



Fakulta elektrotechnická
Katedra kybernetiky

Safety evaluation of robot applications

- Task specification -

Subject: Humanoid robots

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■ Task description

The client, ACME Corporation, asks for the evaluation of the task captured by the following example file: `Example-06.f-Pick and Place CNC and Dual RobotiQ Gripper-UR10.rdk`

The client's goal is to automate the introduction and extraction of pieces into a CNC machine by the use of a UR robot. In addition to the RoboDK model and information contained in it, the following information is available (you can refer to these points in your report by the provided abbreviations):

DES00 The maximum task velocity is currently assumed to be 2 m/s.

DES01 The processed piece taken from the CNC machine is sharp and would pierce the operator's skin.

DES02 The processed piece weight is 0.45 Kg, after processing it weights 0.3 Kg.

DES03 The currently used gripping force is 180 N.

DES04 The CNC machining takes 30 seconds.

The technical specifications of the deployed robot and grippers are found in the provided official PDFs.

In addition to the modelled robot behaviour, the client provides you with the following requirements (you can refer to these points in your report by the provided abbreviations):

REQ00 If the robot encounters a problem while placing a piece into the CNC machine, it is assumed the human operator is going to access the CNC machine and attempt to clear the obstruction.

REQ01 The application assumes that the operator accesses the finished products and collecting them when the whole tray is full (but before the robot places a new finished piece).

REQ02 The application assumes that the operator replaces the empty tray of the pieces that are meant to be processed.

REQ03 If the robot encounters any unforeseen situation, it is assumed the operator tries to clear it.

REQ04 The surroundings of the CNC machine are part of the shop-floor and other humans might walk by it.

REQ05 The CNC machine processing does not start until the CNC machine door is closed.

REQ06 The maximum allowed cycle length is 5 minutes.

Following the provided methodology file, try to analyse the risks of the presented application (in the example and with the additional requirements provided here) and create a report that describes the risks you identified and how you would mitigate their effects.

Feel free to suggest any signalling devices, sensors, changes in the robot behaviour, the setup, etc. that would mitigate any risks you identified. Yet make sure to clearly describe them and keep the original intention of the client intact.

■ Evaluation criteria

You need to submit a PDF report following the methodology document. It is enough to submit the PDF export of the sheet filled with the appropriate responses and data, but do not forget about the commentary sheet to provide additional reasoning and details.

■ 1. Formatting: Submitted a clearly written PDF [1 pt]

The PDF should contain your **full name** or **student ID**. It should be readable (e.g., digitised handwriting that is unreadable won't get any points).

■ **2. Questionnaire: Completely and accurately filled out methodology questionnaire [1 pt]**

You should fill out the questions in the provided methodology document. If the information is not available in the task description, then you can make the information up. Any information that you made up but is part of the risk assessment needs to be supported by an explanation.

■ **3. Risk identification: Report identifies correctly and clearly the risks (at least 3) [1 pts]**

Looking at the provided example file and reading the client requirements, identify at least 3 risks. These risks can be just listed but do not forget to clearly delimit them with respect to the application and requirements.

■ **4. Risk mitigation: Report correctly mitigates the risks [2 pts]**

Determine the overall risk for each of the identified risks. Risks that exceed the allowed level (i.e., Low or Negligible) need to be mitigated and you should provide a description of the risk mitigation and the resulting overall risk calculation after the risk mitigation. Use the provided sheets to describe these values.

■ **5. Discussion: Report discusses properly alternatives and decisions [3 pts]**

Any decision in your assessment needs to be well-documented. Use the information from the lectures to support your decisions (e.g., present a calculation that shows that your choice of velocity is accurate). Provide and describe also the alternatives that you considered and explain why they were omitted/not chosen. This part of the report should be clear and provide sufficient arguments for the client (or examiner ;) to see the reasoning behind your decisions. Be specific! We need to see if you understood the methods and reasons behind them. If no discussion or explanation is provided, zero points are given.

■ **6. Bonus: creativity bonus [1 pt]**

As this is an open ended task, for creative solutions or ideas out of the ordinary, a possible bonus of up to 1 pt can be granted.

■ **General notes**

Please, submit your solution to BRUTE.

There is a soft and hard deadline. Solutions uploaded after the soft deadline will gain **only half** of the points. Solutions uploaded after the hard deadline will gain **no points**.