

Custom LED fixture & Locking Techniques to Secure and Illuminate Public Female Toilets

Introduction

Shenberger Technology is an IT company located in Mercersburg, Pennsylvania, USA. We provide innovative electronic and mechanical concepts and prototypes as well as a variety of traditional IT and cybersecurity solutions.

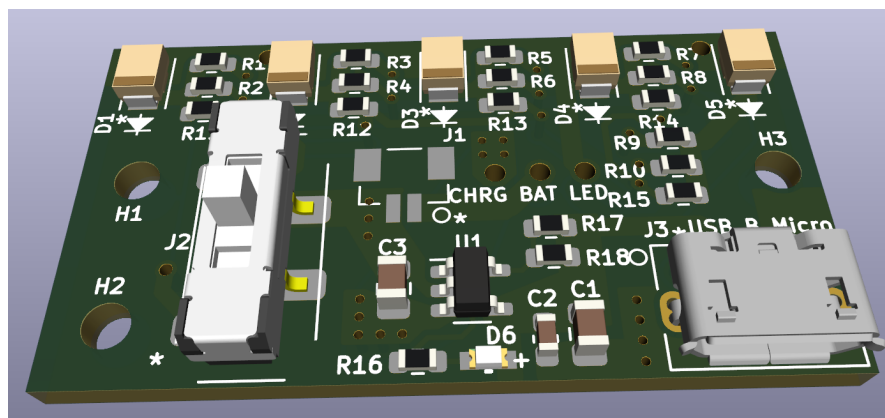
This proposal seeks to respond to all three components of the challenge: lighting, locking, and alerting.

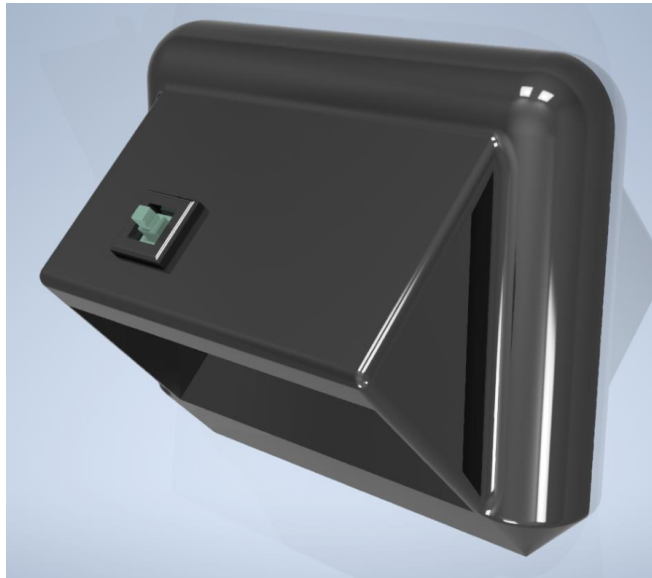
Our lighting solution is compact, energy-efficient, and can be easily converted into a portable model. The locking and alerting concept we propose is secure, innovative, easily retrofittable, and versatile.

Abstract

Lighting

The lighting solution implements a three-level, adjustable-brightness LED array in a compact format (36mm x 20mm) with an onboard battery charger that works with any standard USB Micro charger and a standard lithium battery pack connector (not shown in the 3D model below). This light can be wall mounted in the cubicle using the mounting holes or a 3D-printed case such as the one shown below. In such a case, it's easily used as a mounted light or a portable flashlight. A basic limit switch on the door latch mechanism triggers the light.





