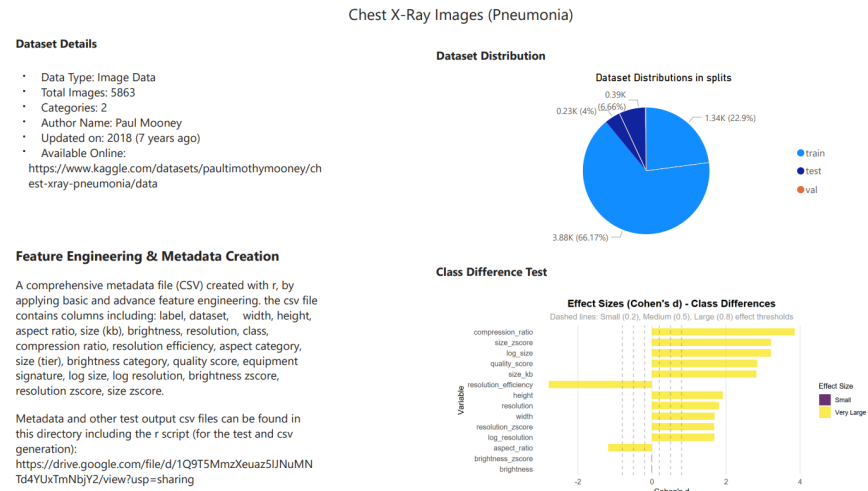


Figure 6.2: Data analysis on Chest X-ray image dataset 1

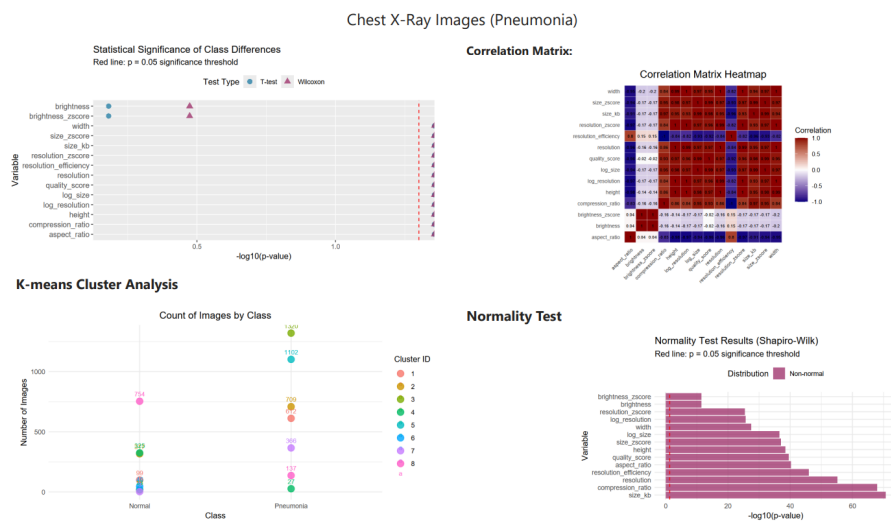


Figure 6.3: Data analysis on Chest X-ray image dataset 2

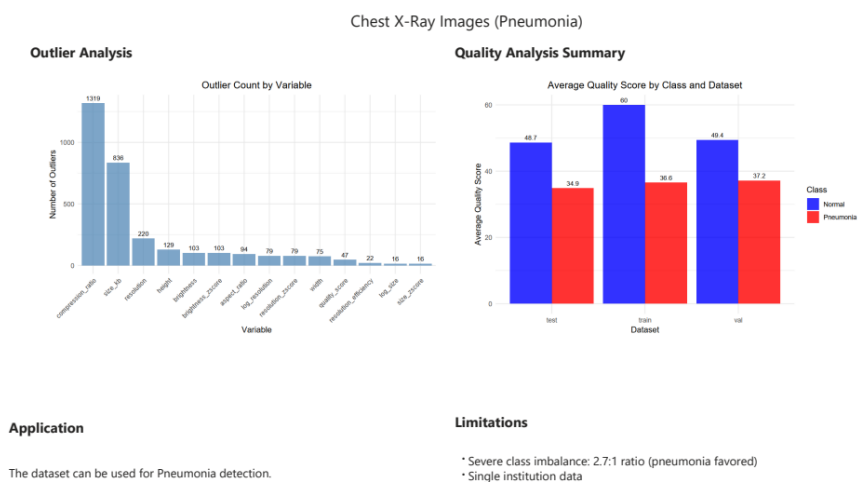


Figure 6.4: Data analysis on Chest X-ray Image dataset 3

## Skin Cancer Multi-class Dataset

### Dataset Details

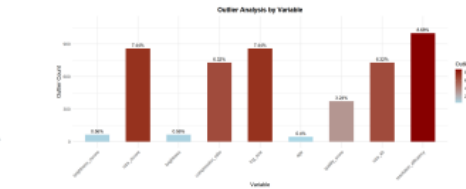
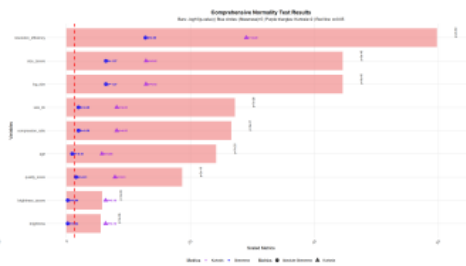
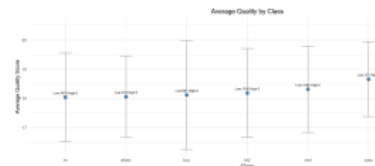
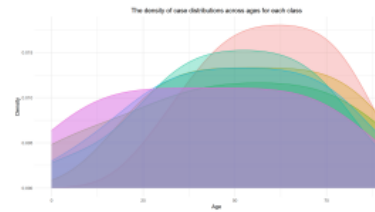
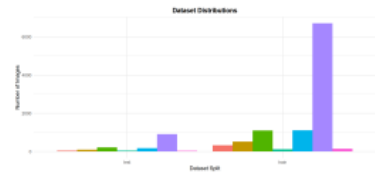
Data Type: Dermoscopic Image Data

Combination: HAM1000 (Training split) and ISIC 2018 (Test split)

Total Images: 11526 (10015 (Training) + 1511 (Test))

An enhanced metadata file has been created by basic and advanced feature engineering.

The enhanced metadata file and all test results has been saved as csv and xlsx file can be found here:  
<https://drive.google.com/drive/folders/1rkqXHSqELSVuOW8bskgN7tBWmFsBcJ8?usp=sharing>



### Limitations

1. Class Imbalance.
2. No separate validation dir.
3. Average quality scores are low.

### Applications

A perfect dataset for multi-class classification of skin cancer.

Figure 6.5: Data analysis on Skin Cancer Image dataset

## 6.1.3 Energy Meter Reading Project

The development of the YOLOv11s–TrOCR hybrid model successfully automated the detection and recognition of energy meter readings. Through preprocessing, annotation, model tuning, and post-processing, the system achieved high accuracy in extracting meter values, units, and numbers from images. The integration into a Flask-based web application allowed real-time inference, enhancing usability and accessibility for non-technical users.

#### **6.1.4 Pretrained Deep Learning Model development for Medical Datasets**

Pretrained CNN and Transformer-based models (ResNet, InceptionNet, DenseNet, MobileNet, VGG, EfficientNet, ViT, CaiT, Swin Transformer, etc.) were fine-tuned on datasets including Brain Tumor, HAM10000, OCT 2017, and PTB-XL. Model optimization through hyperparameter tuning, learning rate scheduling, and early stopping resulted in improved classification accuracy and generalization.

