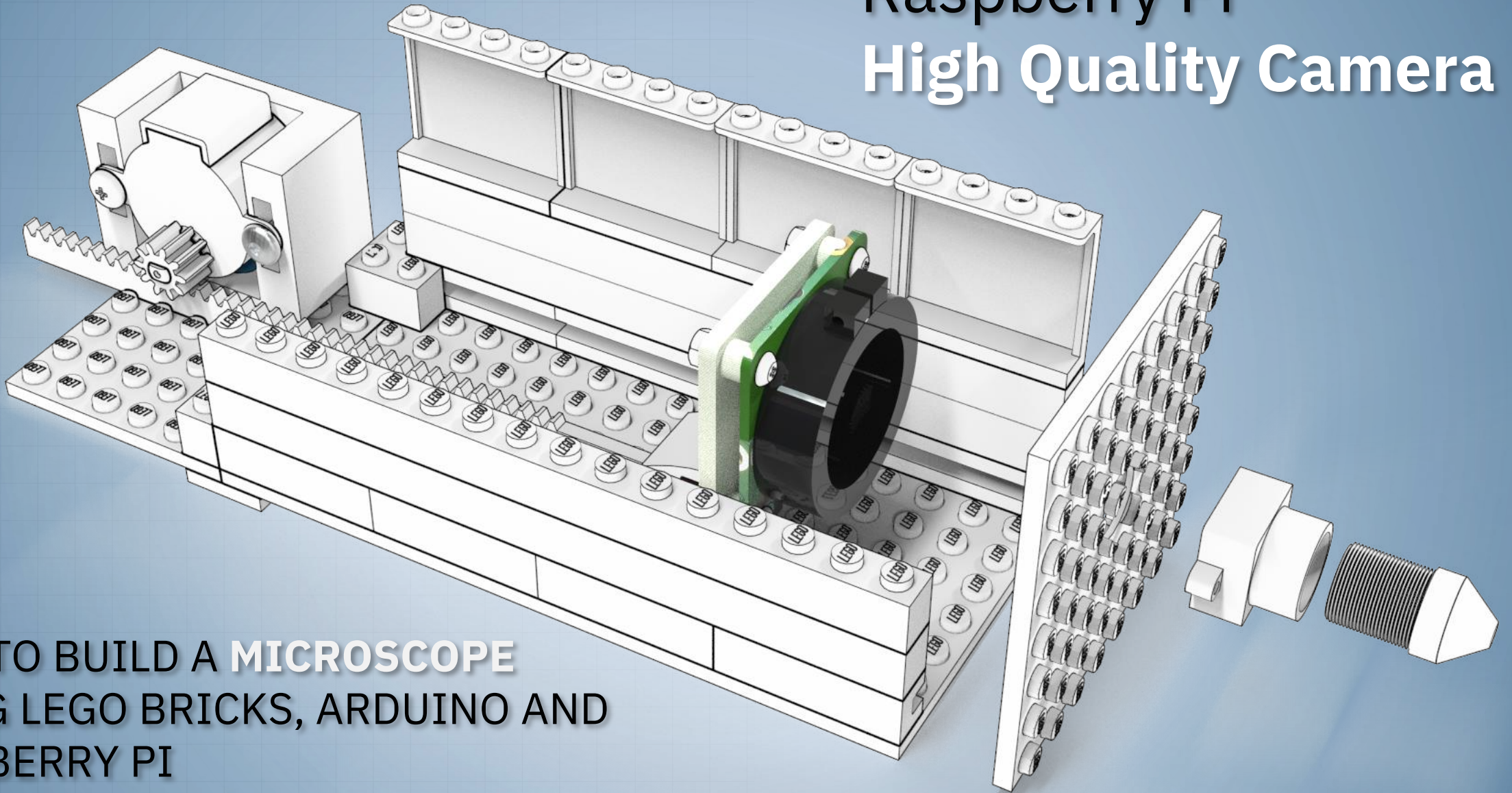
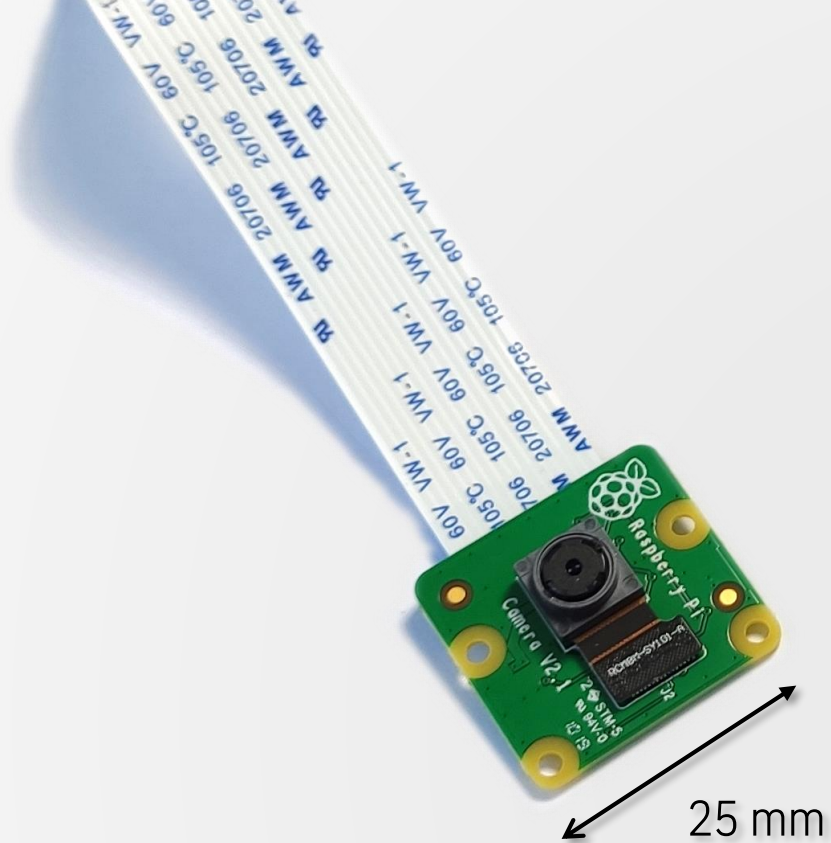


Raspberry Pi High Quality Camera



HOW TO BUILD A **MICROSCOPE**
USING LEGO BRICKS, ARDUINO AND
RASPBERRY PI

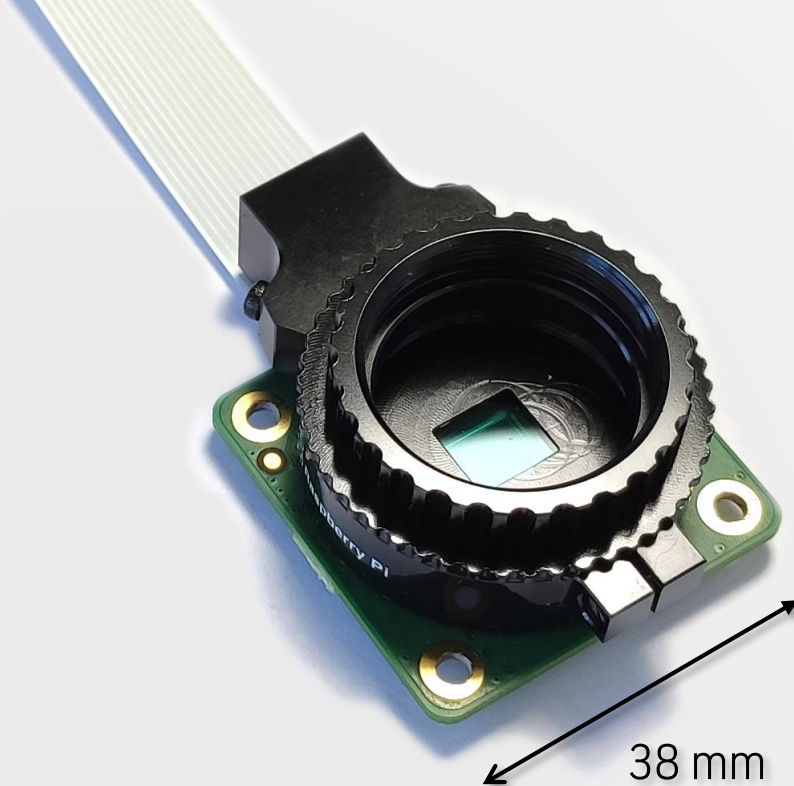


Camera Module v2

\$25

8MP (3280 × 2464)