Example lighting enclosure

Locking & Alerting

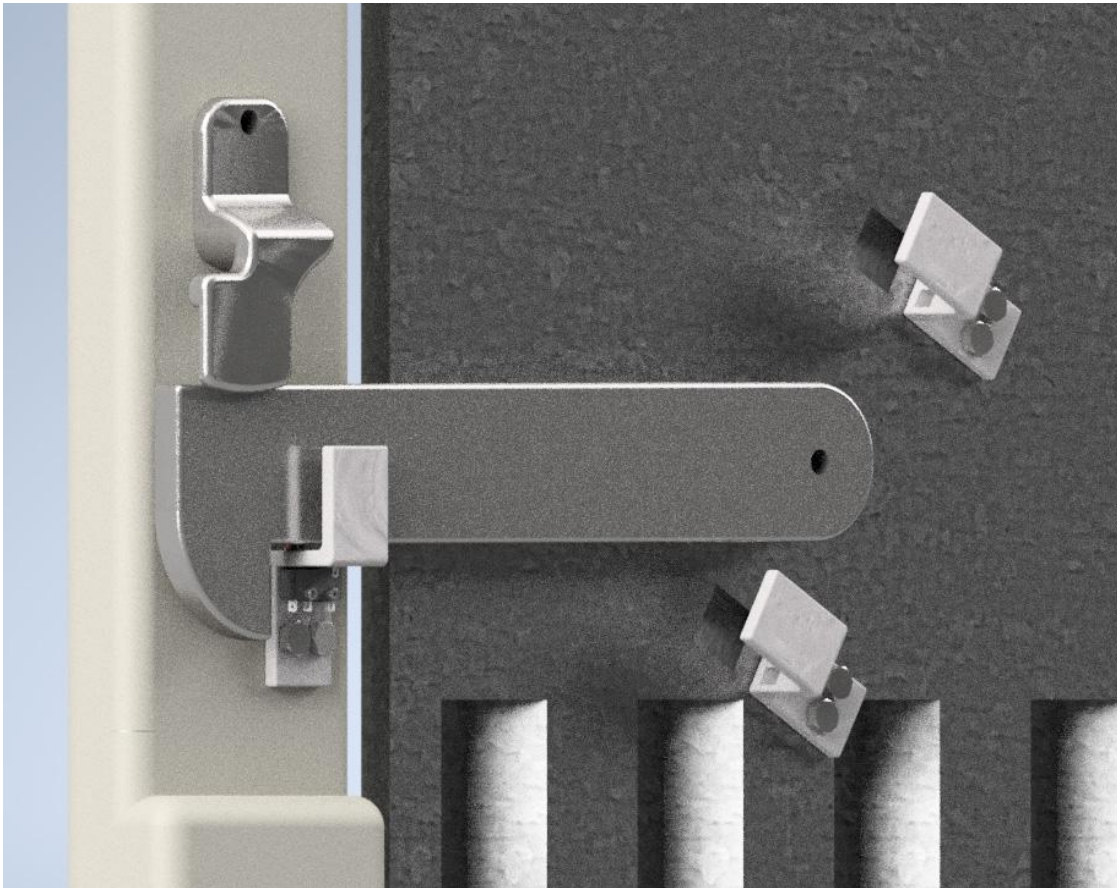
The locking mechanism is presented as a concept that can be implemented affordably either through bulk manufacture or out of materials on hand, such as pieces of scrap metal. The primary components are:

- a flat metal bar with a hook on one end and a single hole on the other
- three identical Z-shaped metal pieces with two mounting holes
- a fourth Z-shaped piece with a single hole

For the purposes of alerting, the flat locking bar would have sections along its length painted in three different colors (Red, Yellow, and Green) on the external-facing side. These painted segments would align with holes in the door and frame that would provide immediate external visibility as to the status of the toilet: unlocked, green; locked, yellow; and, requiring service, red.

It is structured such that attempts to bypass the lock will require significant force, even if it constructed out of relatively inexpensive metal, since the direction of force requires deforming the metal along its strong axis, not just flexing or bending it. In addition, when locked, there will be no way of opening the door from the outside without effectively cutting apart or disassembling the door.

Attachment methods are versatile such that bolts, rivets, screws, or almost any other attachment mechanism can be used to secure the locking bar and its simple components to the door and frame. To provide additional security, a fourth Z-shaped piece with two holes could be added at the edge of the door (not shown in this drawing).



This design also shows mounting holes for the lighting limit switch and a small cutout for the actuator to protrude into the path of the locking bar.