#### **6.1.5 Real-Time sEMG & IMU Data Acquisition**

The CLI-based Arduino system efficiently captured synchronized biomedical signals for hybrid model training. Data structuring, timestamping, and BLE streaming ensured high-quality datasets, which enhanced model robustness and enabled accurate gesture recognition for assistive technologies such as the automated wheelchair, Arduino or ESP based systems.

#### **6.1.6 Adaptive Hybrid Model for Automated Wheelchair**

The few-shot learning-based adaptive model successfully allowed rapid personalization for new users with minimal data. The combination of convolutional and recurrent layers captured spatial and temporal patterns from EMG/IMU signals, demonstrating reliable performance across multiple users.

#### **6.1.7 Overall Findings:**

The internship experience demonstrated that combining rigorous data collection, preprocessing, annotation, and hybrid deep learning model development leads to high-performing AI applications in healthcare and assistive technologies. The projects improved accessibility, interactivity, and real-world usability of intelligent systems, contributing to EVOMED's mission of making healthcare smarter, inclusive, and human-centered.

## 6.2 Learning and Development

During my internship at EVOMED Technology, I gained extensive practical knowledge and developed both technical and professional skills. From the outset, I learned to approach complex projects systematically, starting from literature review, dataset acquisition, and preprocessing, to model development, testing, and deployment. Working with diverse datasets, including images, audio, video, and biosignals, enhanced my understanding of data management, annotation techniques, and the importance of high-quality ground truth generation for supervised learning.

