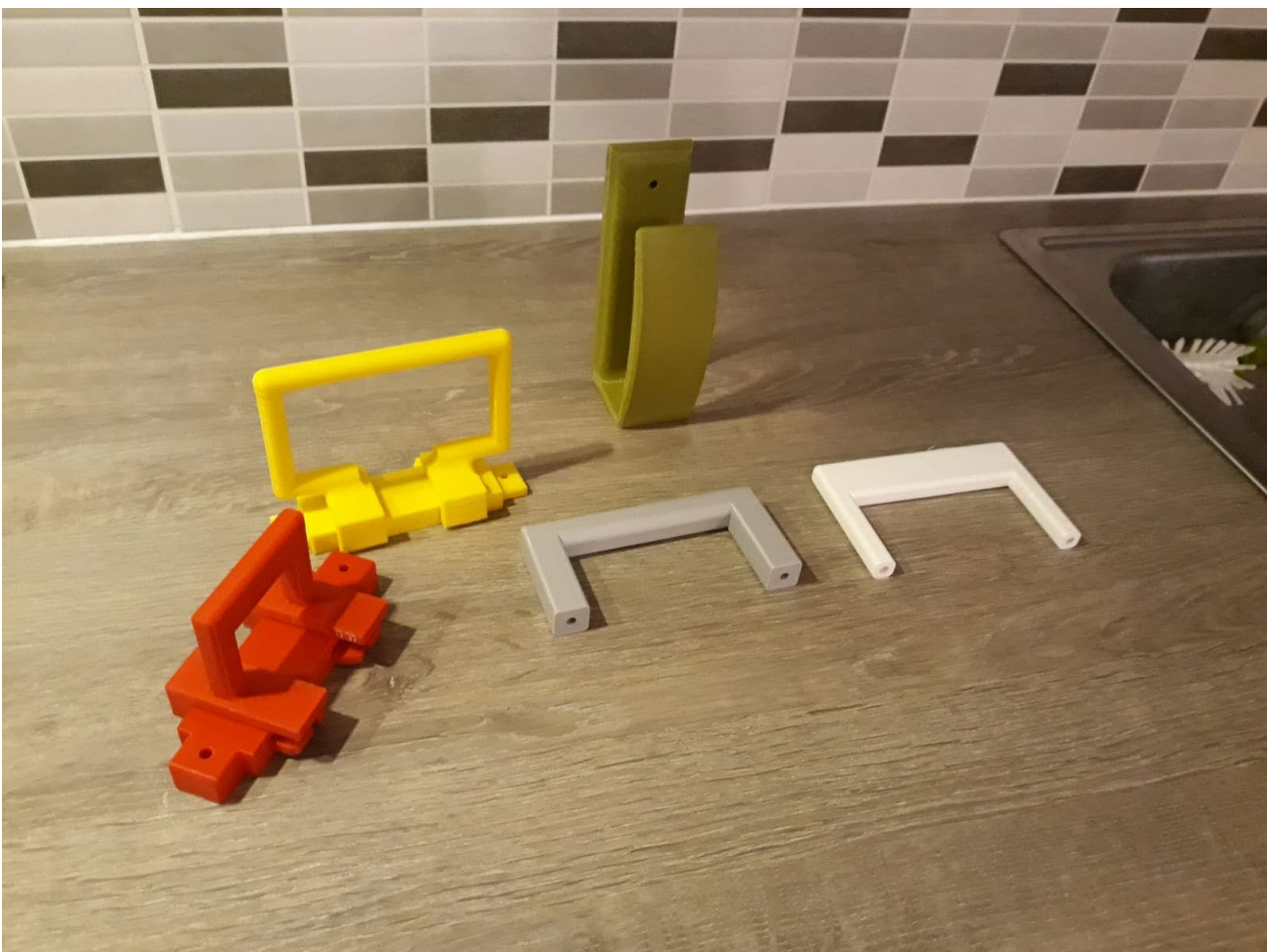


3D printing in furniture customization - handles

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Several physiological and physical changes occur in aging. Some of the latter are decreased grip strength and degenerative changes in hands and fingers due to underlying conditions such as rheumatoid arthritis. This presents difficulties in managing everyday activities and may affect independent living. Adapted furniture and its parts can promote independent functioning at home as well as in other residential spaces. Furniture handles are one example that is often not designed for adequate use by seniors that have difficulties gripping. Often existing handles do not provide a good grip or the space between the handle and the cabinet or drawer is too small and thus difficult to fit the hand in. 3D printing technology enables a fully customizable design of handles, which results in more functional use.