Sensor area: 3.68 × 2.76 mm



HQ camera

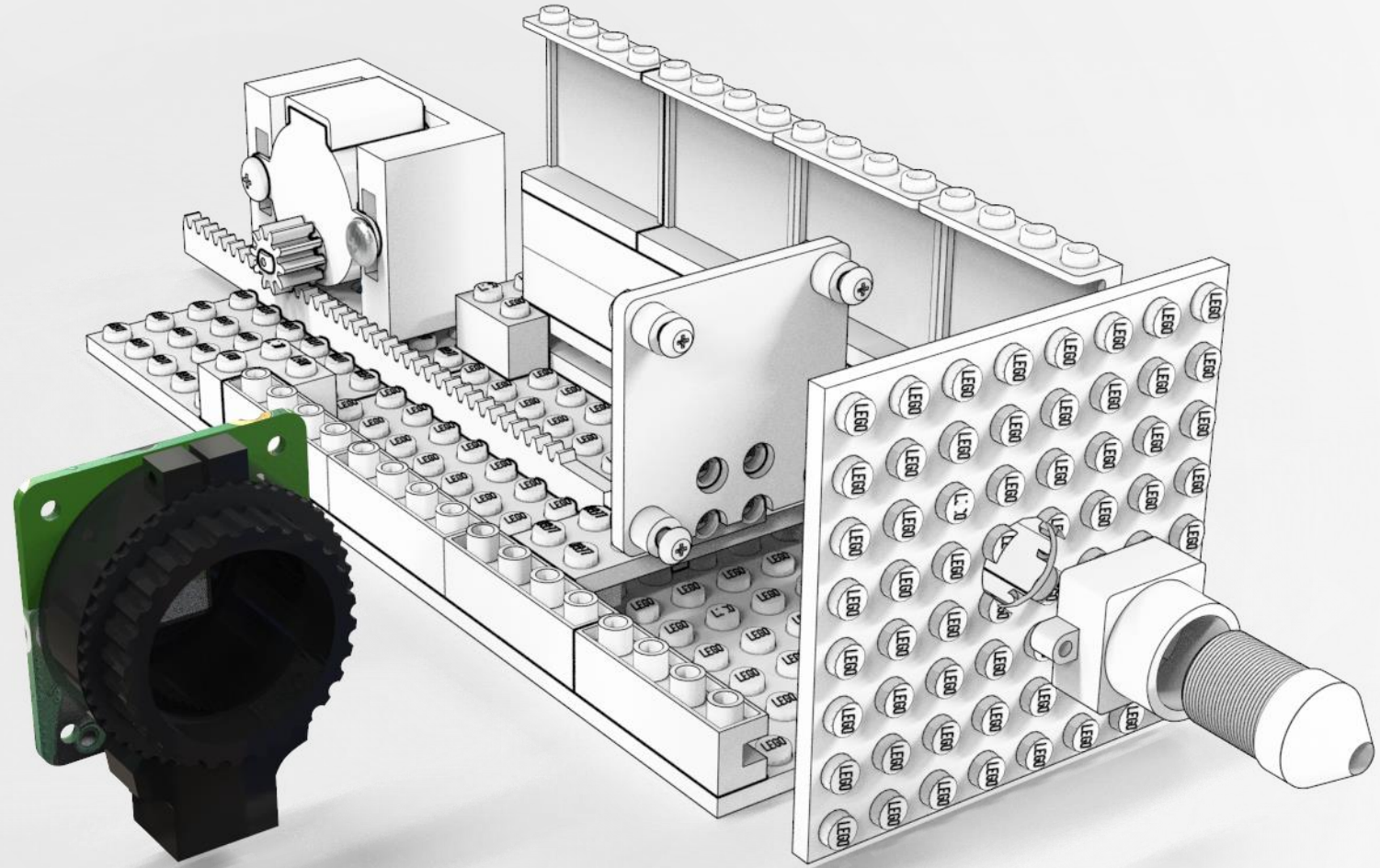
\$50

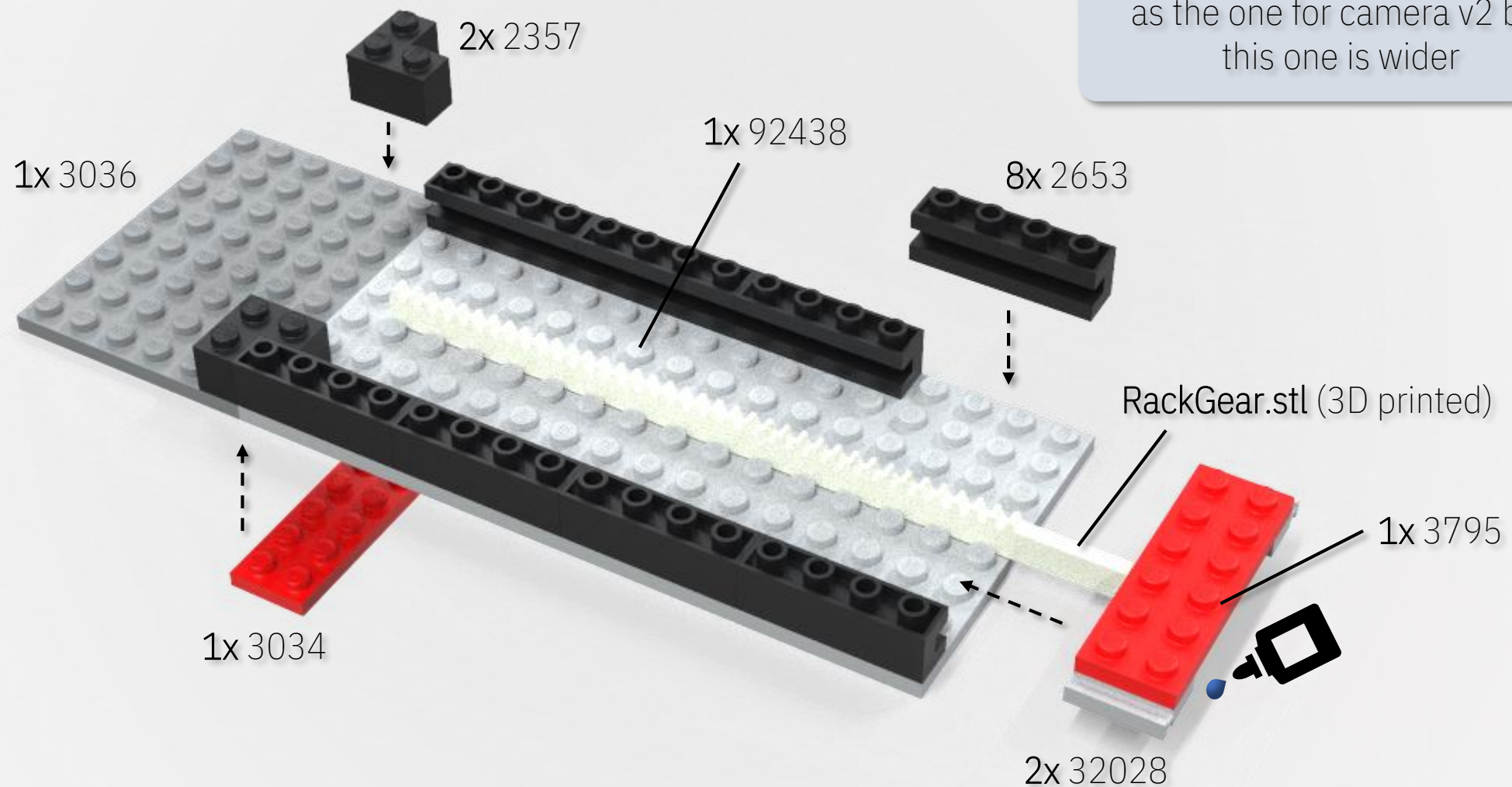
12MP (4056 × 3040)

Sensor area: 6.287 × 4.712 mm

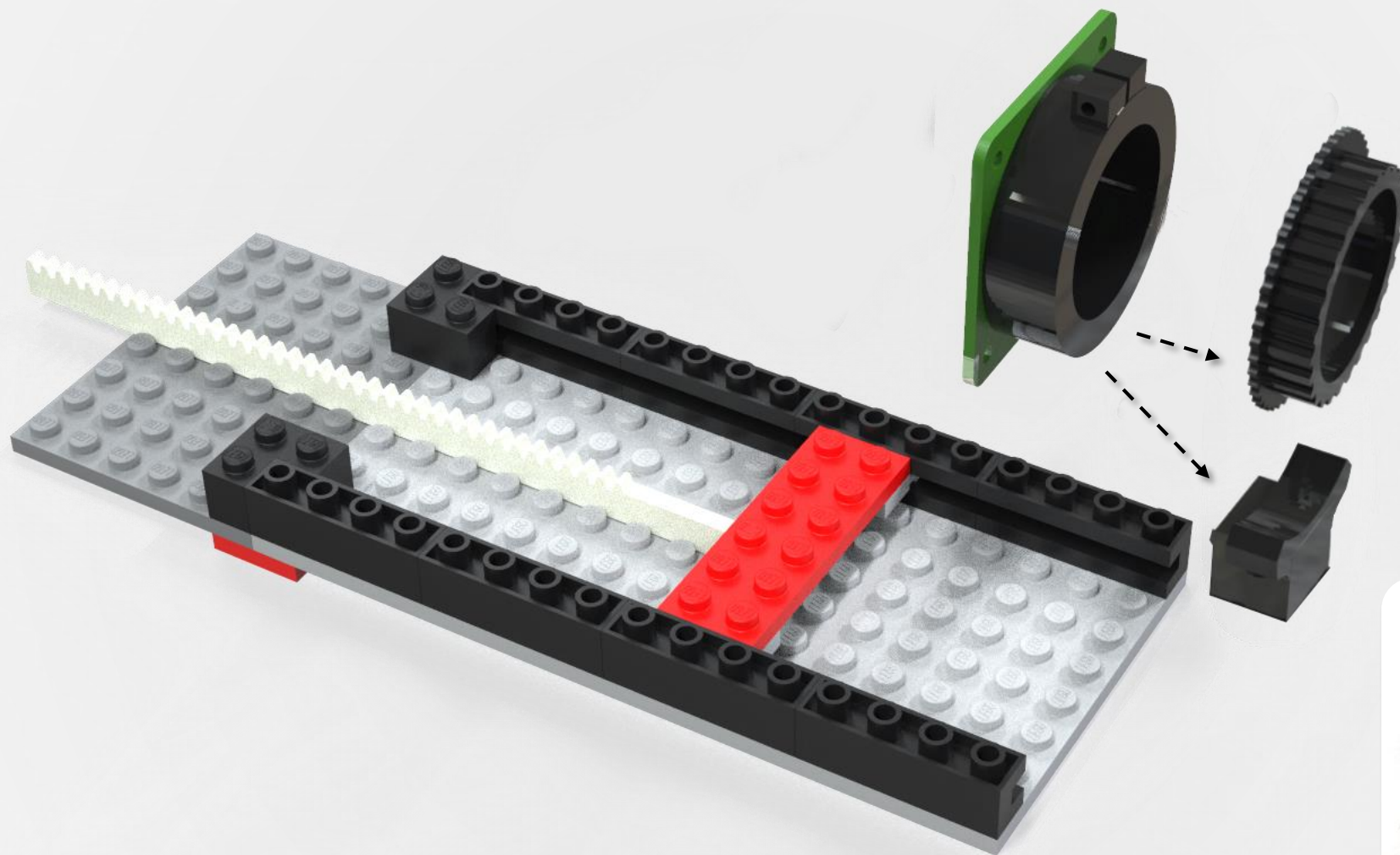
Important notes:

- HQ camera is 50% larger than camera module v2
- Therefore, the Lego housing had to be larger and heavier than the one for the camera module v2
- This challenged the tilting stage, so more supports and glue were needed
- Zoom range of the HQ camera was lower than that of camera module v2
- Overall, the advantage of the HQ camera is marginal for this microscope because the quality of images is anyway limited by other factors

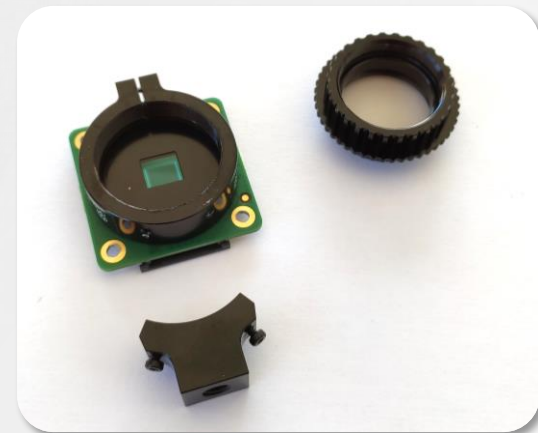




The linear actuator for **HQ camera** has the same principle as the one for camera v2 but this one is wider



Remove the adapter and the tripod mount



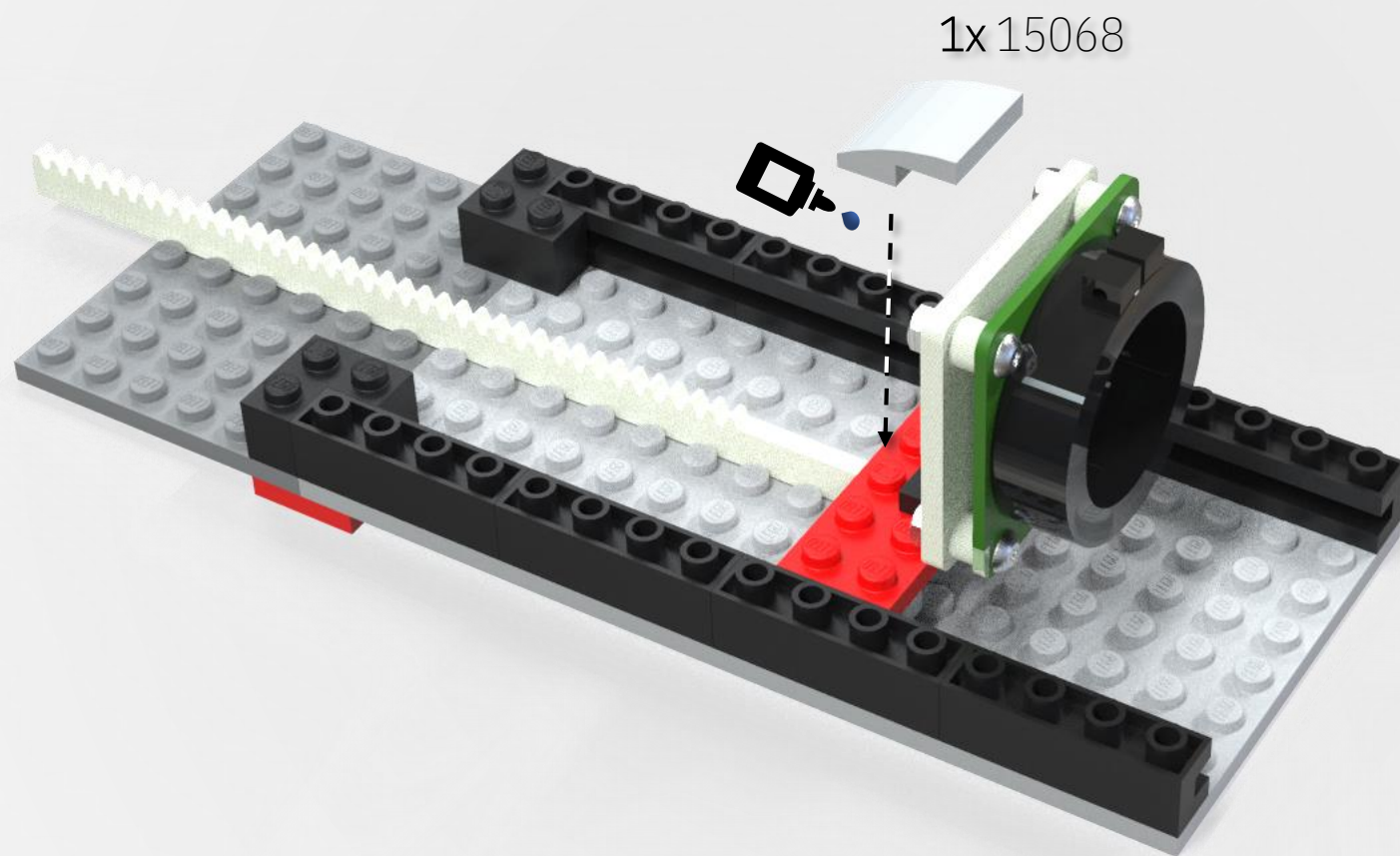
(3D printed)

