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| Project Work 1 - Outline | | |
| **Study Cohort** | | AD22 |
| **Title** | | Process Modeling and Implementation with Blockly, Python, and Node-RED |
| **Confidential** | | No |
| **Specialisation** | | Robotics, IoT |
| **Names** | Students | Kai Aebli  David Senn |
|  | Supervisor | Marco Brunschwiler |
| **Assignment**   * **Initial status** * **Objectives** * **Additional Assignment Modalities** | | **Key terms:**  **Dobot Magician:**  The dobot magician is a 4-axis robot arm that can perform numerous tasks. It is designed for educational and small-scale industrial processes. The dobot is programmable and can also be controlled with software interfaces like Dobot Studio. The robot can be connected to sensors and actuators like color-sensor, conveyer belts and more. Thus allowing the automation of tasks like pick-and-place, 3D-Printing, laser engraving etc.  (dobot-robots, n.d.)  **Node-RED:**  Node-RED is an open-source flow-based programming tool. It allows users to create flows in order to define the behaviour of an application. The flows are created by connecting nodes that are given some data, then do something with the data and finally pass the data on to the next node constructing a data stream. With this approach Node-RED offers a visual representation of a system that can be grasped by a wider range of users. The generated data can easily be transferred to higher-level systems like SQL servers, enterprise management systems or cloud-based services.  (Ferencz & Domokos, 2020)  **Edge Cluster:**  Edge cluster is a term from edge computing. Edge computing is characterized by decentralized data processing at the edge of a network. The difference between cloud and edge-computing shows in the location of data processing. While it does not matter where data is produced for cloud computing in edge computing the processing happens next to the production facility where data is generated. The big advantage of edge computing is that the edge knows the location of each part in the production system. Further it enables faster response time and allows to process more data in almost real-time than cloud computing. The edge cluster describes the network of the interconnected computing devices.  Bachelorarbeit //(Pahl et al., 2016)  Robot arms and other actuators play an important role in the automation of processes in laboratories and production plants. Examples of such devices are Dobot Magicians. The Dobot Magician is a 4-axis robot arm that is suitable for various tasks in the laboratory context. Such robot arms and other actuators often work together in strictly defined processes, whereby the process flow considers certain external signals or conditions depending on the context. The semi-formal modelling of such processes plays an important role in the digitization and automation of laboratories and production plants. The robot arms can be programmed using the so-called "no-code" environments Node-Red and Blockly. In a "no-code" environment, functional blocks are arranged in a graphical interface.  Raspberry Pi are single-board computers that are used in various industries such as Engineering, Computer Science, Physics, Astronomy, Biochemistry, Genetics, Molecular Biology, Materials Science, Chemistry, Environmental Science, Mathematics, Robots, Chemical Engineering, Business, Management and Accounting. Looking closer into the field of Robotics there are numerous applications:   * **Multi-Utility/Multi-functionality Robots** can be used in the military to assist and protect soldiers from metal bombs and land mines. In the industry – in combination with Raspberry Pi – intelligent robots can be developed and deployed easily. * **Surveillance Robots** can be used in unrecognized, inaccessible areas. Raspberry Pi enables surveillance technologies with minimal cost and high accuracy. * **Line following robots** are commonly used in hospitals, medical centers, farming, military and factories. These robots follow a given path autonomously by using infrared sensors with the Raspberry Pi to help tracking a line and differentiating it from the background. * **Crop disease detection:** The leaves of plants provide essential information about their health. By using image processing diseases get detected and the farmers can be alerted automatically. Further the cause of the disease and important parameters like humidity, moisture, temperature or the water level of the tank may be delivered and monitored.   There are many more applications like automated billing in supermarkets, mapping of inaccessible tunnels, rescue operations in unknown environments, herbicide spraying, wall painting, fire exterminating etc.  (Mathe et al., 2022)  A further benefit of the Raspberry Pi is their low cost while having relatively high computing power and low power consumption. Additionally they are resilient against power failures or challenging environments such as hot or cold temperatures. These benefits makes the Raspberry Pi 4 optimal for the use as control units of the IoT devices or as edge clusters (Pahl et al., 2016) (Wolfgang & Cao, 2023)  **Objectives:**  The aim of this project is to further investigate the application of Raspberry Pi and the Dobot Magician in Robotics and process automation. Further the usability of Raspberry Pi as edge cluster in combination with the no-code environment Node-RED will be explored. Finally the goal is to determine possible real-world scenarios where the system used in this project could be applied.  Research questions:   * How can Raspberry Pi help with process automation in the industry?   + What are the benefits and disadvantages? * How well can the Dobot Magician be used for process automation in the industry in combination with Raspberry Pis?   + What are the benefits and disadvantages? * Are Raspberry Pi effectively usable as edge cluster in the industry? * What are the advantages and limitations of using no-code environments like Node-RED for implementing process automation? * How does abstracting recurring patterns in processes contribute to reusability and scalability of automation solutions? * What are possible real-world applications for automation processes similar to the one implemented during the project?   Preliminary table of content  Zusammenfassung  Abstract  Table of content  Glossary  1 Introduction  2 Theoretical background  3 Methods  4 Results  5 Discussion  6 Conclusion  7 Bibliography |
| **Formal Requirements** | | * All relevant [Guidelines](https://www.zhaw.ch/de/lsfm/studium/studiweb/bachelor/pruefungen-und-studentische-arbeiten/) for student papers * Citation management software: Zotero * Citation style: APA 7 |
| **Timeline** | | *See excel file on github* |
| **Submission Deadline** (12:00 PM) | | *23.05.2024 12:00* |
| **Remarks** | | Submission requirements:  Project report: Uploaded digitally via Complesis (as PDF and original file format)  Code: tracked and documented on a Github repository |
| **Workplace** | | ZHAW Wädenswil |
| **References** | | dobot-robots, DOBOT Magician | An all-in-one STEAM Education Platform. (n.d.). Abgerufen 4. April 2024, von <https://www.dobot-robots.com/products/education/magician.html>  Ferencz, K., & Domokos, J. (2020). Using Node-RED platform in an industrial environment.  Mathe, S. E., Pamarthy, A. C., Kondaveeti, H. K., & Vappangi, S. (2022). A Review on Raspberry Pi and its Robotic Applications. 2022 2nd International Conference on Artificial Intelligence and Signal Processing (AISP), 1–6. <https://doi.org/10.1109/AISP53593.2022.9760590>  Pahl, C., Helmer, S., Miori, L., Sanin, J., & Lee, B. (2016). A Container-Based Edge Cloud PaaS Architecture Based on Raspberry Pi Clusters. 2016 IEEE 4th International Conference on Future Internet of Things and Cloud Workshops (FiCloudW), 117–124. <https://doi.org/10.1109/W-FiCloud.2016.36>  S. Wolfgang and X. Cao, "Raspberry Pi Based Computing Prototypes: Design, Implementation and Performance Analysis," *2023 IEEE International Conference on Electro Information Technology (eIT)*, Romeoville, IL, USA, 2023, pp. 059-066. <https://doi.org/10.1109/eIT57321.2023.10187384>  Untersander, A. (2023). Personalisierte Food Production mit Cloud und Edge Computing. Bachelorarbeit ZHAW. unveröffentlicht |

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