

Design and Testing Notes

Design Intent



The attached design is intended for use on door-knobs and spherical or cylindrical tap heads of 50-74mm diameter (standard door-knob sizes range from 60.3mm to 69.9mm). This is demonstrated in the attached renders and below.

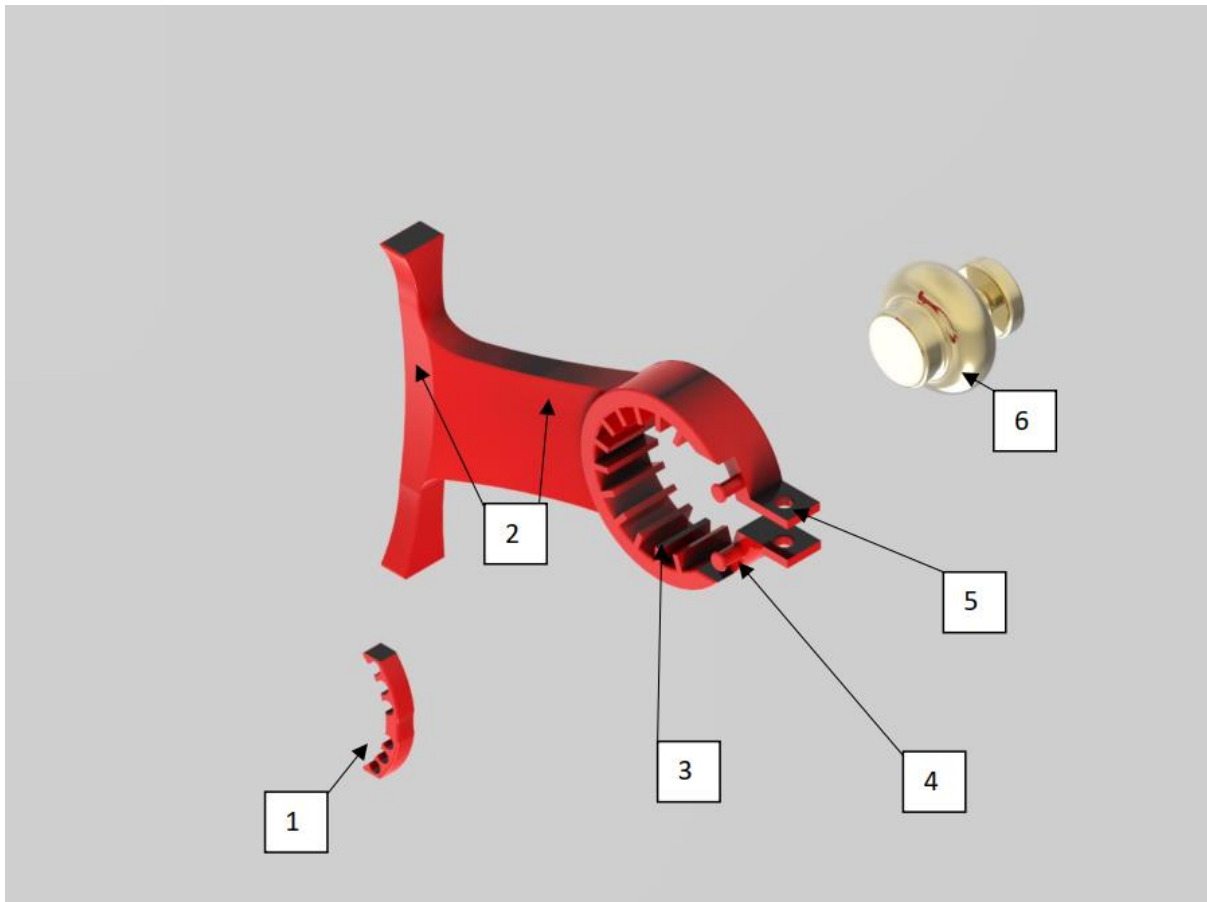
This design was created as there seem to be a wide range of solutions in place (or even proposed in the competition already) for modern cylindrical door handles and slightly more modern tap designs.

This design aims to provide a solution for 'traditional' door-knob and tap designs while maintaining usability for both able bodied and disabled, less-than-able and elderly demographics.

The final design can be easily detached and moved elsewhere or stored. The device can be cleaned and disinfected with ease using relevant medical cleaning processes in line with the material used. For example, if plastic is used, cleaning processes akin to those used for plastic catheters and stents can be used.

Additionally, more rudimentary household cleaning items can be used as standard if cleaning requirements are less rigorous.

Operation



1. Adjustable clip that can 'snap' on to dowels
2. Main design wrist mounts for both door and tap use
3. 'Teeth' to grip on to surface of application
4. Dowels for the adjustable clip
5. Zip-tie holes
6. Door-knob

The device functions by the 'teeth' inside the cylindrical section fitting tightly around a range of door-knob diameters and tap heads. A tight fit is ensured by both the adjustable clip that 'snaps' on to dowels on the main design as well as the holes on the main design that allow for a zip-tie to be secured through. The outer arm is ergonomically shaped for a wrist to fit comfortably in to and around - both to rotate the door-knob and pull the door open. the device is symmetrical so it can be used in various orientations to suit the user. Additional ergonomic wrist surfaces are placed across other edges of the devices arm to allow for placement when it is secured on taps in the adjacent configuration.

Additionally, the device can fit around taps with long protruding handles by positioning them at the point where the ring splits.

Manufacture

Multiple methods of manufacture were considered for this design, but it was determined that additive manufacturing processes would be best suited to allow for sufficient modularity of the design and to adhere to desired timescales and quantities required. It is recommended that the design be made from high impact ABS as testing was performed with this material.

Prior to manufacture with another material, it is recommended that further testing is performed. Additionally, testing was performed on a theoretical solid body and it may be best to prototype with users desired print qualities to ensure sufficient strength.

Other methods considered included injection molded silicon or a combination of 3D plastic printing and injection molding of silicon to create the inner ring with the teeth. This would allow for greater applications of the design across non-standard door or tap radii while maintaining friction to ensure the device is secure.

Testing

ASDMA states maximum opening forces (when measured at the lever handle position) should not exceed 35N when turning the knob from 0-30 degrees and from 30-60 degrees this force should not exceed 27.5N. In the FEA study conducted with a rough model, using a safety factor of 2, a force of 70N was applied in the downward direction on the surface of the wrist mount. Furthermore, the pull force required to open a door should not exceed approximately 44.4N.

These design cases were simulated against the surface which acts as resistance for the user to apply their wrist to when opening the door. Again, this was performed with a factor of safety equal to 2 and the FEA simulations were successful in keeping stresses below 20% of material yield stress and displacement levels below 0.5mm.

The study was conducted by setting the part material to 'High impact ABS plastic'. However, print quality will dictate the parts strength and it is recommended that prototyping is done to ensure intended device function.