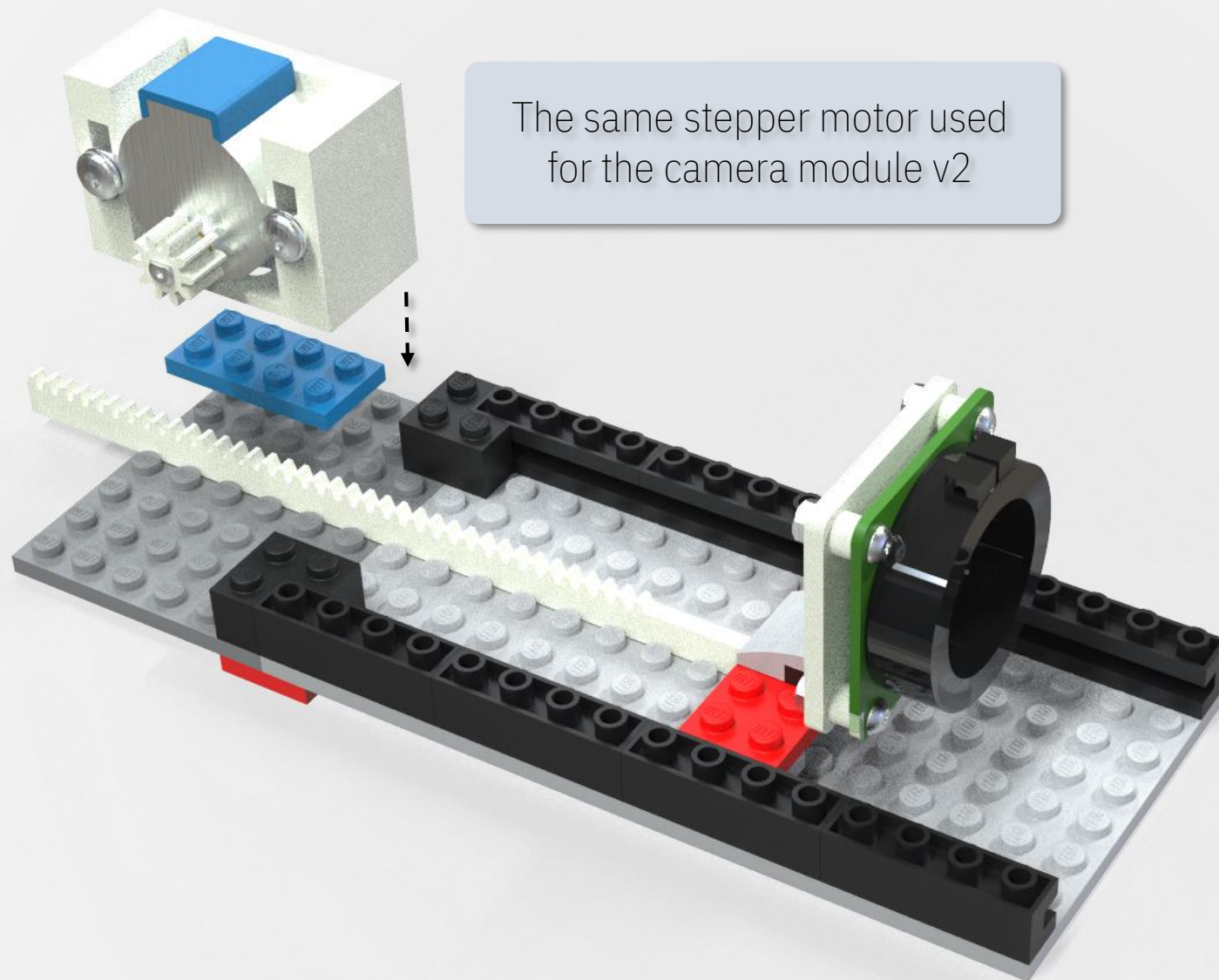
1x 99207

4x M2

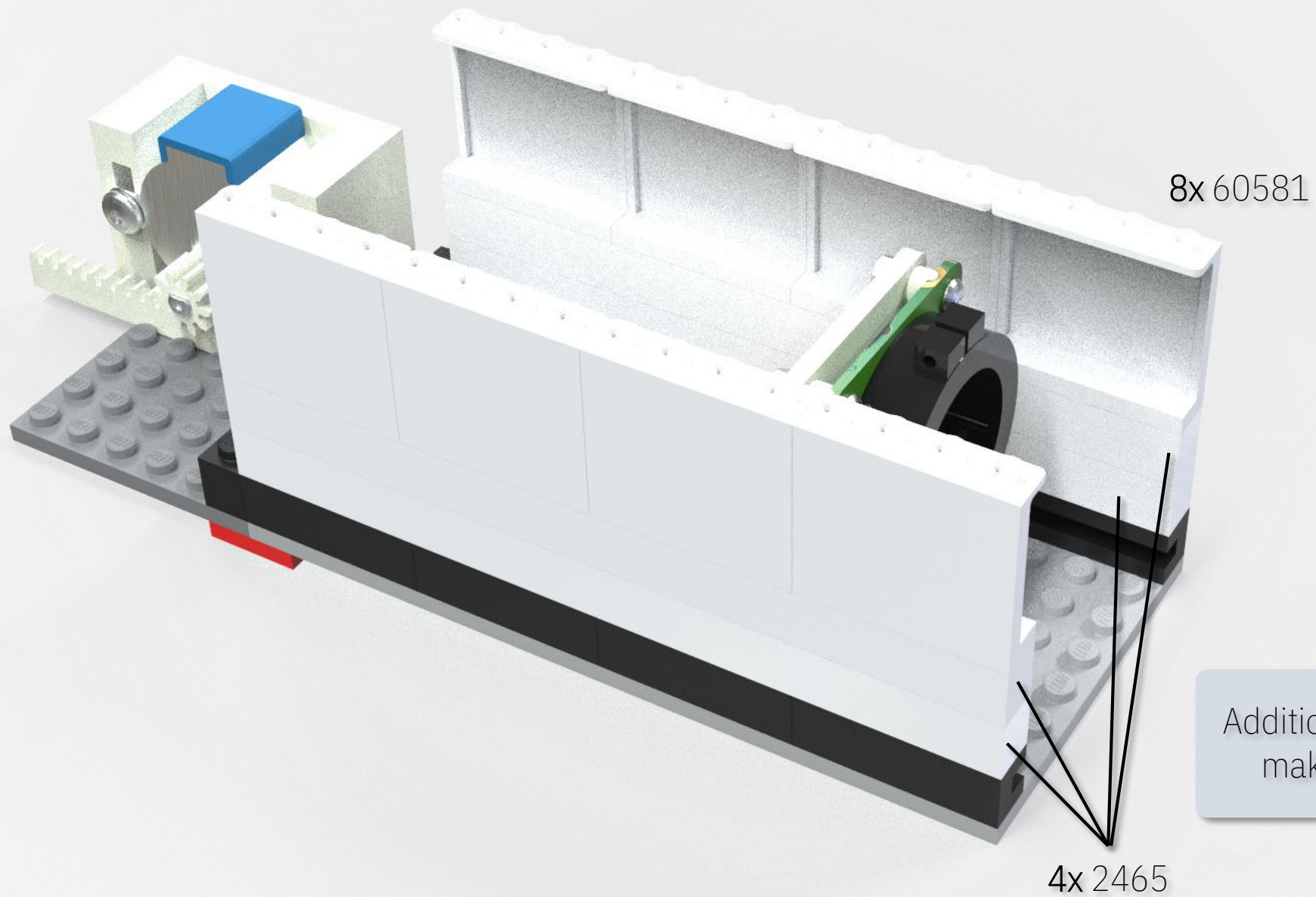
This diagram illustrates the assembly of a custom component onto a LEGO base. The base is constructed from grey 1x12 Technic plates, black 1x6 Technic beams, and a red 1x4 Technic beam. A white, serrated strip is positioned along the length of the base. A black 1x3 Technic brick is placed on top of the base. A 3D printed part, labeled '(3D printed)', is shown being attached to the black brick. This 3D printed part is a white, L-shaped bracket with four holes. A black 1x3 Technic brick is also shown being attached to the 3D printed part. A green 3D printed part, labeled '(3D printed)', is shown being attached to the 3D printed part. This green part is a circular ring with a central hole. Four M2 screws are shown being inserted into the green ring. The assembly is shown in an exploded view, with dashed lines indicating the alignment of the parts.

