sustainablySMART

Sustainable Smart Mobile Devices Lifecycles through Advanced Re-design, Reliability, and Re-use and Remanufacturing Technologies

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Disclaimer

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1 Introduction

This report will show the demonstration of the project outcome – the automatic, collaborative disassembly machine for mobile phones. It involves a description of how the equipment works.

2 Technical Tasks

A multitude of different smartphone-types need to be dismantled to remove hazardous materials (e.g. batteries) as well as valuable components (PCBs). This leads to a flexible adaption of the disassembly equipment. A modular construction for an adaptive set-up is necessary and was developed. A special challenge is the dissolving of three-year-old glued joints. The heating of the device to dissolve the bonds is tested under observation of different approaches.

The typical process consists of:

1. sorting the input stream (supplied by the project partner REFIND)
2. picking phones from a belt
3. opening the phones
4. removing the battery
5. removing the PCB
6. sorting the gained fractions.

3 Description of the Demonstrator

Within the framework of the project ProAutomation has developed a collaborative robot system. The concept implies that the mobile phone disassembly is performed by a robot, while certain complex tasks such as unscrewing PCB screws is performed by operators. To this end, the collaborative robot SAWYER has been employed (see Figure 1). Hence, the recycling process shall become simpler and more efficient for the end-user.

Figure 1: SAWYER collaborative robot

The initial idea implied that the process would be developed for the high volume recycling processes. However, due to the fact that recycling companies do not have access to large volumes of many smartphone types yet, the concept has been adjusted to meet the current needs of these companies that do not need to process large numbers of old mobile phones yet. Therefore, a collaborative approach aimed at low volume processes has been adopted.

Smartphone analysis

The MPHs have been analysed with regard to:

- built-in components;
- types of component attachment (clips, glue, screws, etc.), and
- size of the MPH model.

Demonstrator

ProAutomation has set up the demonstrator at the earliest stages of the project in order to ensure the possibility to timely react to the evolving requirements of the project and the market and adapt the concept accordingly.
The following key steps have been implemented:

- Concept development for the demonstrator finalized;
- Mechanical design developed (see Figure 2);
- Electrical design developed;
- Software design developed;
- Construction performed;
- Tests carried out.

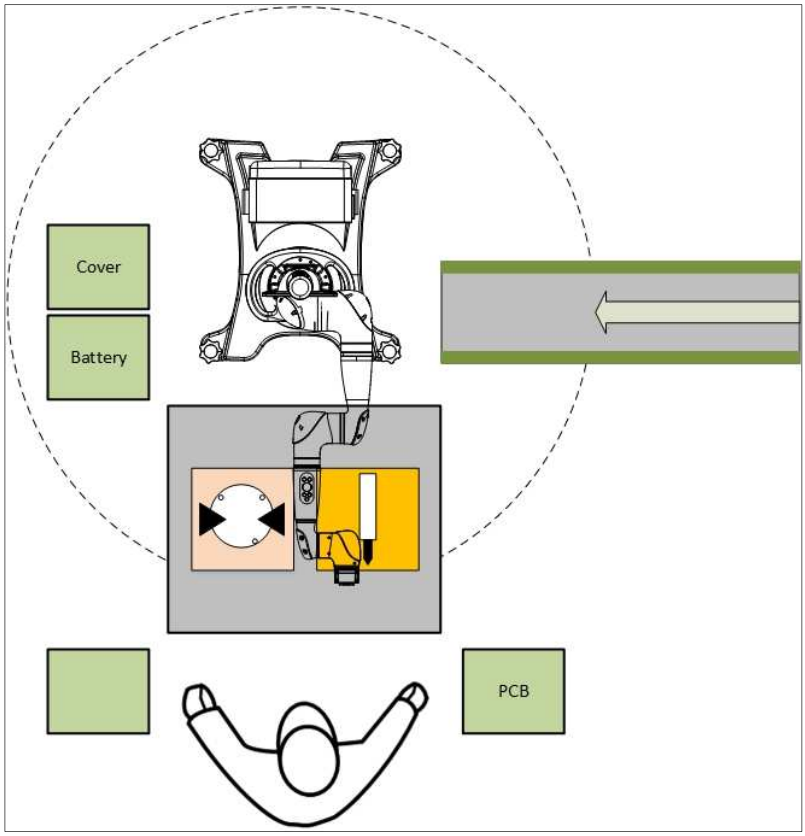

Figure 2: Demonstrator layout

The tests of the demonstrator include the following steps:

- Camera software detects the phone;
- Robot picks up the phone;
- The phone is fixed in the fixture (see Figure 3);
- If the housing is glued, it is heated first;
- Cover is removed and placed in the cover fraction (see Figure 4);
- Battery is removed and placed in the battery fraction;
- An unscrewing module unscrews the screws on the PCB;
- The robot removes the PCB and places it in the PCB fraction
- The robot drops the remaining part of the smartphone in the fraction for the remaining parts.

This whole process allows the equipment to gain and sort 4 fractions:

1. covers
2. batteries
3. PCBs
4. residual fractions.