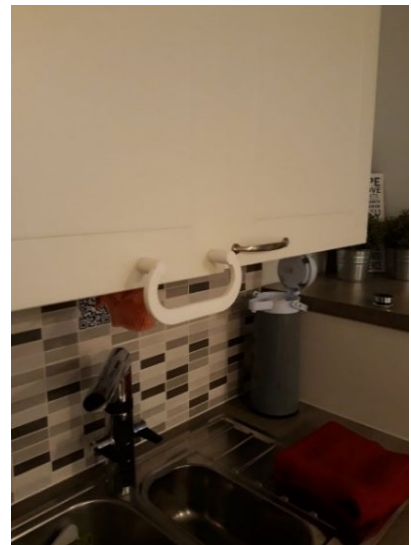
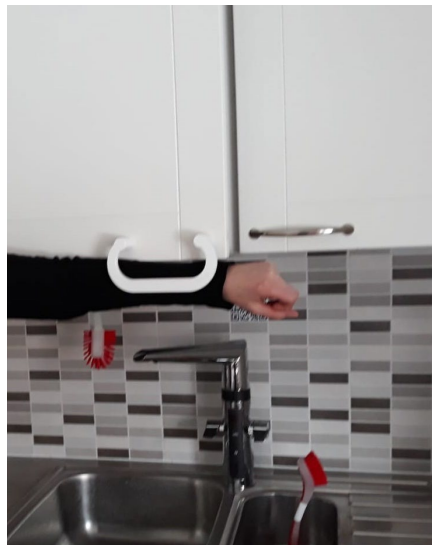
Several furniture handles were created and 3D printed for this purpose. Designs were created in Autodesk Fusion 360 software, and printed with Ultimaker Cura 3D printers using polylactide (PLA) material. All handles provide a larger space between them and the furniture, which they are attached to. Ideation, design and printing was done at Satakunta University of Applied Sciences (SAMK) in Finland as part of the BaltSe@nioR project.



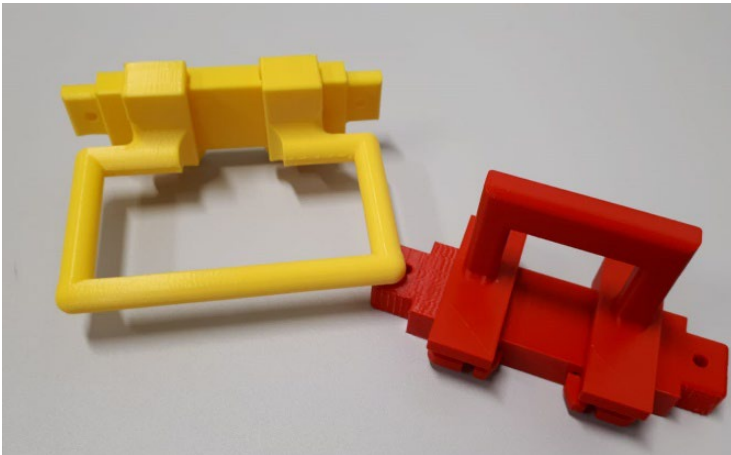
Handles in various colours displayed in MeWet smart home in Ulvila, Finland.



Wide gap handle (left and middle photo). Compare the space between the regular handle and the cabinet versus 3D printed handle and the cabinet. **Pulling handle** (right) can be used by people with inability to grip due to painful degenerative changes in hands (such as rheumatoid arthritis). This handle enables pulling with a straight hand, which decreases the load on the small joints of fingers. It can be installed onto the cabinet or drawer vertically or horizontally.



Ear handle. Another handle with larger space that can be used also by pulling with forearm and is thus suitable for people with decreased ability to use hands due to e.g. spasticity, contractures, degenerative changes. As the handle does not require direct contact with the hands and fingers, there is a smaller possibility for contamination to the handle when e.g. cooking or cleaning. Due to the same reason, it also enables a more hygienic use. If installed in upper cabinets, the handle creates smaller distance to reach for the individual because the grabbing part extends under the edge of the cabinet (see photo on the right). It is therefore suitable also for people with shorter height and people on wheelchairs.



Locking handle consists of a handle and a fixed part attached onto the furniture/cabinet by a locking mechanism. This allows an easy change of handle whereas the fixed part remains the same and permanently attached on the furniture. This is especially useful in homes with temporary residents or accommodations with frequent resident changes, such as elderly homes and tourist accommodations.

All handles can be printed in different colours that fit with the furniture of the elderly person living at home and different materials – not only plastic – can be used. They can be easily fully customized for individual's needs.