

Smartphone Magnification Stand

DESIGN RATIONALE

Introduction

This inexpensive 3D printed smartphone stand will allow for a smartphone to be held up while it is being used as a magnifier. This phone stand may be beneficial to someone with visual impairment that requires text to be enlarged or better contrasted to its surroundings in order to read it. The phone stand is designed to hold the user's smartphone up high enough from the page that the camera on the back of the user's phone can fully focus.

Research

In order to determine how tall or how wide to make the phone stand, it was required to research different widths and minimum focus distances for various smart phones. Many phones were researched, and below is an excerpt of what could be considered the smallest and largest width of popular smartphones:

	Name	Brand	Width (mm)
Smallest Width Phone	<i>iPhone SE</i>	<i>Apple</i>	<i>67.3</i>
	<i>iPhone SE with case</i>	<i>Apple</i>	<i>79.2</i>
Largest Width Phone	<i>iPhone 13 Pro Max</i>	<i>Apple</i>	<i>78.1</i>
	<i>iPhone 13 Pro Max with Case</i>	<i>Apple</i>	<i>86.7</i>

The table below is an excerpt of the various popular smartphones and their minimum focus distances. It was found that most minimum focus distances were 80mm or less.

Name	Brand	Minimum Focus Distance (mm)
<i>iPhone 13 Pro Max</i>	<i>Apple</i>	<i>20</i>
<i>iPhone 12 Pro Max</i>	<i>Apple</i>	<i>80</i>
<i>Google Pixel 6 Pro</i>	<i>Google</i>	<i>80</i>
<i>Samsung Galaxy A52</i>	<i>Samsung</i>	<i>50</i>
<i>Samsung Galaxy A71</i>	<i>Samsung</i>	<i>50</i>
<i>Samsung Galaxy S20 Ultra</i>	<i>Samsung</i>	<i>153</i>

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Commercial Option:

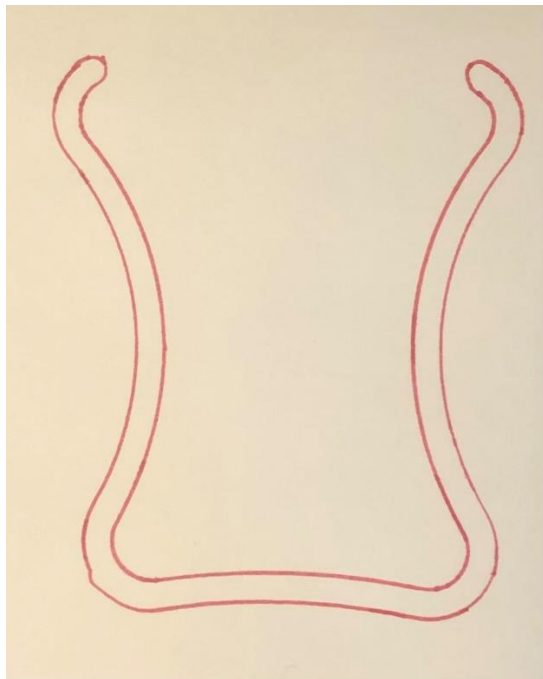
Name	Vendor	Cost	Link
Visor Stand	Visor App	\$41.26	Smartphone Stand — Visor – Magnifier App for iPhone and Android (visorapp.net)

Design Considerations

The goal of this project was to develop an open-source version of a simple stand for a smartphone so it can be used as a magnifier. A key requirement of the phone stand was that it must be able to accommodate a variety of smartphones that are different widths and may have different minimum focus distances for their cameras.

Ideation

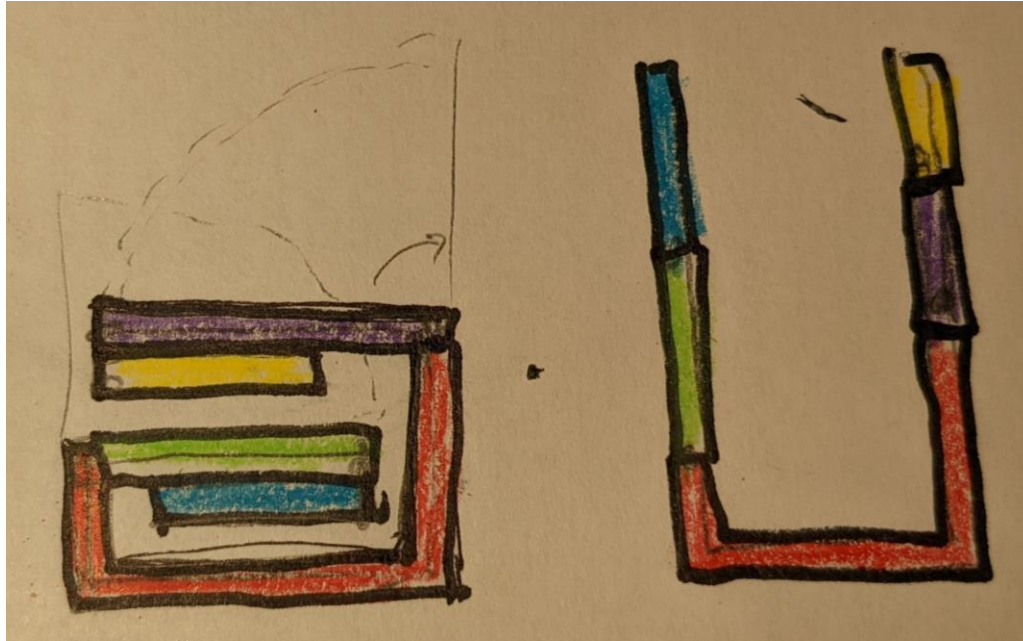
Idea 1: The first design was inspired from the Visor Stand. This design is very simple and requires no assembly.