I developed proficiency in using a wide range of tools and technologies. This experience strengthened my skills in data analysis, visualization, deep learning, hybrid model design, and real-time system development. I also learned advanced techniques like few-shot learning, CNN–RNN hybrid modeling, and Transformer fine-tuning for both medical and IoT-based applications.

Beyond technical skills, I improved my problem-solving, debugging, and workflow management capabilities. I learned to overcome challenges methodically, optimize pipelines for efficiency, and maintain clear documentation for reproducibility. The experience of integrating AI models into both desktop and web applications taught me best practices for user interface design, real-time inference, and system usability.

Moreover, the internship enhanced my professional development in project planning, time management, and communication, as I frequently coordinated with team members to review progress and share insights. Overall, the internship not only strengthened my technical competence but also prepared me for real-world applications of AI and IoT in healthcare, reinforcing the importance of innovation, precision, and consideration in technology-driven solutions.

## 6.3 Tools and Technology

During my internship at EVOMED Technology, I worked with a diverse set of software, hardware, and technologies that supported the development of AI-driven healthcare solutions. The tools were integral to data collection, model development, application deployment, and visualization tasks. These includes:

- Programming Languages & Frameworks: Python, R, JavaScript, Flask, HTML, CSS.
- Python Libraries: TensorFlow, PyTorch, Keras, OpenCV, NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn, Plotly, transformers, Tkinter, PyInstaller.
- Annotation & Dataset Tools: CVAT and Roboflow.
- Data Visualization & Dashboards: Microsoft Power BI and Tableau software.
- Hardware & IoT Devices: Myo armbands, Custom IoT boards with integrated BLE.
- Pretrained Models & AI Techniques: YOLO, ResNet, InceptionNet, DenseNet, MobileNet, VGG, EfficientNet, TrOCR, EasyOCR, PaddleOCR, Donut, ViT, CaiT, DeiT, iGPT, Swin Transformer, Grad-CAM, Grad-CAM++, SHAP, LIME.

The combination of these tools and technologies enabled comprehensive end-to-end workflow management, from data collection and preprocessing to model development, integration, and visualization, enhancing my proficiency in AI, IoT, and healthcare technology applications with practical experience.

## 6.4 User Guideline

This section provides detailed instructions for users on how to effectively operate the software applications developed or worked on during the internship. The guidelines are designed to ensure a user-friendly experience and to help users understand the functionality and features of the applications. Here, I'm including user guidelines for a desktop and a web application as examples from several final deliverable applications developed during the internship. **Almost identical procedures for other projects too, these will be published by EVOMED Technology in near future.** By following these guidelines, users can efficiently interact with the applications, access the full range of functionalities, and obtain accurate results with minimal errors.

### 6.4.1 Evo Extractor Desktop Application

The Evo Extractor desktop application is designed for various tasks using a Myo armband. The following steps outline its usage below [EVOMED Technology \(2025\)](#).

- Installation and Setup:
  - Download the standalone executable (.exe) file.
  - Ensure the Myo armband is charged and Bluetooth is enabled on your PC.
  - Connect the armband to the computer via BLE.
- Launching the Application:
  - Double-click the executable file to open the application.
  - The main GUI displays several option for various tasks.
- Using main Features:
  - Gesture Profile Management: Create or select gesture profiles to assign specific commands.
  - Data collection: The application can record EMG and IMU signals in CSV format for offline analysis. Set the desired recording duration and file name in the GUI.
  - Keymapper: Map gestures to keyboard inputs or application functions.
  - Data Logging:
    - Real-Time Monitoring: Observe the connection status and battery levels via dynamic indicators.
    - Real-Time live data visualization: Visualize the real time live EMG and IMU data upon clicking the 'Visualize' button.

### 6.4.2 Flask-Based AI Web Application

The web application is designed to provide real-time predictions using a pretrained deep learning model for energy meter reading. The following steps outline its usage [EVOMED Technology \(2025\)](#).

- Accessing the Application:
  - Open the provided URL in a web browser (Chrome or Firefox recommended).
  - Ensure a stable internet connection for smooth inference.
- Uploading Images:
  - Click the upload button and select an image of the energy meter.
  - Supported formats: JPG, PNG.
- Prediction and Results:
  - The backend performs real-time inference using the integrated YOLOv11s–TrOCR model.
  - Results, including meter readings, units, and meter numbers, are displayed dynamically.
  - Loading animations indicate ongoing processing.
- Error Handling:
  - Invalid or corrupted image files will prompt an error message.
  - Ensure images are clear and properly oriented for accurate readings.

