



Co-funded by the  
Erasmus+ Programme  
of the European Union

# **Mobility Report**

**Muhammad Ali Arif**

**Visit of University of Lorraine**  
**12-11-2023 – 03-12-2023, 2023**

- Name: Muhammad Ali Arif
- Institution: COMSATS Islamabad, Wah Campus, Pakistan
- Host Institution: University of Lorraine (UoL), Nancy, France
- Dates of Visit: 12-11-2023 – 03-12-2023

## **Overview of the Mobility**

During my three-week visit to the University of Lorraine (UoL) in Nancy, France, COMSATS WAH team collaborated with the UoL team on the demonstration and development of a fetus health monitoring belt. This mobility provided a unique opportunity for knowledge exchange, hands-on development, and technological enhancement.

## **Week 1: Demonstration and Feedback**

**Objective:**

The first week was dedicated to the demonstration of the initial version of the fetus health monitoring belt. This version was designed to monitor fetal heart rate, and fetal movements.

### **Key Activities:**

#### **1. Product Demonstration:**

- On 14 November 2023, I demonstrated the current capabilities of the fetus health monitoring belt to the UoL team, including researchers from the biomedical engineering department and other relevant faculty members.
- The belt utilized a combination of sensors, including an accelerometer and a heart rate monitor, to track fetal health metrics.

#### **2. Feedback Session with UoL Team:**

- The UoL team provided valuable feedback on the functionality, ease of use, and potential areas for improvement.
- Suggestions included the need for more advanced sensors to monitor additional health parameters and to improve the accuracy of movement tracking.
- The team also recommended considering the inclusion of temperature monitoring to track maternal body temperature during pregnancy, which is a critical indicator of maternal and fetal health.

## **Week 2: Upgrading the Fetus Health Monitoring Belt**

**Objective:**

Based on the feedback received, the second week focused on upgrading the belt with additional sensors and refining its performance.

### **Key Activities:**

#### **1. Research and Development:**

- Collaborated with UoL engineers and researchers to integrate a **temperature sensor** into the monitoring belt. This addition aimed to track maternal temperature, which can help detect early signs of infection or other complications.
- Developed and tested different sensor placements to optimize accuracy and comfort for the wearer.

#### **2. Gyroscope Integration:**

- A **gyroscope** was added to improve the tracking of mother's movements. This allowed for a more detailed analysis of fetal position and activity patterns, complementing the existing accelerometer.
- We worked to ensure that the data collected by the gyroscope and accelerometer were synchronized and could provide a comprehensive movement analysis.

#### **3. Software Updates:**

- The software of the monitoring belt was upgraded to support the new sensors. This included calibrating the gyroscope and temperature sensor to ensure accurate readings.
- A new user interface was developed to display temperature data alongside existing fetal health metrics.

### **Week 3: Testing and Final Review**

#### **Objective:**

The third week focused on testing the upgraded version of the fetus health monitoring belt and conducting a final review with the UoL team.

### **Key Activities:**

#### **1. Testing:**

- Conducted extensive testing with the upgraded belt, ensuring that the added sensors (temperature sensor and gyroscope) functioned as expected. The belt was tested in various scenarios to monitor its performance under different conditions.

- We validated the accuracy of the temperature sensor and confirmed that the gyroscope improved movement detection without compromising wearer comfort.

## **2. Final Presentation and Feedback:**

- The final version of the fetus health monitoring belt was presented to the UoL team.
- The feedback from the team was overwhelmingly positive, highlighting the improved functionality and the value of the added sensors. They praised the project for addressing critical health monitoring needs and suggested further clinical trials to validate the device in real-world settings.

## **Conclusion**

My three-week mobility at the University of Lorraine was a significant success. The initial demonstration, combined with UoL's insightful feedback, helped elevate the fetus health monitoring belt to a more advanced stage of development. The integration of a temperature sensor and a gyroscope significantly improved the belt's ability to monitor maternal and fetal health. This collaborative effort laid a strong foundation for further development, testing, and potential commercialization.