Figure 3: Robot places the smartphone into the clamping unit after heating it in the heating unit

Figure 4: The robot places the removed back cover into the cover fraction

Modules

The demonstrator consists of a collaborative robot and a set of modules, i.e. the heating unit and the clamping unit (see Figure 5 and Figure 6).

Figure 5: The heating unit

Figure 6: The clamping unit

A collaborative robot is equipped with a multigripper: One gripper is used to pick up the MPH from the belt and remove the battery, while another one is used to remove the cover. Modules are tables with fixtures developed for certain phone types, e.g. Samsung S3/S4. It is easy to change modules based on the phone type that needs to be disassembled. This configuration is simple, but efficient and cost-effective. In the future, another configuration is possible, subject to cost calculation and effectiveness analysis.

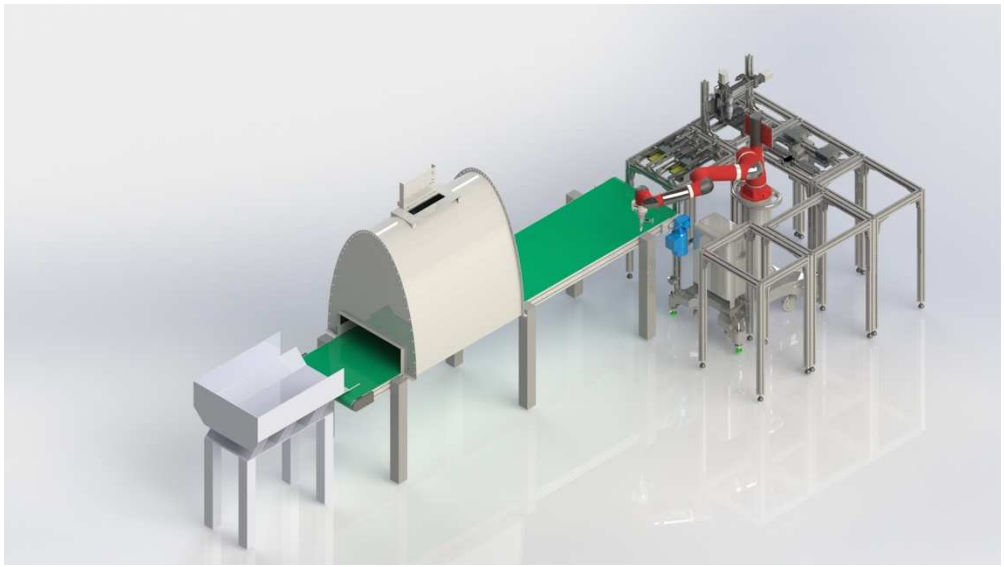

Figure 7: Side view of the complete demonstrator including identification, sorting and disassembly.

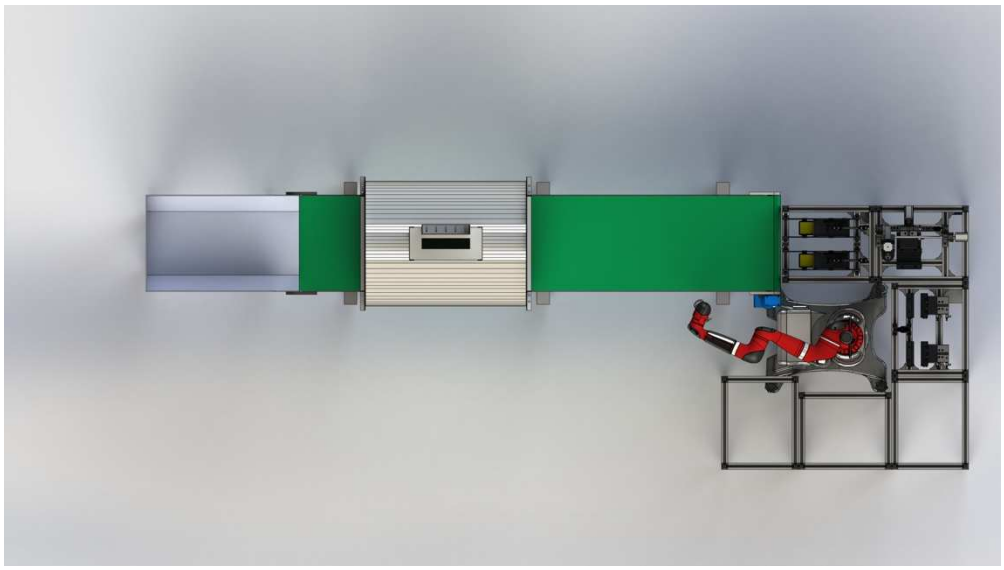

Figure 8: Top view of the complete demonstrator.

4 Demonstration of the equipment

The first 2 modules of the demonstrator, including the robot and camera application was already shown at the GA in Vienna. Additionally there is now a unscrewing module added, which is able to unscrew the PCBs. The demonstrator will also be shown to a selected group of interested professionals during the CARE conference in November 2018 in Vienna.