Production Details

Lighting

Manufacturing costs are estimated at between \$6 each (from JLCPCB, China) and \$10 each (Aisler, Germany) at a quantity of 200. 1,000mAh lithium batteries are available from Aliexpress for ~\$2.50 each¹. Limit switches are less than \$.70/each. In higher quantities, U.S.-based manufacture could also be competitive and many of the components would be more readily available.

Manufacturing cost of the enclosure shown is estimated at less than \$2 in material when 3D-printed, but a much simpler, streamlined case design can be provided, if desired, which could be mass-manufactured for less than \$1 each.

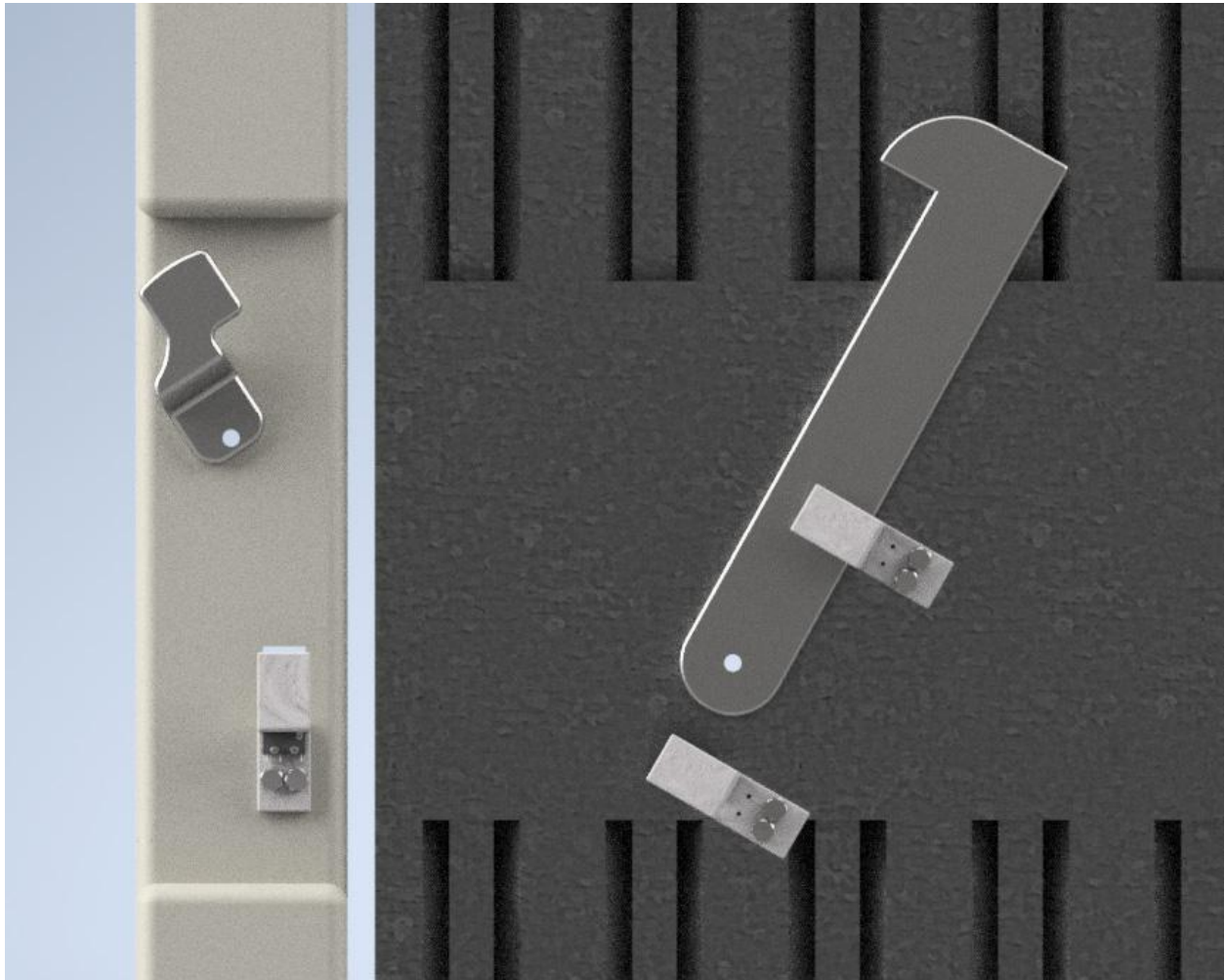
¹ <https://www.aliexpress.us/item/3256802542021832.html>

This electronic design and PCB layout is wholly created and owned by Shenberger Technology, so there are no external intellectual property dependencies. In addition, we have manufactured a version of this for home use and have found it to be versatile and useful around the home and when traveling. In practical use, battery life of quality lithium batteries is extraordinary, extending to weeks of intermittent use without a charge.