**Visit Report on Institute Jean Lamour,  
University of Lorraine, France**

by

**Ahmad Hassan**

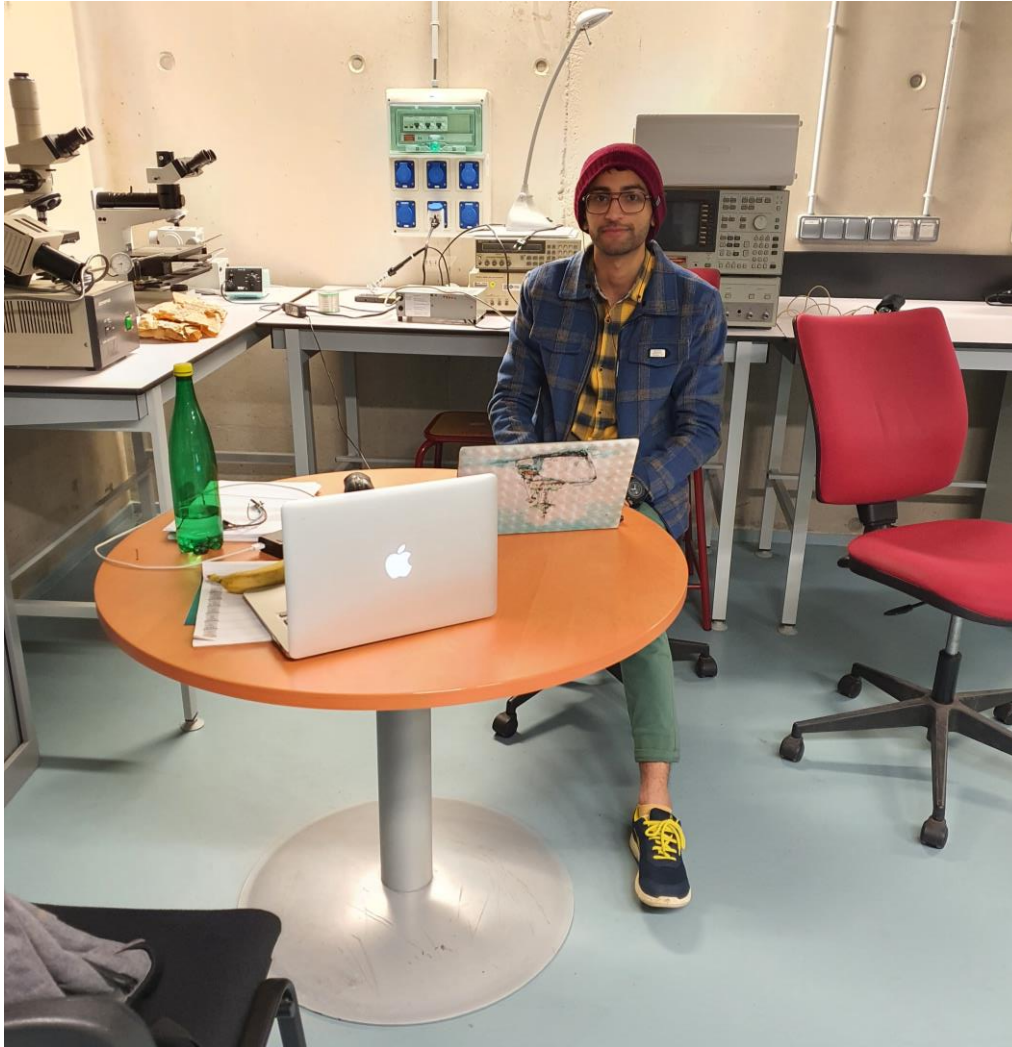
**From 12-11-23 to 02-12-23**

I had the privilege of being invited by Institute Jean Lamour, University of Lorraine, Nancy, France to attend a three-weeks research training program. This valuable opportunity greatly enhanced my academic and professional journey. These three weeks in Nancy helped me significantly. This period not only expanded my academic knowledge but also helped me to gain practical insights for my professional growth and current technological trends in healthcare.