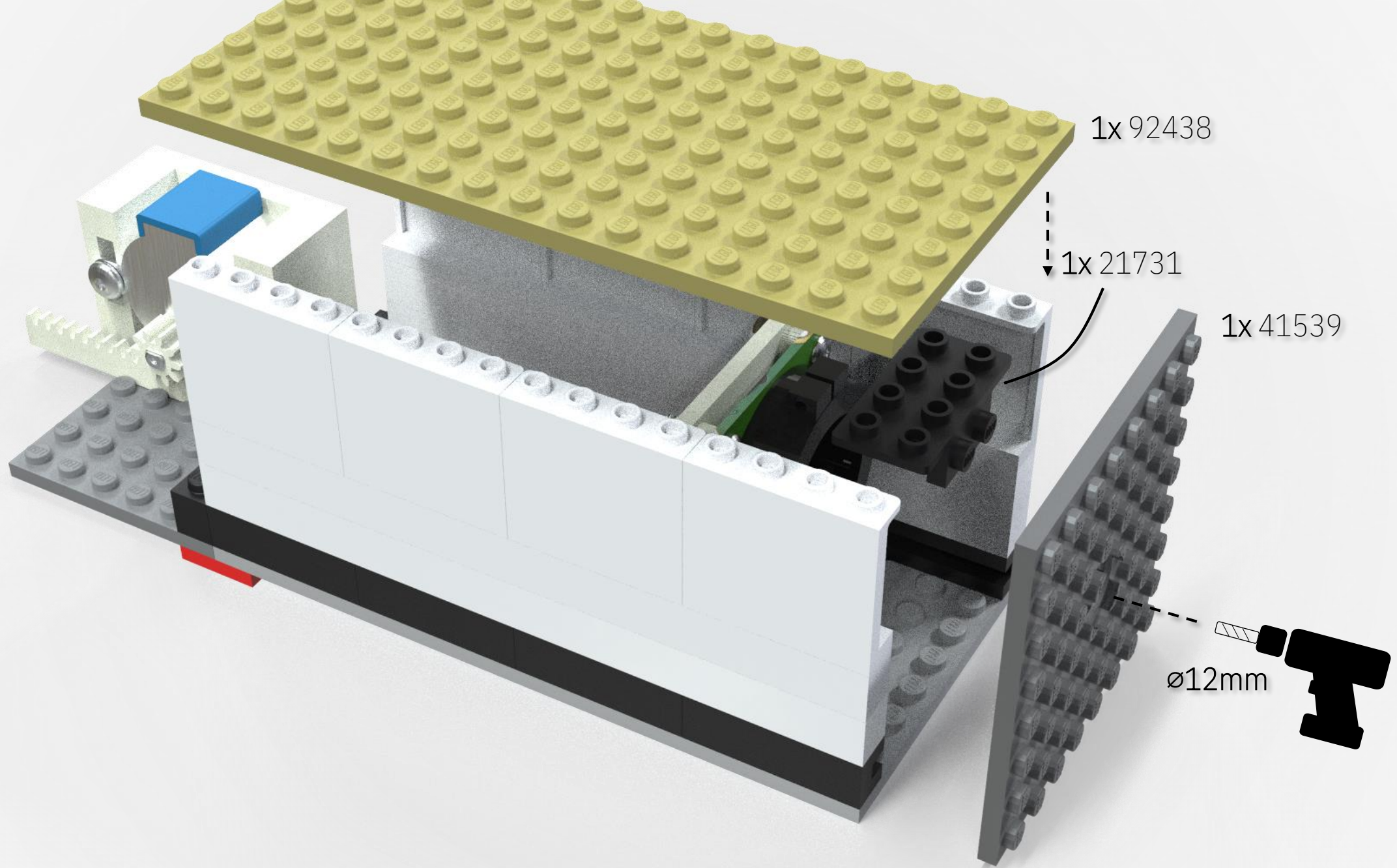
4x M2

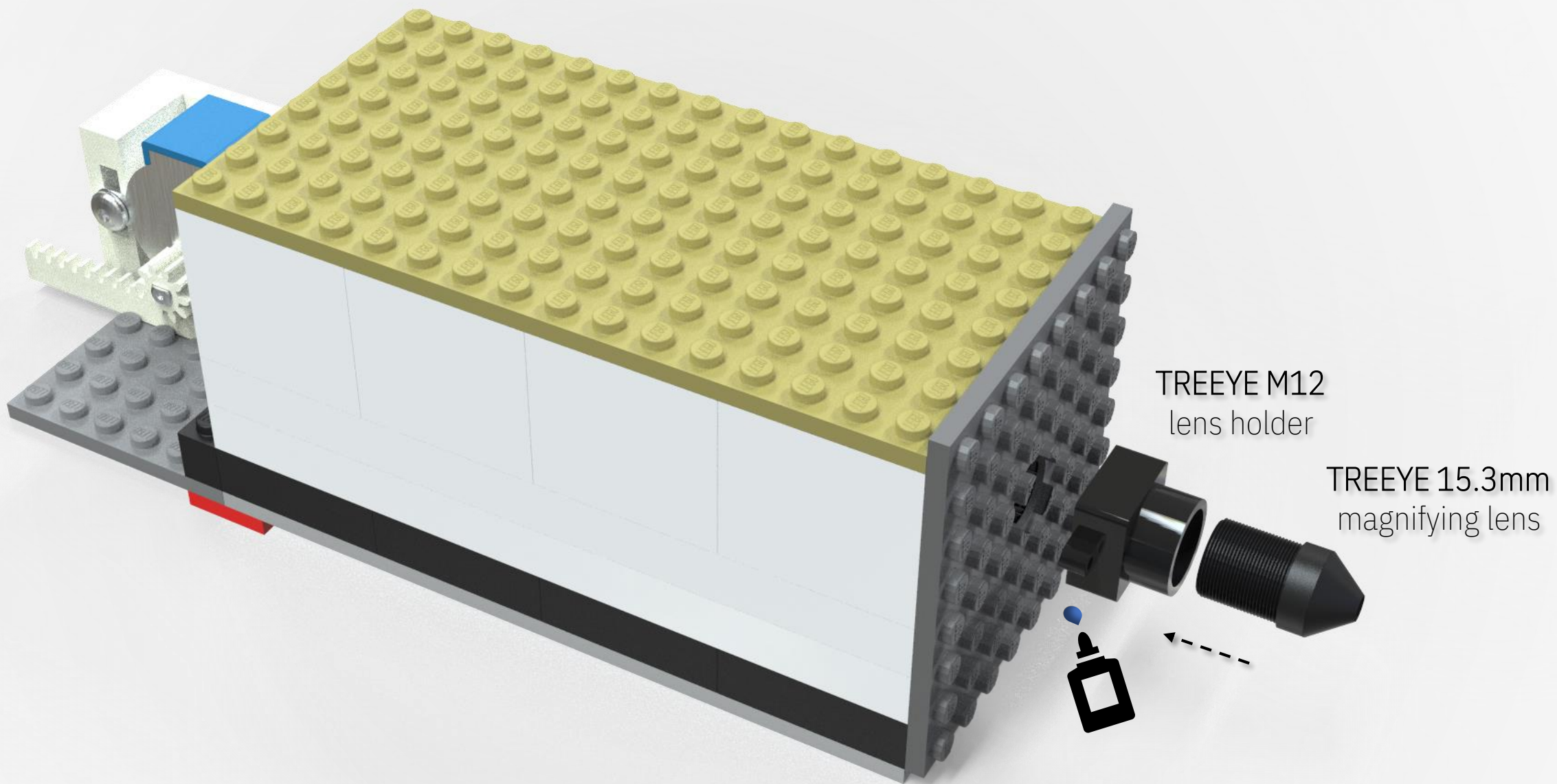


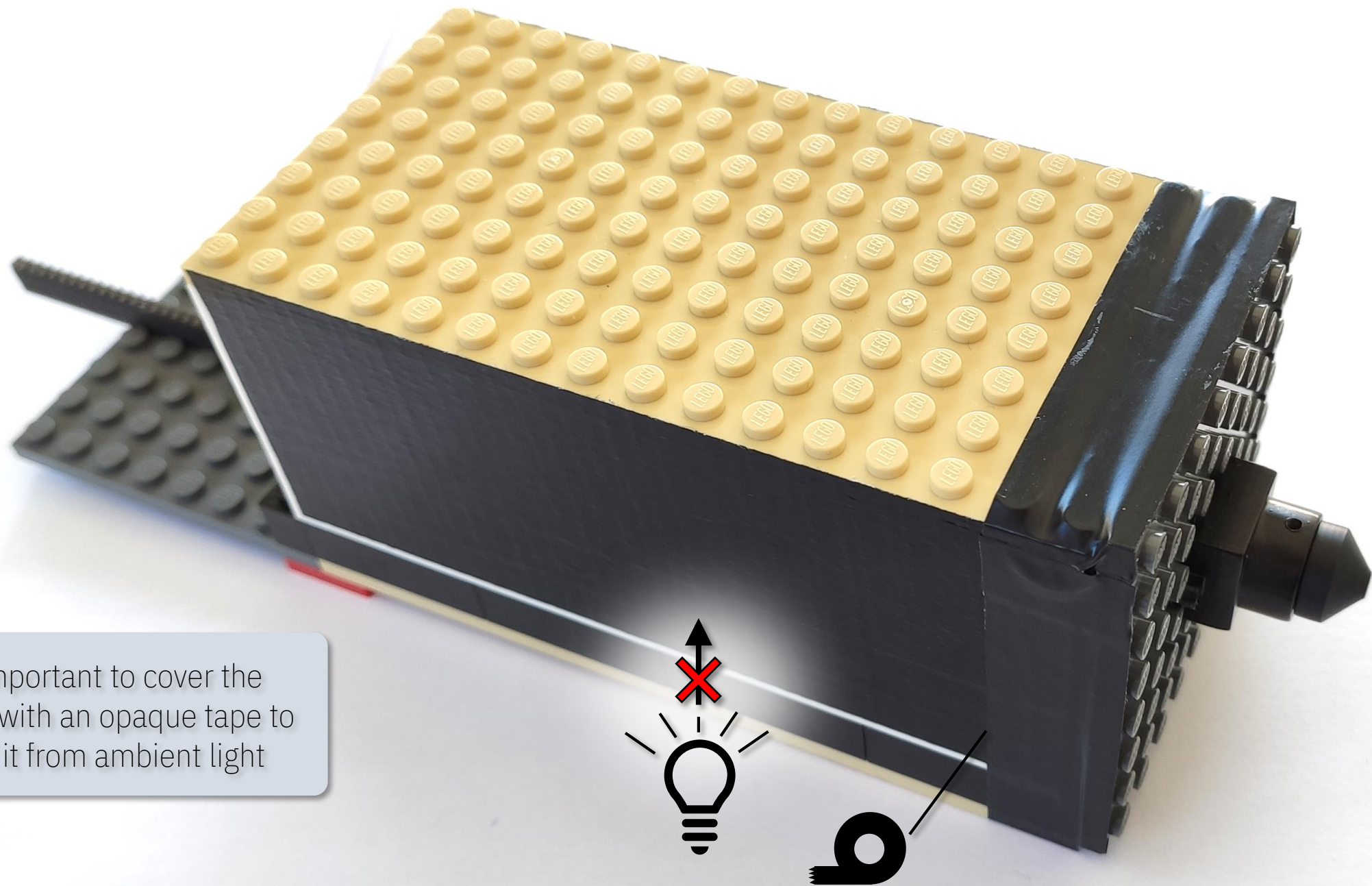


The same stepper motor used for the camera module v2

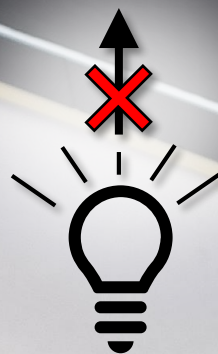




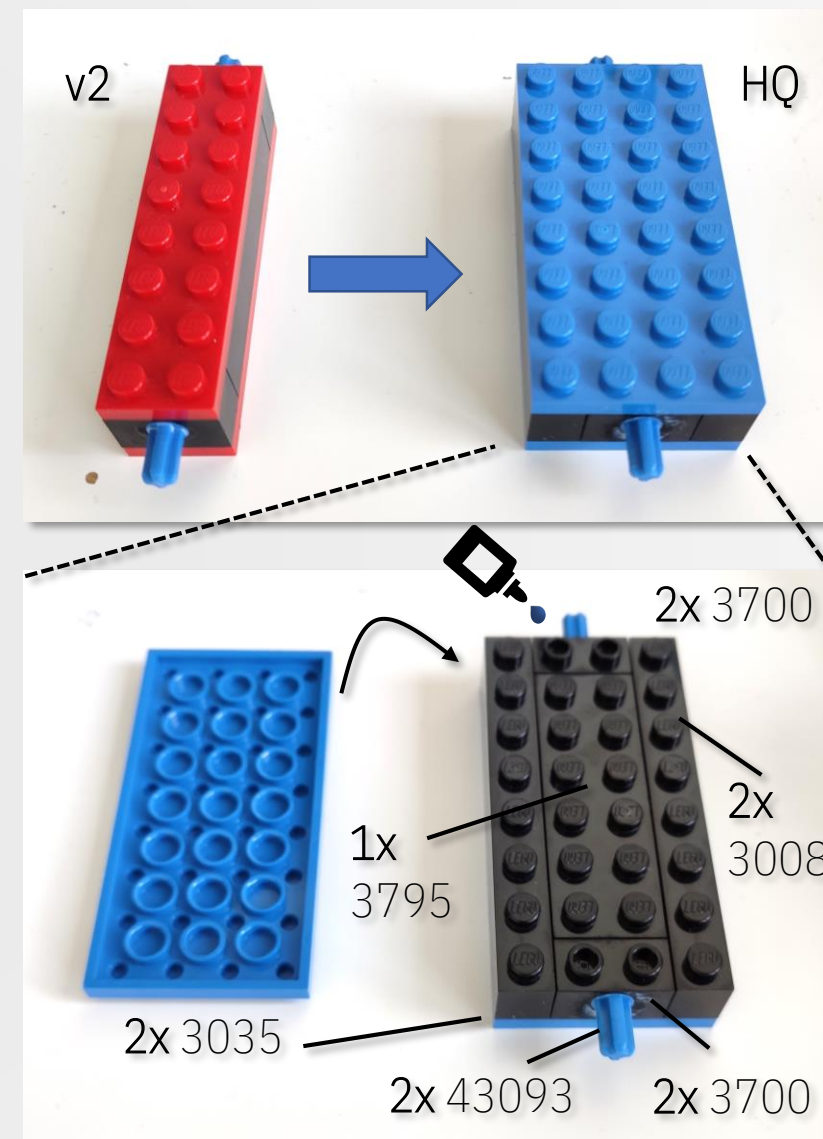
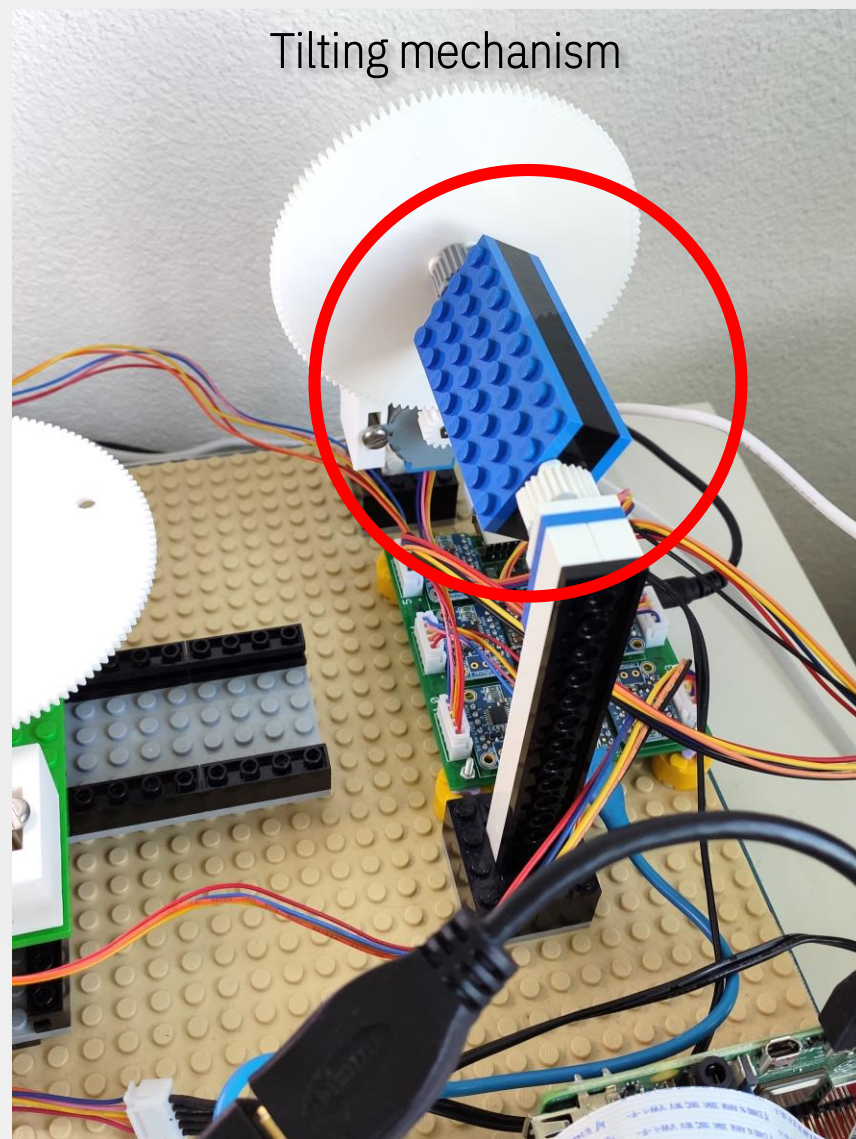