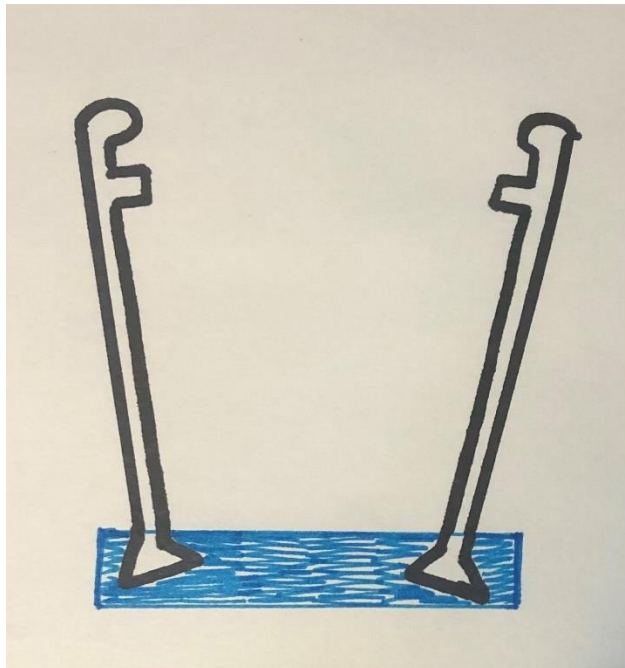
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Idea 2: The second idea was to design a phone stand that can fold so it could be more portable. The sides of the phone stand are longer than the base, so it would be required that the sides themselves would also have to fold in. The pieces would have to be able to fold opened and lock at a given angle to hold the phone.



Idea 3: The third idea was to design a phone stand that could be disassembled so it could be more portable. It is required that the phone stand must be able to be put together quickly for efficient use.



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Prototyping

It was decided to continue developing a phone stand based on the first idea as it is the simplest and there is no assembly required. Many prototypes were made in order to determine which design would best work for the majority of popular smartphones. Some of the factors that varied over the course of the prototypes included: how tall the phone stand was, its depth, how thick the walls were, how wide the opening was, and how curved it was.

Height: The height of the phone stand was chosen in order to try and accommodate the minimum focus distance of most smartphones. It was found that most smartphones had a minimum focus distance of 80mm or less. Making the phone stand much taller would not only increase print time, but it would make the phone stand bulkier, as well as obstruct the view of the camera more. Blocking the view of the camera can be solved by sliding back the phone stand away from the camera, but doing this too much makes the phone and phone stand unstable.

Depth: The depth of the phone stand was chosen based on the trade off between ensuring that the phone stand was stable, without increasing the print time too much. It can also be noted that if the phone stand is too thick, it might obstruct the view of the camera. Through prototyping, it was found that the taller the phone stand required a thicker base to achieve the same level of stability.

Wall Thickness: The wall thickness of the phone stand was selected based on the trade off between strength and flexibility of the phone stand. It was found that if the walls were too thin, they became fragile and more likely to break. If the walls were too thick, the phone stand would exert a greater force on the phone and would sometimes press in the buttons on the side of the phone.

Opening Width: The size of the opening width of the phone stand was selected to ensure that most different width smartphones could use the stand. The opening had to be small enough that the smallest smartphones would not fall out, but wide enough that when the phone stand is pulled apart to accommodate bigger phones, that it would not break.

Curvature: The curvature of the phone stand was selected as it allowed for the phone to be held up, as well as contributed to the phone's flexibility.

Testing

Each prototype was tested by placing different sized phones in the phone stand. It was through testing that different discoveries were made with regards to the height, depth, wall thickness, opening width, and curvature, mentioned previously. Another discovery that was made through the process of testing was that many of the phone stands broke at the bottom corners when the phone stand was pulled apart too far. Upon further investigation, it was determined that the corners were breaking across the infill and not at the existing outer shells. This observation then led to increasing the number of shells in order

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to eliminate the need for infill. This allowed for the phone stand to become stronger and actually improve its flexibility.

Final Design

The final design was inspired from the Visor Stand. This design is very simple and requires no assembly.



Opportunities for Improvement

- Portability: to design a phone stand that can fold or dismantle in order for it to be easier to transport.
- Flexibility: Designing a phone stand that is not required to be in a constant strain to accommodate different sized phones.
- Improving balance: Increasing stability in the phone stand without blocking the view of the camera of the smartphone.

Credited Resources Used In Development

<https://www.visorapp.net/magnifiershop/smartphonestand>