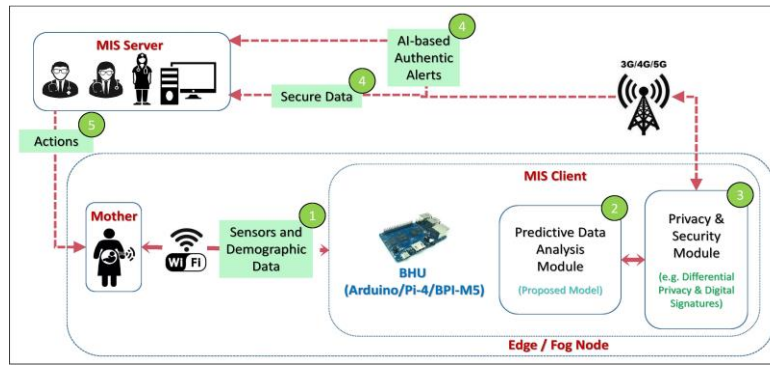


The major objective of the visit was to perform R&D activities related to the SAFE-RH project. With the consultation of my supervisor, Dr. Saima Gulzar Ahmad, I worked on a research paper in an area that is related to the project. The area that we had finalized was the “Remote Sensing and Predictive Modelling for Gestational Diabetes Mellitus”. The primary objective was to advance my academic and professional skills, with a particular emphasis on collaborative learning, hands-on training, and the completion of a comprehensive research article.

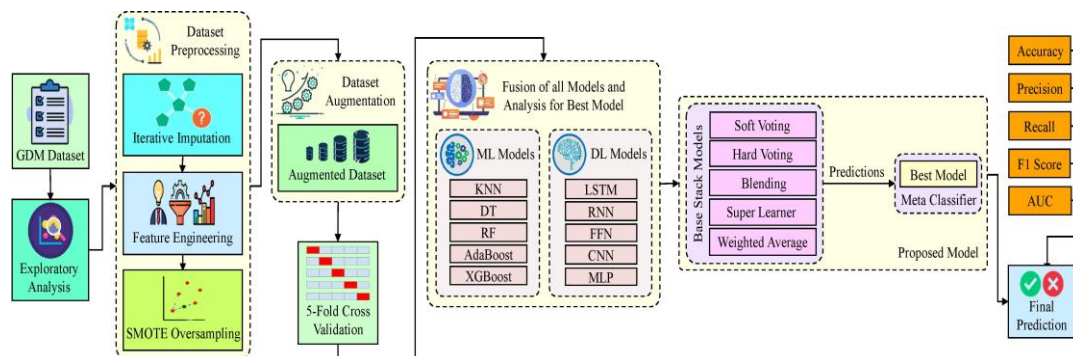
My research experience at the Institute Jean Lamour was both challenging and rewarding. Under the guidance of Dr. Hassan Rabah, I learned a great deal. Collaborating with a team of talented PhD researchers at the institute broadened my perspective and enhanced my communication and teamwork skills. It was a fantastic opportunity to learn. I also gained insights into new technology trends. Overall, this experience significantly improved my academic abilities.



During my three weeks at the Institute Jean Lamour, I spent my days immersed in Dr. Hassan Rabah's lab, focusing on research for predicting Gestational Diabetes Mellitus (GDM) using Machine Learning (ML) and remote sensing technologies. My work involved several key steps essential for writing a comprehensive research paper.