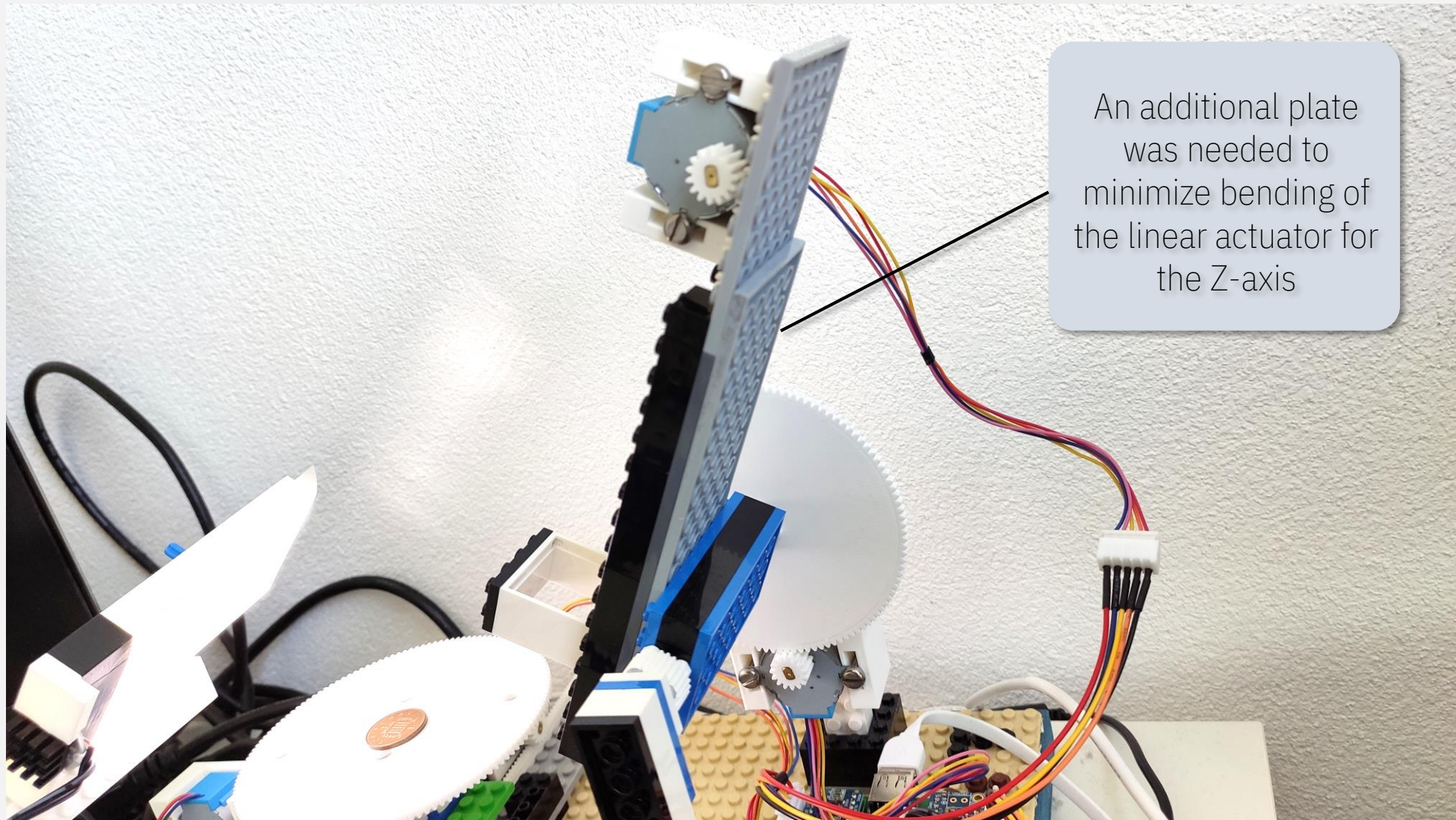


It is important to cover the housing with an opaque tape to shield it from ambient light



The microscope with a heavier camera module required stronger Lego connections and supports

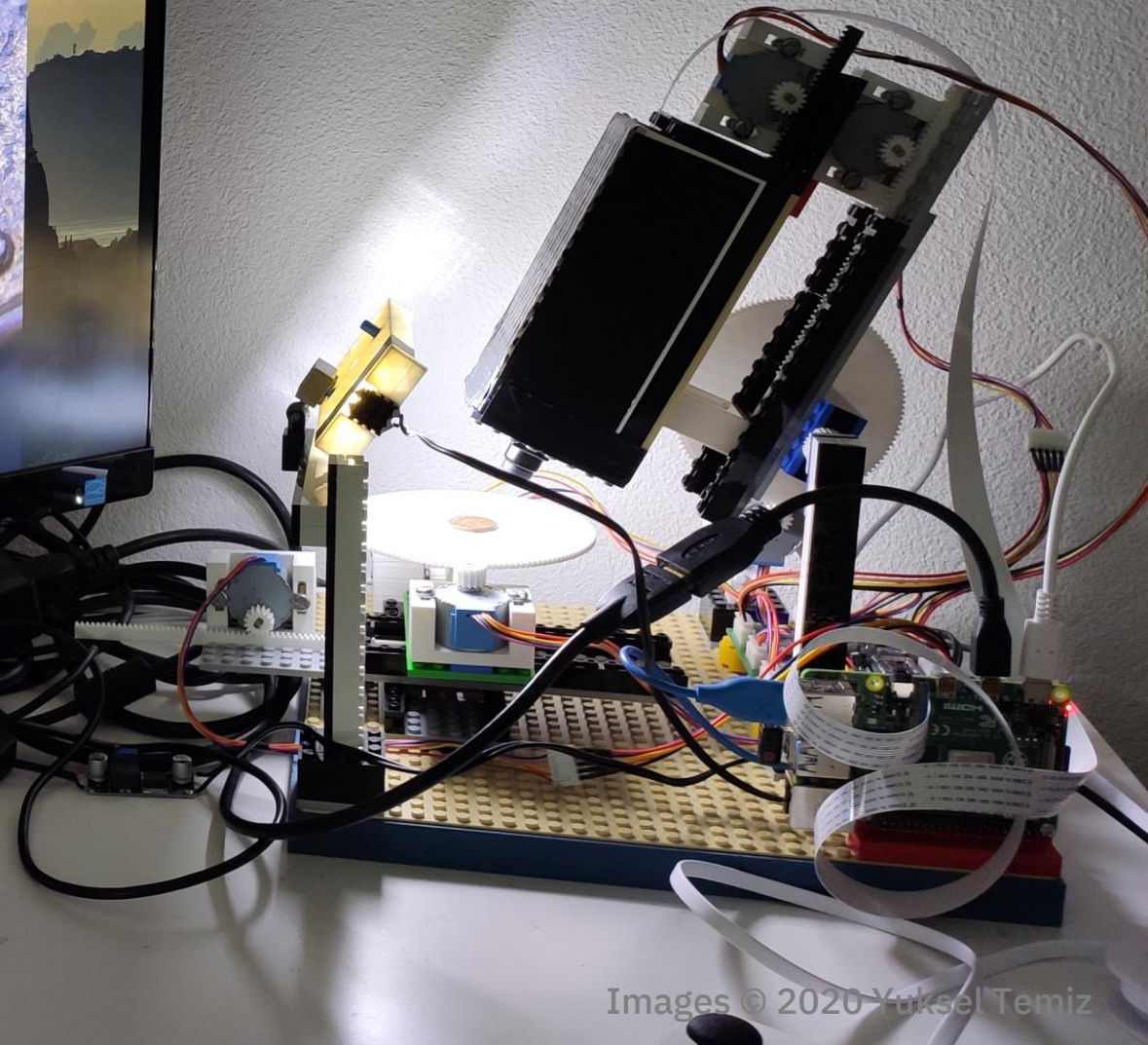




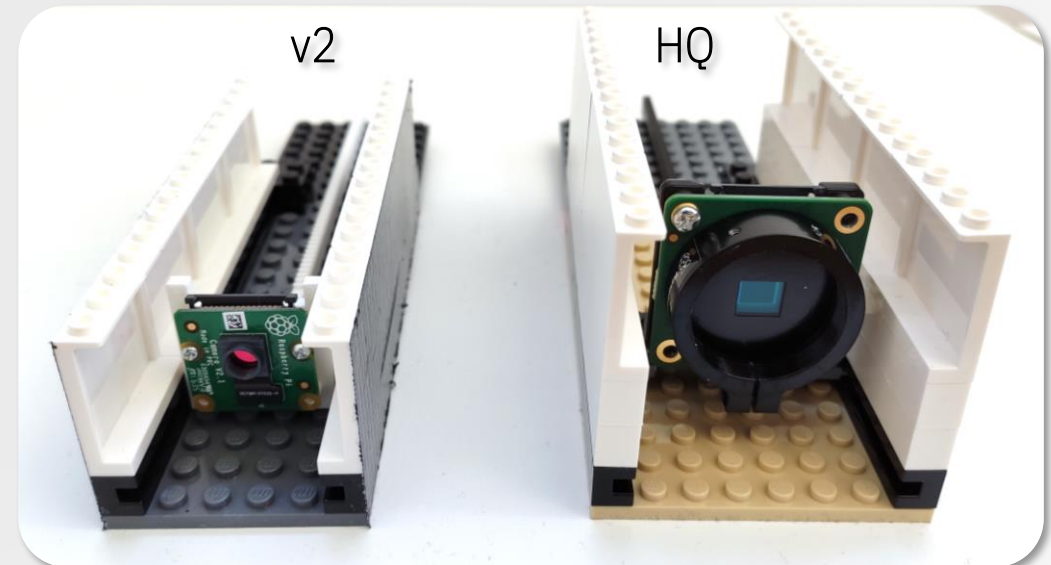
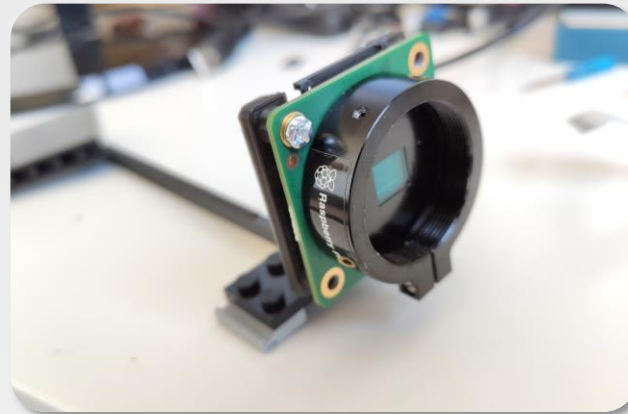
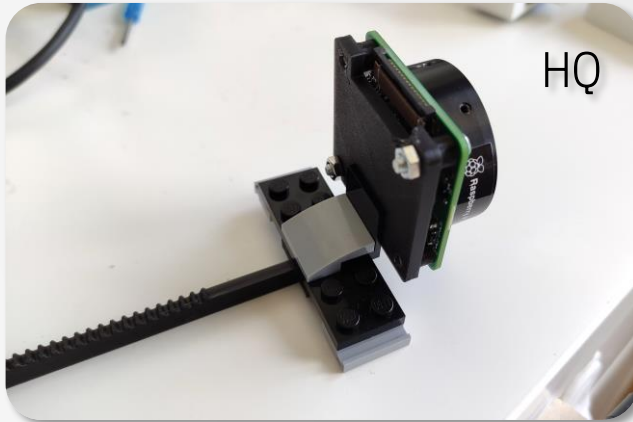
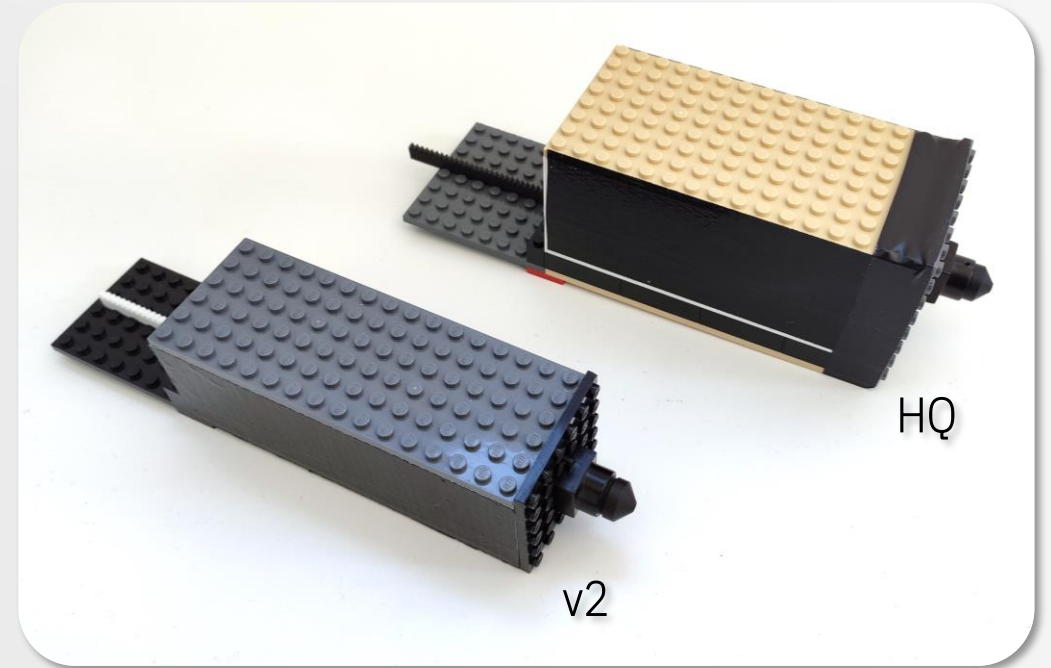
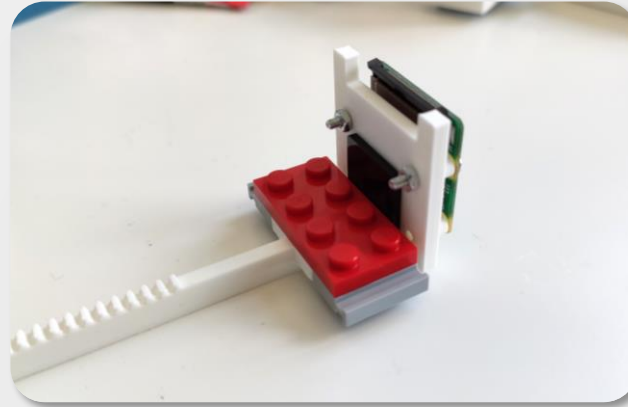
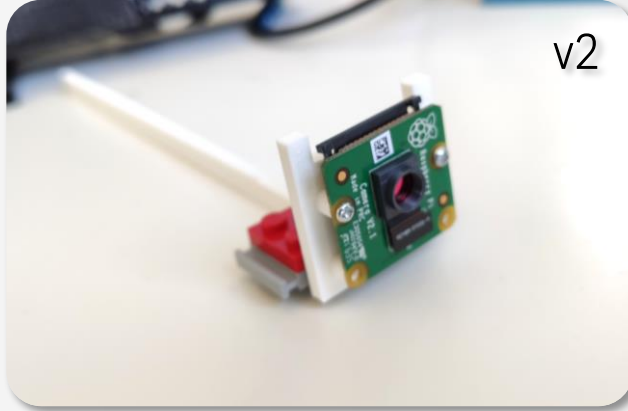
An additional plate
was needed to
minimize bending of
the linear actuator for
the Z-axis