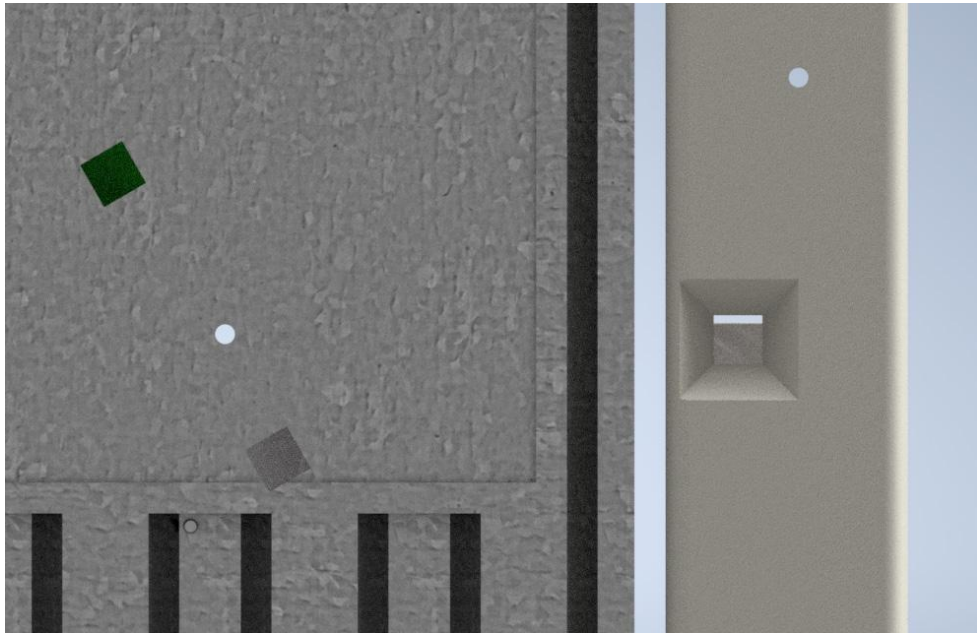
Locking & Alerting

Illustrations will be used here to provide clarity into the different alerting states of the locking mechanism.

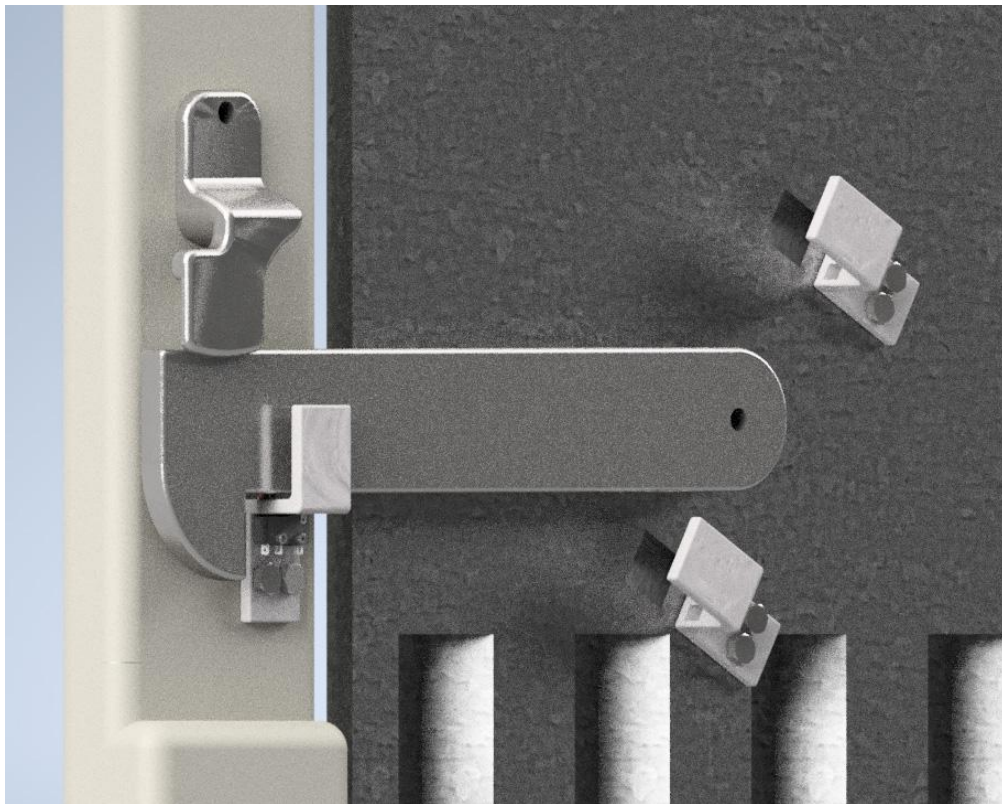
When the door is unlocked, the locking bar will be in this position.



