



**Ubica**

Robotics

Scanroboter für den Einzelhandel

Ubica Robotics GmbH • Konsul-Smidt-Str. 20 • 28217 Bremen

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S M Firoj Mahmud  
Leher Heerstraße 17  
28359 Bremen

## Reference Letter

Mr. S M Firoj Mahmud, born on 20.08.1992 in Barisal, Bangladesh is employed in our company as a working student in the area of hardware development and production since 07.06.2022 up to and including 30.09.2023.

Ubica Robotics GmbH is a young and successful spin-off of the University of Bremen. We develop, produce and distribute autonomous scanning robots for stationary retail.

As a working student in the Hardware Development and Production department, Mr. Mahmud performed the following activities:

- Development of electronic circuit boards (PCB), including the schematic planning, simulation of relevant parts of the circuits, layout following good practices for electromagnetic compliance, and preparation for production.
  - o Development of a motor driver integration PCB, that integrates two motor controllers and all the necessary connectors for power distribution and filtering, optical encoders, USB communication, EtherCAT communication, and safety signals. After receiving the manufactured PCB, he also did the initial testing and debugging, and we plan to install this PCB as a part of our next production of robots.
  - o Development of a passive battery balancer for a 48V lead-acid battery pack. The initial version includes an isolated 5V to +-12V DC-DC converter, ability to measure the battery voltages, a precision analog-to-digital converter, an I2C port extender, and MOSFETs for controlling current flow over ceramic resistors. After a performance evaluation, we concluded that an active battery balancer based on a switching-capacitor principle would be better, and he has investigated different circuits and evaluated their performance in simulation.
  - o Changes to existing PCBs for improving layout, or changes in connectors. Some of these PCBs are used in our production robots as well.
- EMC Pre-compliance tests: He assisted us in visits to a certified EMC compliance laboratory (Messtechnik Nord GmbH), where he gained hands-on experience of the measurement process. In our development laboratory, he did measurements for pre-compliance using a spectrum analyzer, a LISN, a biconical measurement antenna, and near-field probes.



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- PCB testing and troubleshooting, including the documentation of tests. Also, serial protocol decoding of a Battery Management System using an oscilloscope and a signal analyzer.
- He also completed his Master Thesis under our supervision, with the title: "Design, Implementation and Verification of an Obstacle Avoidance System for Collision-Free Movement of a Robot". He developed the sensors and communication network for a distance measurement sensor for our robots that uses Time-of-Flight measurements. The system includes multiple sensors distributed along the outer hull of our robot, that are networked together using an I2C bus. The sensor interface PCB includes voltage regulation, I2C level shifting, I2C address configuration techniques, ESD protection, and filters. He programmed the system based on an ESP32 microcontroller using C++ for the firmware and Python for data analysis.

Mr. Mahmud has comprehensive and sound specialist knowledge, which he was able to put into practice well at all times. He was extremely reliable, and his working style was always characterized by very careful planning and a systematic approach. He always impressed with qualitatively and quantitatively outstanding results. He was also well able to cope with increased time pressure and workload.

Mr. Mahmud always performed his duties to our complete satisfaction and optimally met our expectations in every respect. Mr. Mahmud always behaved in an exemplary manner towards superiors and employees. He contributed to excellent and efficient teamwork.

Mr. Mahmud will leave our company at the end of his studies. With him, we are losing a valued colleague. We would like to thank Mr. Mahmud for the always excellent cooperation and are very sorry to lose him as an employee. We wish him all the best and continued success in his future career and life.

Bremen, 29. August 2023



**Alexis Maldonado**

Team Lead Hardware Development