The rest of the microscope is identical to the one using the camera module v2



Camera module v2 vs HQ camera



One-cent coin (minimum magnification comparison)

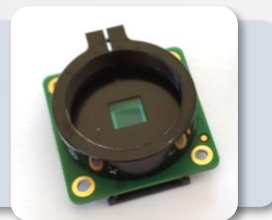
Camera Module v2



HQ camera



The minimum zoom level in the HQ camera was limited because the plastic housing in the HQ camera limits the closest distance between the CMOS sensor and the objective lens

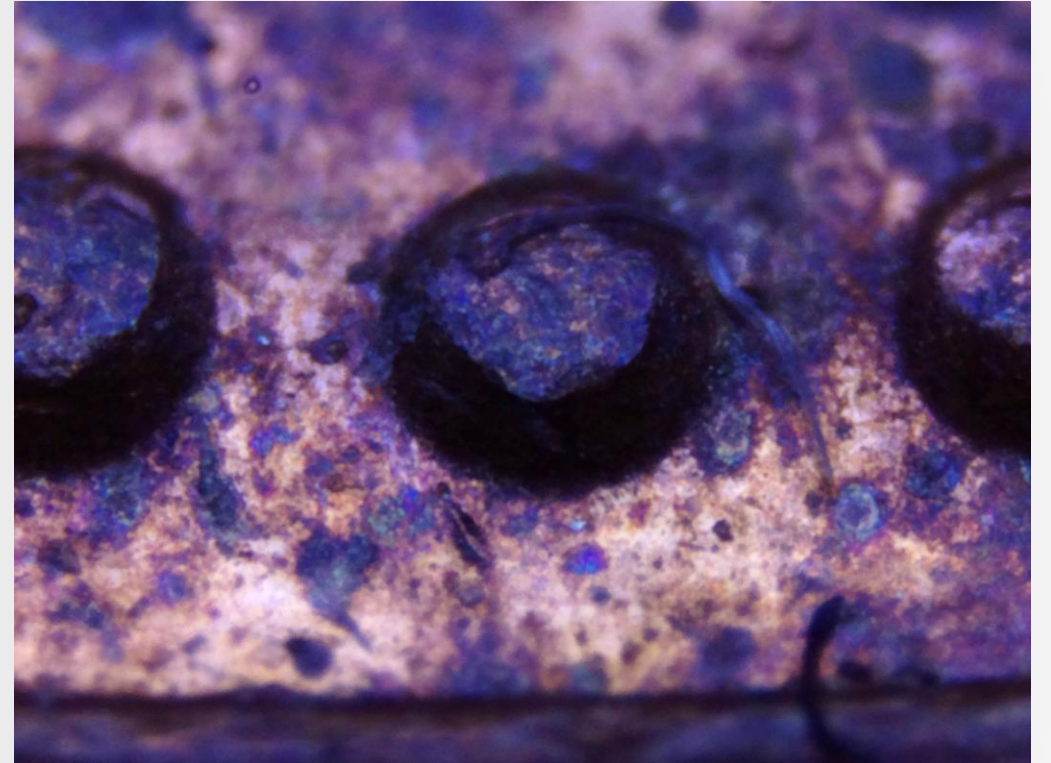


One-cent coin (maximum magnification comparison)