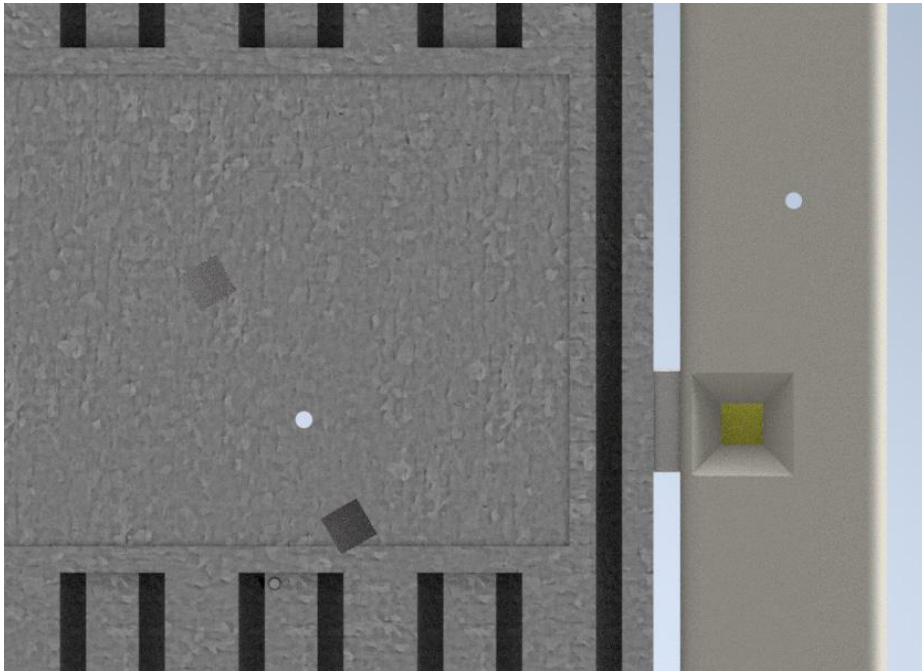
And from the exterior, this will appear as a green paint indicator showing.