### 6.4.3 Best Practices for Users

- Always keep the software updated to the latest version for improved stability.
- Follow proper calibration procedures for the Myo armband to ensure accurate gesture recognition.
- Use high-quality images for the web application to maximize OCR accuracy.
- Regularly review the generated logs or outputs to monitor data quality and model performance.

## 6.5 Impact of the Internship

During my internship at EVOMED Technology, my work contributed directly to advancing the company's vision of building a world where healthcare is accessible, intelligent, and personalized for every individual, regardless of geography, complexity, or cost. By developing hybrid deep learning models for applications such as automated energy meter reading, medical image classification, and user-adaptive wheelchair control, I supported EVOMED's goal of delivering proactive, connected, and empowering healthcare solutions. I contributed to a range of projects including image and video annotation, data preprocessing, pretrained model development, hybrid deep learning for energy meter reading, real-time sEMG and IMU data acquisition, data analysis and visualization, and the development of the Evo Extractor desktop and Flask-based web applications. I also worked on an adaptive hybrid model for automated wheelchair control using few-shot learning. These efforts improved dataset quality, model accuracy, and usability, while enhancing the accessibility and interactivity of AI-driven healthcare tools, supporting EVOMED Technology's mission to deliver smart, inclusive, and human-centered solutions. Overall, the internship allowed me to support EVOMED's broader mission by accelerating intelligent healthcare application development, optimizing workflows, and ensuring that technological solutions are precise, accessible, and meaningful for end users.

# Chapter 7

## Conclusions and Recommendations

### 7.1 Conclusion

The internship at EVOMED Technology has been an invaluable learning experience, providing hands-on exposure to AI, IoT, and healthcare technology applications. Through involvement in diverse projects, from data acquisition and preprocessing to hybrid deep learning model development and application deployment, I gained both technical expertise and practical problem-solving skills. The experience also enhanced my understanding of real-world project workflows, teamwork, and professional communication. Overall, the internship not only strengthened my technical and analytical capabilities but also prepared me to contribute effectively to innovative, human-centered technological solutions in the healthcare domain.

### 7.2 Limitations

During the internship, a few limitations were observed that affected workflow. The office setup could be enhanced with additional high-configuration computers to support intensive AI model training and data processing more efficiently. Additionally, the company's official website has not yet been deployed, which restricted access to organizational resources and limited opportunities for public interaction or outreach. Deployment of the website would improve visibility, user engagement, and support broader organizational objectives.

## **7.3 Recommendations**

To enhance operational efficiency and support organizational goals, it is recommended that EVOMED Technology upgrade its office infrastructure by adding more high-configuration computers to facilitate intensive AI model training and data processing. Additionally, deploying the company's official website would improve public accessibility, enable broader user engagement, and provide better visibility for the organization's services and initiatives.

## Chapter 8

# Acknowledgments

I am sincerely grateful to my industry supervisor, Fazlay Rabby, for providing the opportunity to undertake this internship and for his invaluable guidance, inspiration, and mentorship throughout the experience. I also appreciate the guidance and support of my academic supervisor, Prof. Muhammad Golam Kibria, PhD, SMIEEE, Professor & Head (Acting) at the University of Liberal Arts Bangladesh (ULAB). My thanks extend to the team at EVOMED Technology for their cooperation and support, which greatly enhanced my practical learning. I am also grateful to the faculty of the Department of Computer Science and Engineering at ULAB for their knowledge and guidance, as well as to my parents, friends, and relatives for their constant encouragement. Finally, I acknowledge all those who contributed, directly or indirectly, to the successful completion of this internship.

# Appendix

Agreement and offer letter is attached below **EVOMED Technology (2025)**.



## INTERNSHIP AGREEMENT

This Internship Agreement is made and entered into as of May 25, 2025 by and between EVOMED Technology, referred to as the Company, and Md.Rifat Aknda, referred to as the Intern.

### About Us

At EVOMED Technology, we are helping shape a better, smarter future for healthcare. Using the power of the Fourth Industrial Revolution, our advanced Remote Patient Monitoring (RPM) devices combine IoT, Machine Learning, and TinyML to bring faster, more personalized care to people everywhere. Our goal is to make healthcare technology that's high-quality, affordable, and accurate—available to everyone, no matter where they live. By removing barriers like distance, cost, and complexity, we help patients take control of their health and give healthcare providers the tools they need to deliver better care. We focus on creating smart, easy-to-use solutions that improve lives and support a stronger, more connected healthcare system for all.

### Internship Overview:

We are excited to welcome a passionate and driven **Research & Development Intern – AI Engineer** to our team. This internship is an excellent opportunity for students or recent graduates with a strong interest in **healthcare and technology** to gain hands-on experience, build their portfolio, and contribute meaningfully to innovative, life-impacting projects..