Camera Module v2

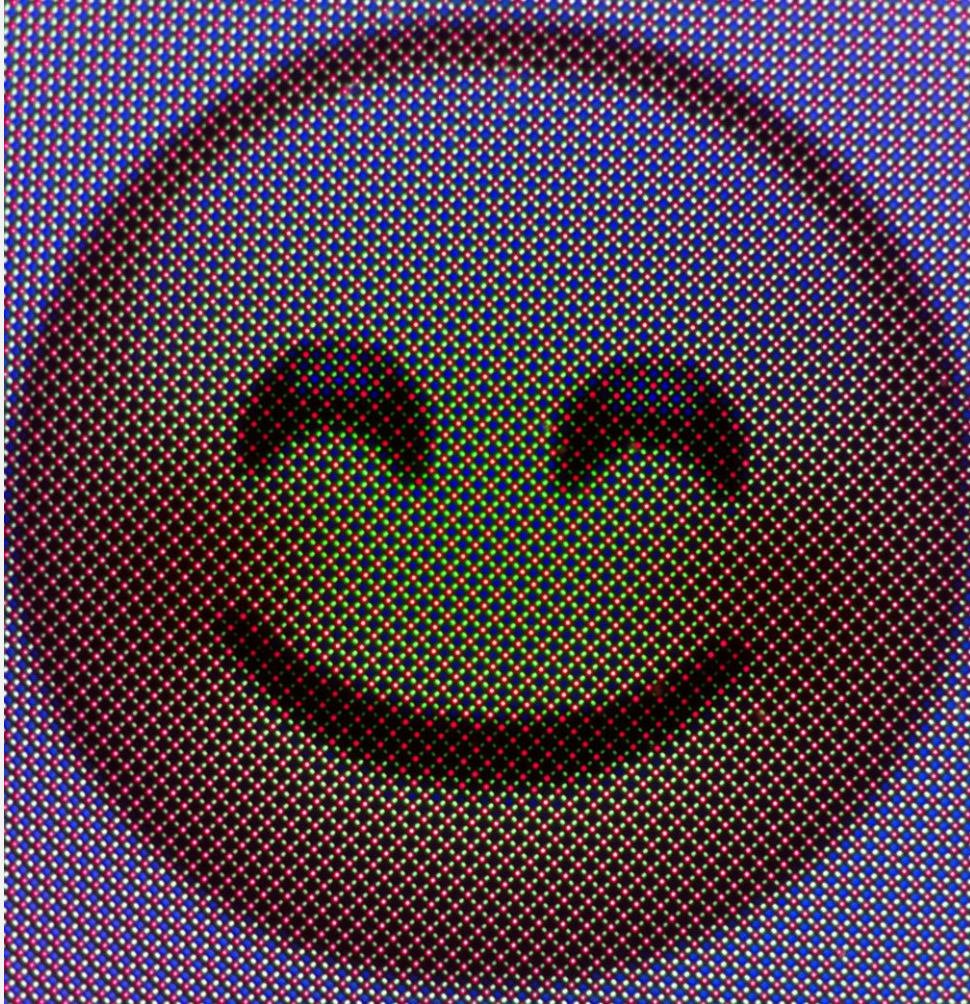


HQ camera



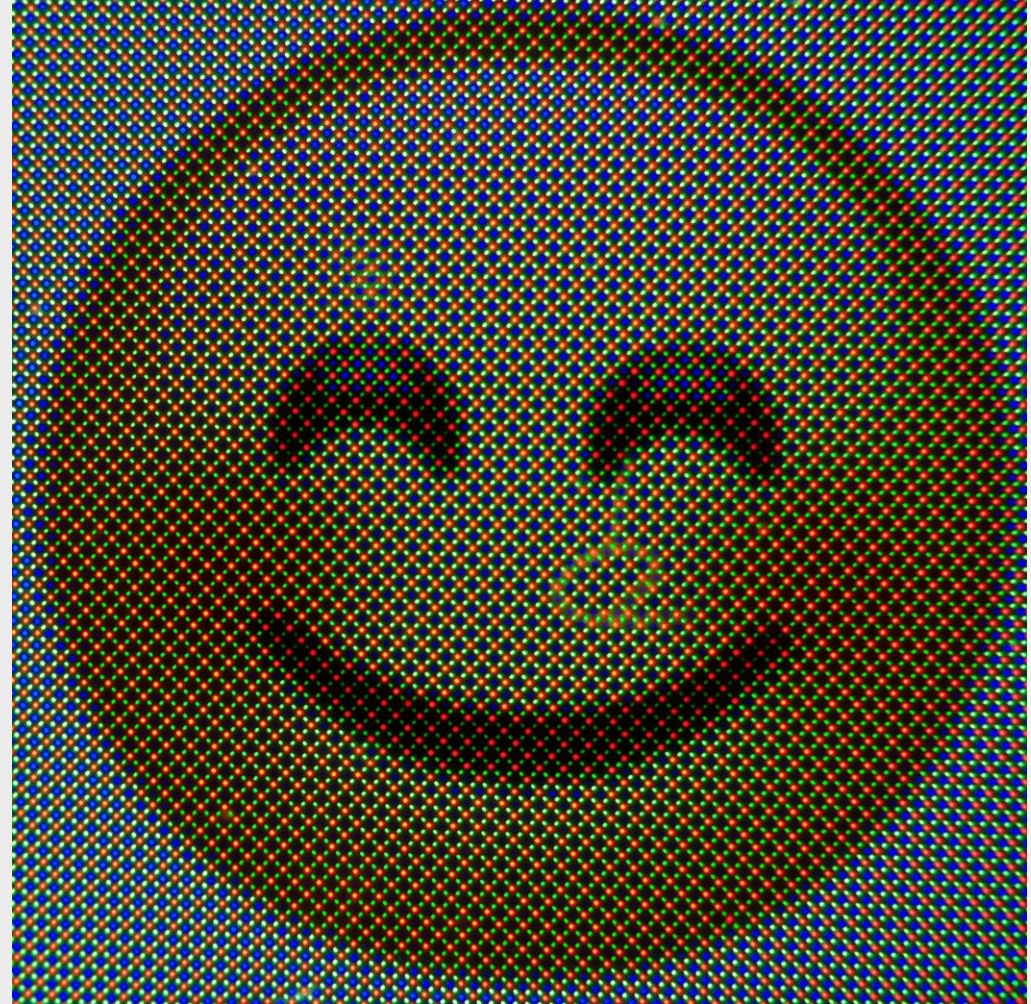
Smartphone AMOLED display

Camera Module v2



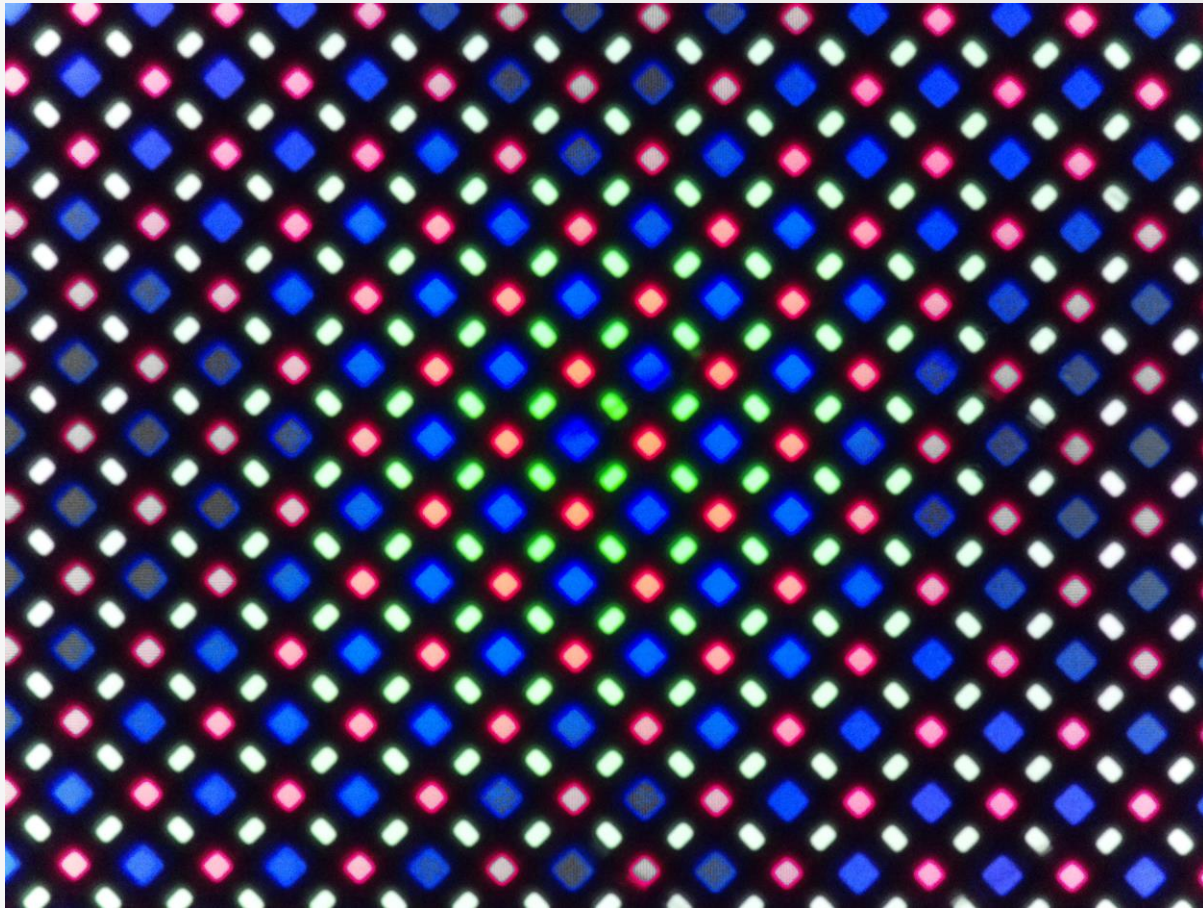
← 4 mm →

HQ camera

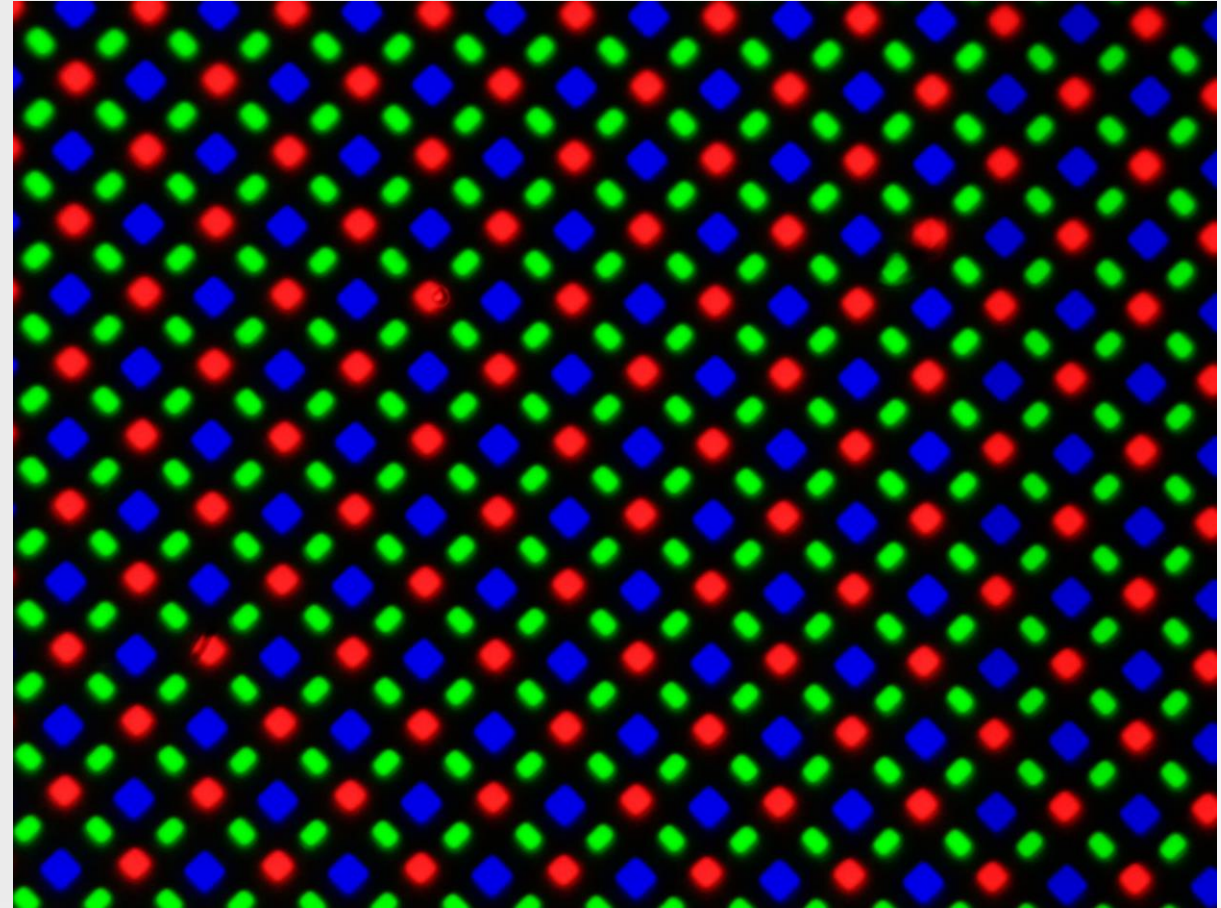


Smartphone AMOLED display

Camera Module v2

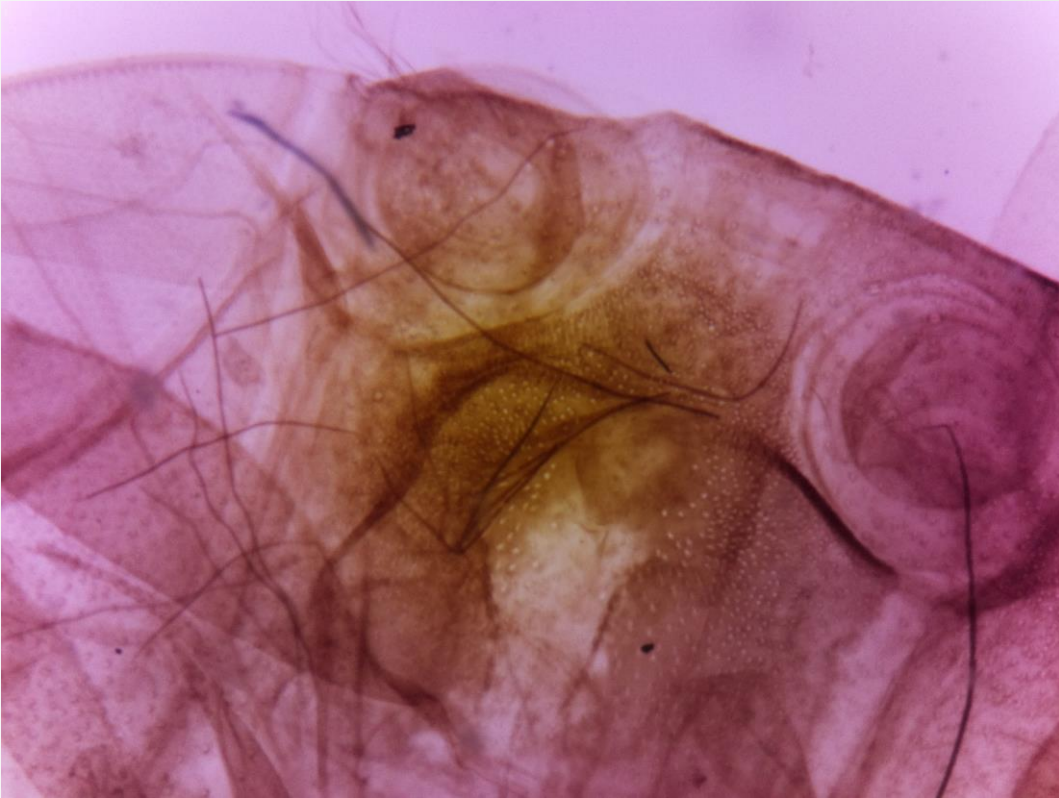


HQ camera

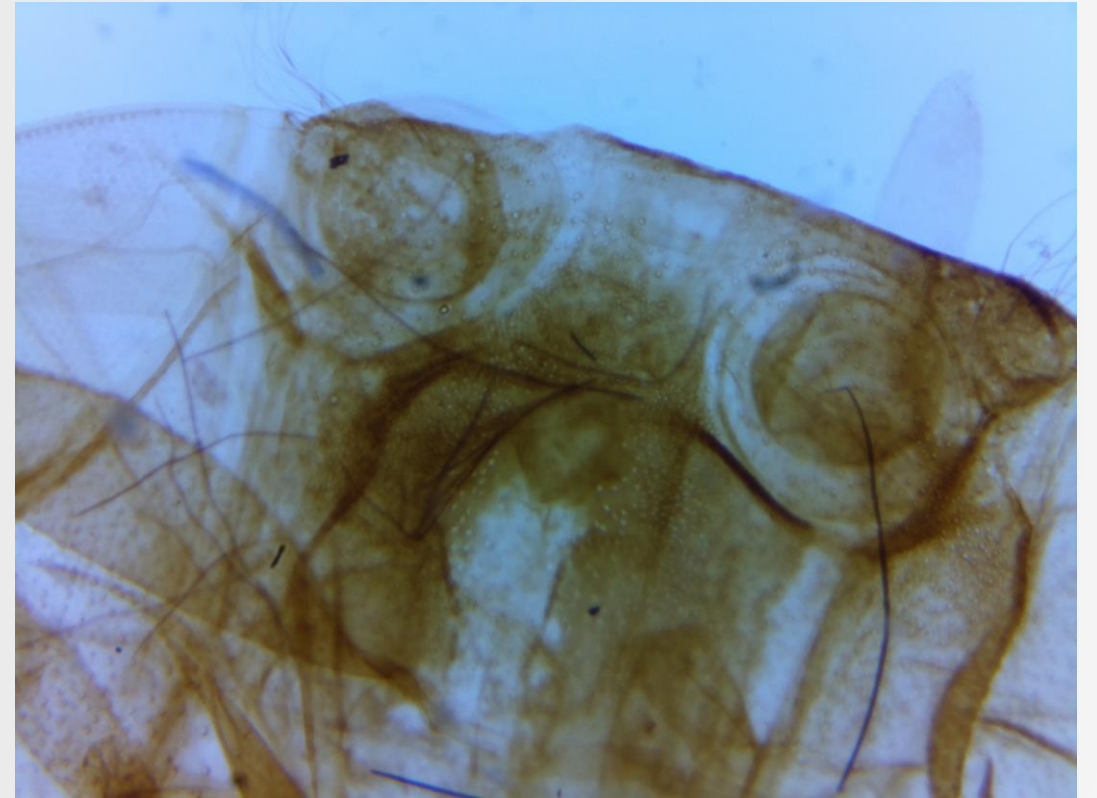


Butterfly (microscope sample)