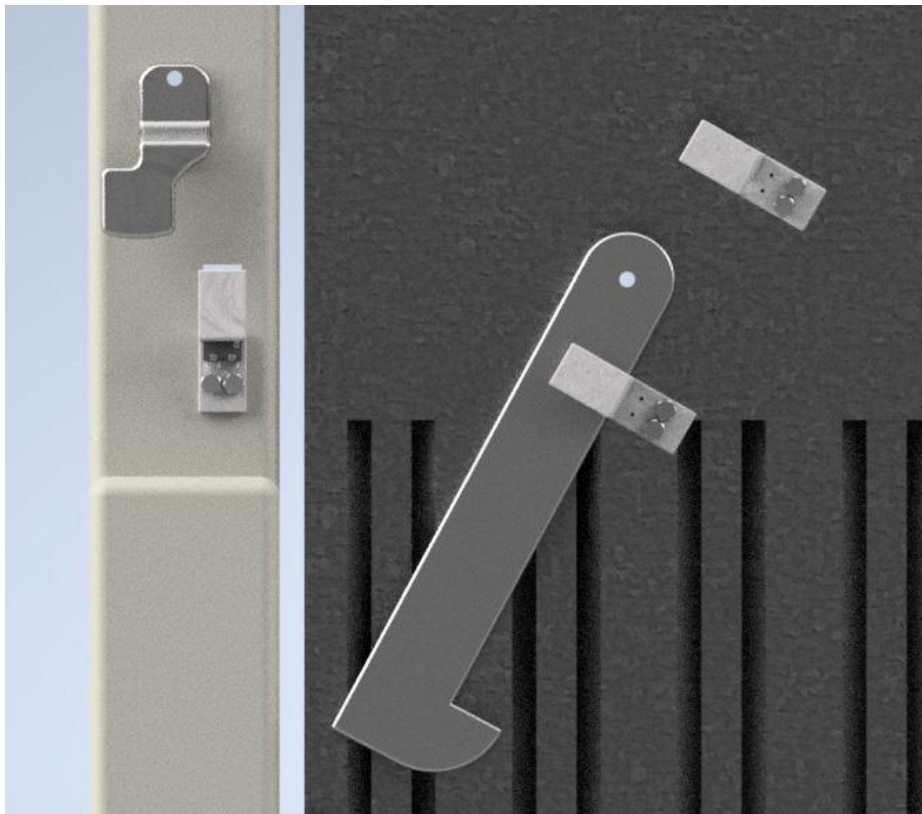
When the door is locked, it will be in this position.



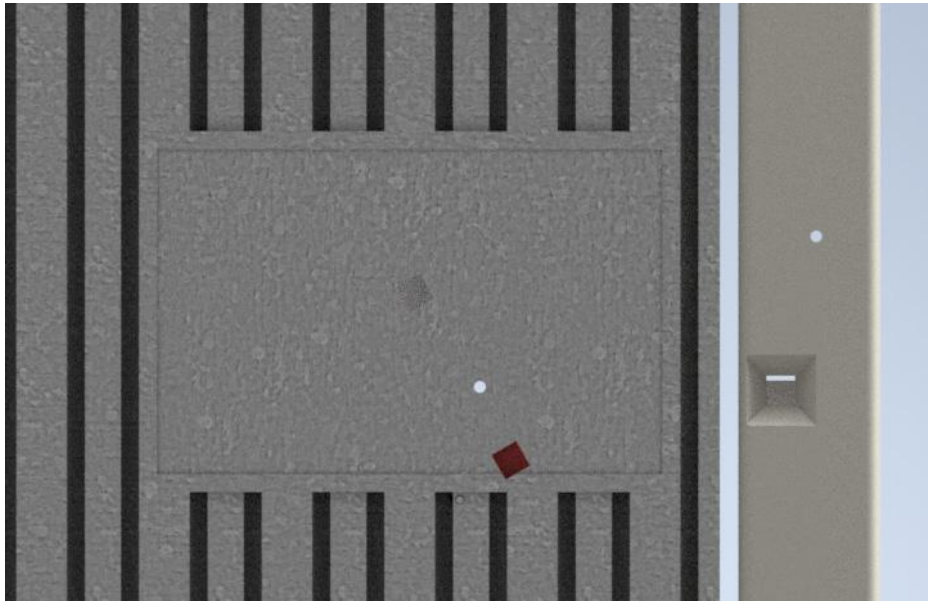
Which will provide a yellow indicator from the exterior.



And finally, when the toilet requires servicing, the locking bar can be placed in this position when the door is open.



When enables the red indicator to appear from the outside.



4mm aluminum bars can be purchase from Aliexpress for just over \$1 each² and can be drilled or worked into the appropriate shapes with minimal machine tooling, or ordered in bulk in the desired shapes.

² <https://www.aliexpress.us/item/3256805577216216.html>