### Responsibilities:

- Design research frameworks, objectives, and methodologies for ongoing and new projects.
- Collect, organize, and manage data using ethical and standardized procedures.
- Analyze datasets and apply ML/AI tools to extract meaningful insights.
- Interpret and present findings in alignment with project goals and stakeholder expectations.
- Contribute to the development of mobile or embedded applications for healthcare use-cases.
- Collaborate with the team, delegate tasks when necessary, and ensure timely execution of project milestones.

### Requirements:

- Intern must be currently pursuing or have recently completed a degree in CSE/EEE related field.
- Possesses strong communication skills and the ability to collaborate effectively in a team environment.
- Be available to work offline for a minimum of 3 hours each day.
- Have the ability to attend in-person office sessions for a minimum of 12 hours per week.
- Demonstrate a "can-do" attitude and commitment to regular report submissions.

### Benefits:

As part of this internship, **Md.Rifat Aknda** will receive the following benefits:

- Hands-on experience with cutting-edge technology and solutions.
- An opportunity to contribute to real projects and solutions with practical applications.
- Exposure to a collaborative and dynamic work environment.
- Learning and growth opportunities through engagement with educators and engineers.
- Flexible work arrangements to accommodate both online and in-person commitments.
- The potential for a full-time opportunity after completing the internship.

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Anywhere.**

**Reporting and signing policy:**

Google Form Daily Sign-In & Sign-out:

Employees are required to use a google form provided by the company to log their daily sign-in and sign-out times.

The Google Form should be completed at the start and end of each workday, indicating the exact time of arrival and departure from remote work.

Employees must ensure that the Google Form is submitted promptly and accurately each day.

**Terms and Conditions:**

This internship is **unpaid** and is intended for educational and experiential purposes.

The duration of the internship will be 25th May 2025 to 25th August 2025.

**Md. Rifat Aknda** agrees to abide by all company policies and guidelines during the internship. Both parties may terminate this agreement with a written notice of 30 days.

**Md. Rifat Aknda** will not disclose any **confidential or proprietary** information of the Company.

By signing below, both parties acknowledge and agree to the terms and conditions of this Internship Agreement.

For and behalf of the employer



Signature  
Name: Fazlay Rabby  
Founder and CEO  
EVOMED Technology  
Mobile: +880 1876419141  
Mail: fazlay.rabby.official@gmail.com  
R39, Noorjahan road, Mohammadpur  
Dhaka:1207, Bangladesh

By the Intern



Signature  
Name: Md. Rifat Aknda  
Address: LVL- 6, H#28, Shekerektek 5

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25th May 2025  
Md. Rifat Aknda  
+880 1955069244  
rifataknda.r@gmail.com

**Dear Md. Rifat Aknda,**

This letter is to confirm your appointment with EVOMED Technology as an Intern, effective from May 25, 2025. This appointment will be for a contractual period of three (3) months, ending on August 25, 2025

*At EVOMED Technology, we are helping to shape a better, smarter future for healthcare. Leveraging the power of the Fourth Industrial Revolution, our advanced Remote Patient Monitoring (RPM) devices integrate IoT, Machine Learning, and TinyML to deliver faster, more personalized care to people everywhere. Our mission is to make high-quality, affordable, and accurate healthcare technology accessible to everyone, regardless of location. By eliminating barriers such as distance, cost, and complexity, we empower patients to take control of their health while equipping healthcare providers with the tools needed to deliver superior care. We are dedicated to creating smart, user-friendly solutions that improve lives and foster a stronger, more connected healthcare system for all.*

During the three-months internship period, you will be expected to fulfill the following responsibilities:

- Design research frameworks, objectives, and methodologies for ongoing and new projects.
- Collect, organize, and manage data using ethical and standardized procedures.
- Analyze datasets and apply ML/AI tools to extract meaningful insights.
- Interpret and present findings in alignment with project goals and stakeholder expectations.
- Contribute to the development of mobile or embedded applications for healthcare use cases.
- Collaborate with the team, delegate tasks when necessary, and ensure timely execution of project milestones.

Please note that, apart from Christmas, Durga Puja, Eid-UI-Fitr, and Eid-UI-Adha, no other official holidays are recognized by the company. Leave arrangements can be made through an official leave request process. Sunday is designated as the weekly holiday.

**Congratulations on being selected for this position. We look forward to working with you and are excited to welcome you to EVOMED Technology**

Your sincerely,

**Name: Fazlay Rabby**  
**Founder & CEO**  
**EVOMED Technology**  
**Mobile: +880 1876419141**  
**Mail: fazlay.rabby.official@gmail.com**  
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