Camera Module v2

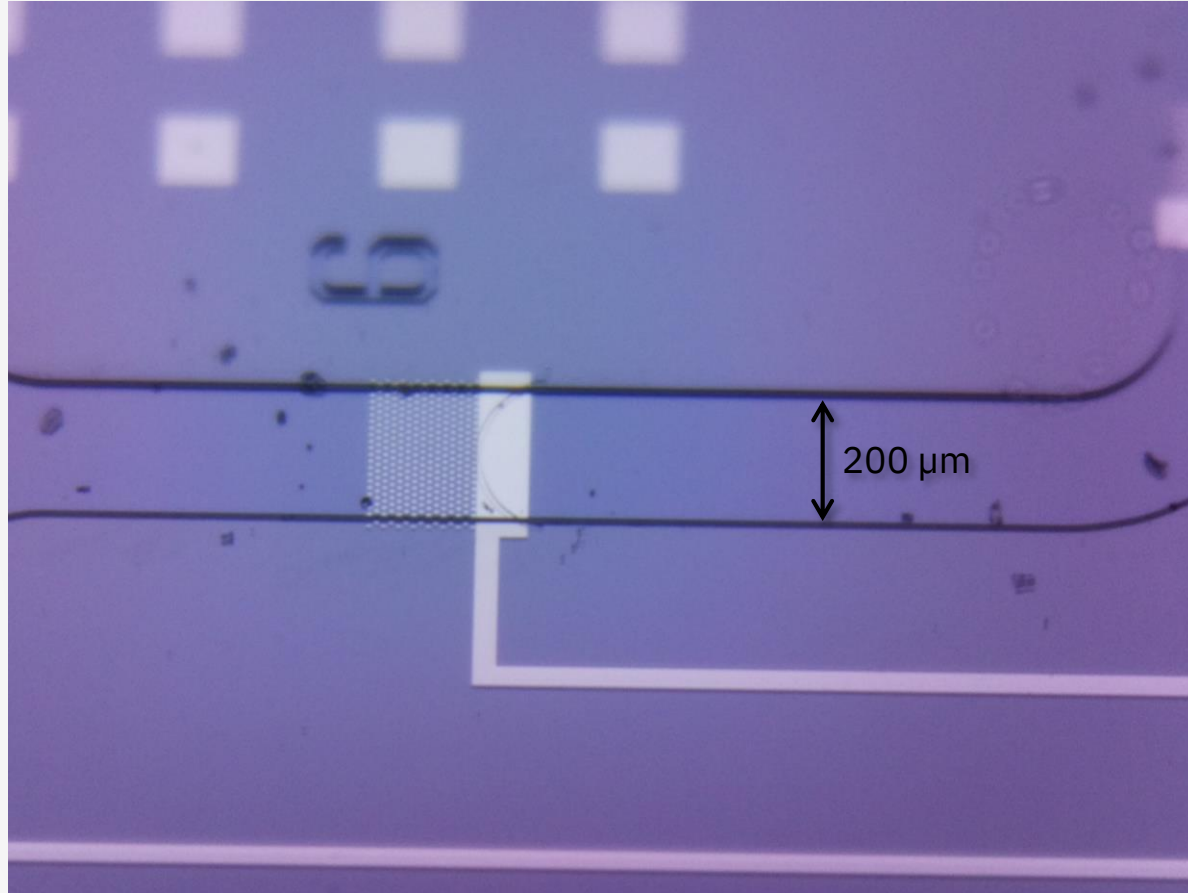


HQ camera

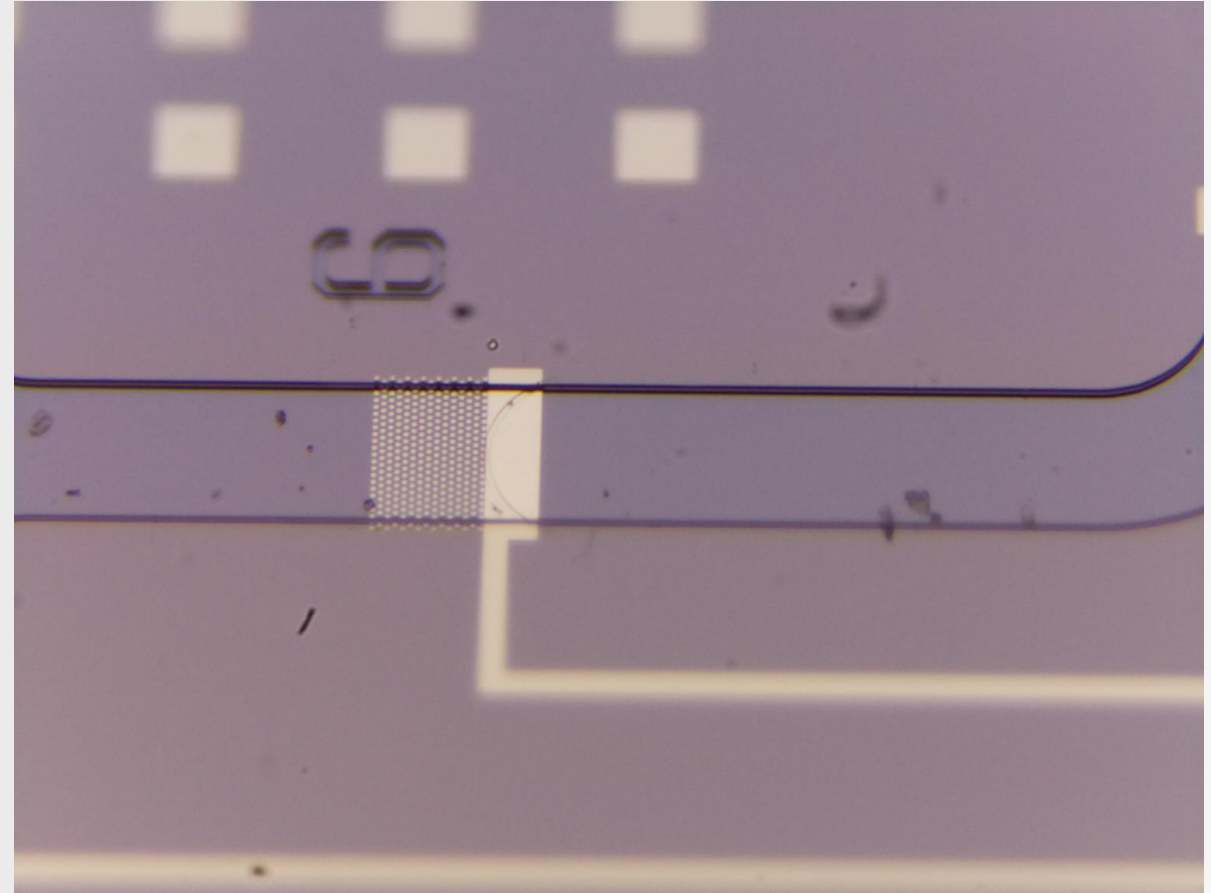


Microfluidic channels

Camera Module v2

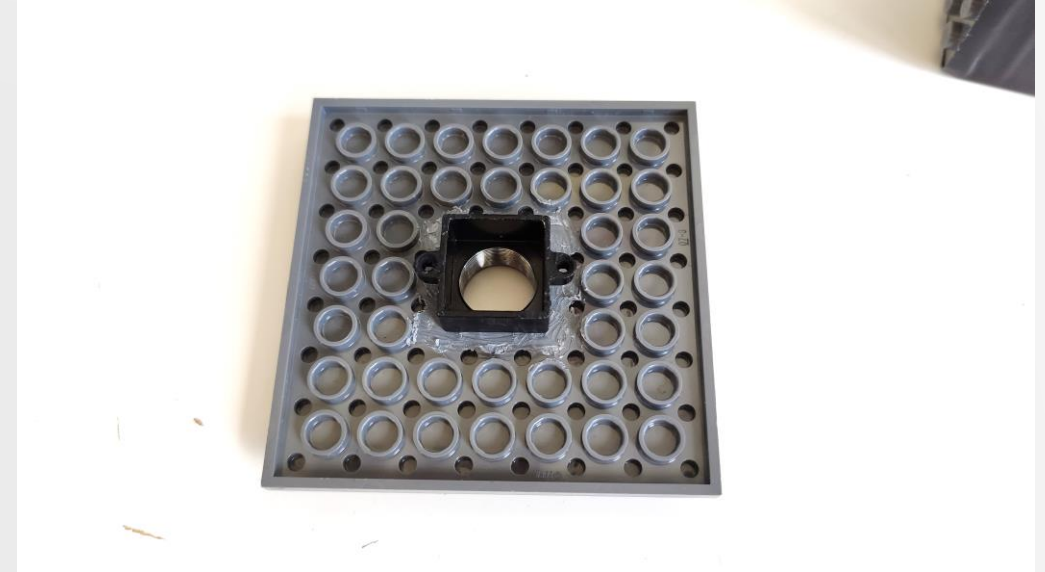
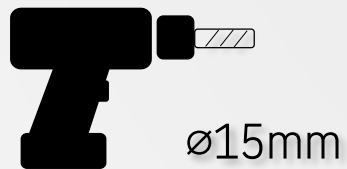
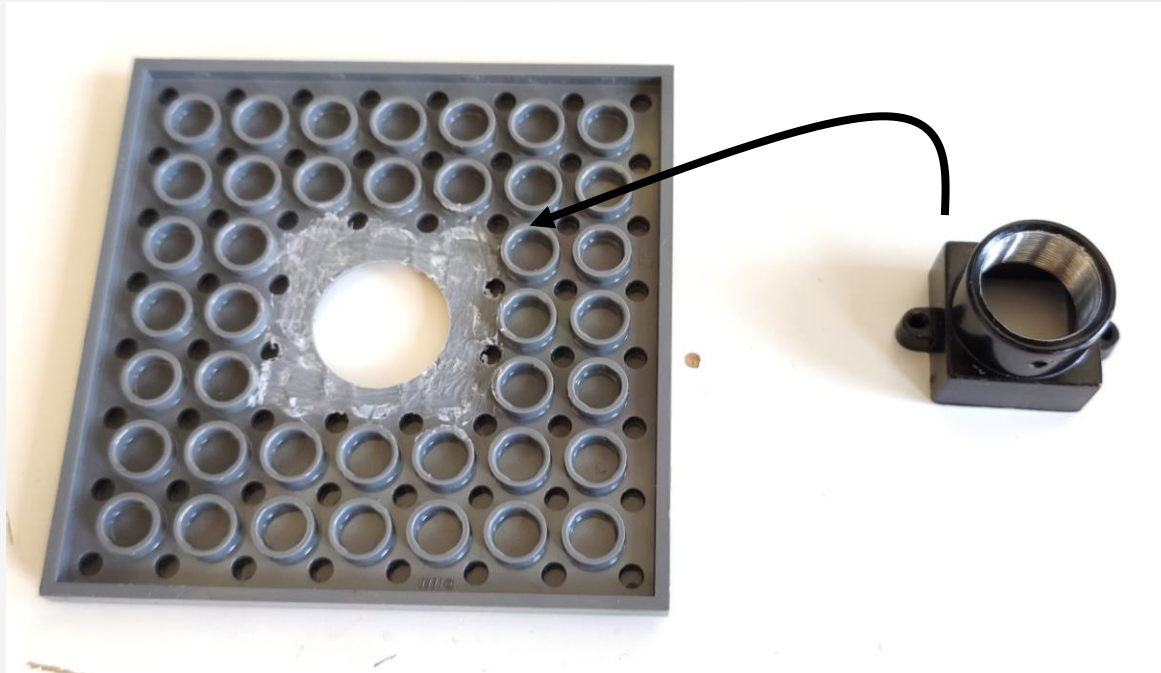


HQ camera



A trick to increase the field of view at the minimum magnification

Placing the lens holder from the other side of the Lego plate so that the objective lens can get closer to the CMOS sensor



A trick to increase the field of view at the minimum magnification