Initially, I conducted an extensive literature review to understand the current state of GDM prediction and identify gaps in existing research. I then gathered and preprocessed a diverse dataset, ensuring it was clean and suitable for analysis. This involved handling missing values, normalizing data, and selecting relevant features. Under Dr. Rabah's guidance, I experimented with various ML algorithms, to determine the most effective model for GDM prediction. Later, I proposed a novel multilevel stack architecture based model to predict GDM effectively. I meticulously tuned hyperparameters and evaluated model performance using metrics like accuracy, precision, recall, and AUC-ROC. Throughout this process, I documented my findings, challenges, and insights, which were crucial for the discussion and conclusion sections of the paper. Collaborating with a team of talented PhD researchers and Professors, I also learned to present my results clearly and concisely to ensure the research was both rigorous and accessible. This experience not only broadened my perspective but also significantly enhanced my communication and teamwork skills.



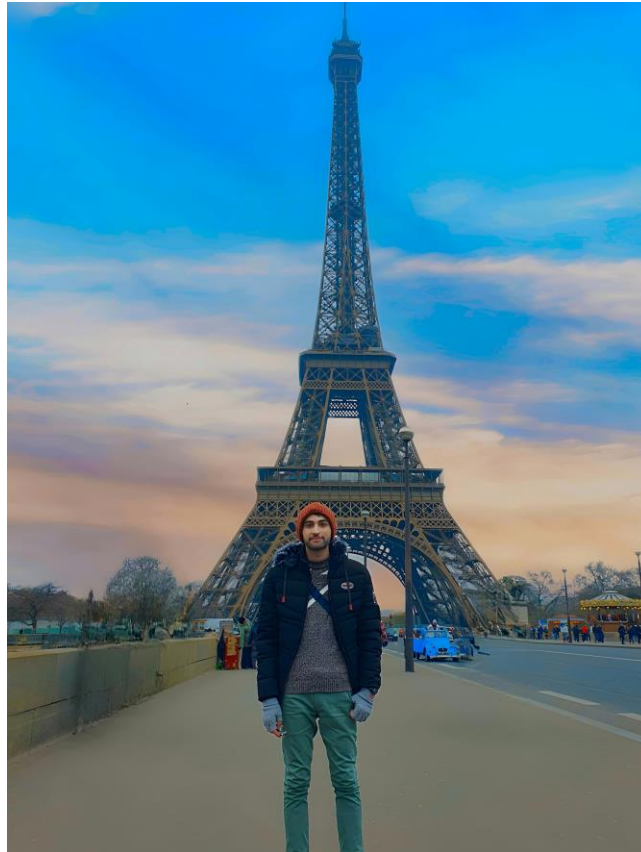


During our time at the Institute Jean Lamour, we had the privilege of taking a lab tour led by Dr. Hassan Rabah and Dr. Slavisa Jovanovic. This tour provided us with an invaluable opportunity to explore advanced lab devices, including robots and sensors. Engaging with these cutting-edge technologies offered a unique hands-on experience that significantly expanded my technical skills. It also deepened my understanding of their practical applications, allowing me to see firsthand how theoretical concepts are implemented in real-world scenarios. This exposure was instrumental in enhancing my knowledge and competence in the computer science field.



On the last day of my training, I delivered my final presentation to Dr. Hassan Rabah, Dr. Slavisa Jovanovic, and the students. Their valuable insights and comments were incredibly

helpful. After incorporating their feedback, I submitted my final research paper to the professors. On the day before my departure, I had the chance to explore some parts of Paris. The experience was absolutely delightful, and I thoroughly enjoyed every moment of it.



In conclusion, my three-week stay at France was an unforgettable experience. I will always cherish this part of my life. Exploring advanced technology applications and contributing to innovative programs have all shaped my academic and professional growth. Reflecting on this journey, I am eager to apply these new skills and perspectives to my future research. I extend my heartfelt thanks to COMSATS University Islamabad, Wah Campus, Institute Jean Lamour, University of Lorraine, the SAFE-RH Project, and the dedicated teachers and mentors who guided me. Their support and knowledge played a crucial role in my development. I am grateful for the chance to contribute to the academic community and for this invaluable opportunity.