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### **Internship Certificate: Mr. Naman Khetan**

Mr. Naman Khetan, born on 16 October 2001, has successfully completed an internship at the Max Planck Institute for Intelligent Systems from 13 May 2024 until 16 July 2024. Mr. Khetan worked in the Robotic Materials Department led by Prof. Christoph Keplinger. The internship was related to Mr. Khetan's study program of Mechanical Engineering at the Indian Institute of Technology (BHU) Varanasi in India. Mr. Khetan worked under the supervision of Mr. Toshihiko Fukushima on soft electrohydraulic actuators for soft robotics.

His activities encompassed three main topics: 1. fabrication of the soft electrohydraulic actuators, 2. analytical study of the electrical-mechanical interfacing of the actuator, and 3. development of a robotic application of the actuator. For the first topic, he implemented a semi-mass-production scale fabrication process, producing over fifty actuators using CNC machining, screen printing, laser cutting, and silicone coating. For the second topic, he formulated the relationship between the electrical and mechanical behavior of the actuator using the Lagrangian equation of motion, partially uncovering correlations between these parameters. For the third topic, he developed a bio-inspired active hinge structure. He initiatively presented the idea of the structure and started this project. He prototyped the joint by surveying biological literature and utilizing bio-mimetic design, CAD design, and 3D printing. The joint successfully worked with high-speed reciprocating motion (20Hz), and he demonstrated it to other intern students. He presented these results in a department meeting, gaining experience in structuring academic presentations. Additionally, he attended the EuroEAP 2024 academic conference as an observer and engaged in discussions with various presenters. He also participated in Robotics Institute Germany Interns (RIGI), actively networking with other international interns.

Overall, Mr. Khetan proactively engaged in his internship and stimulated the department with his active discussions. We appreciate his contributions and dedication.

Sincerely,

**Prof. Dr. Christoph M. Keplinger**  
Director, Robotic Materials Department  
Managing Director, Max Planck Institute for Intelligent Systems, Stuttgart  
Eminent Visiting Professor of Soft Robotics, University of Colorado Boulder, USA  
Honorary Professor, University of Stuttgart, Germany  
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