An Analyisis of Magic Leap's Technology

By Kayvan Mirza, CEO Optinvent

There are lots of articles out there about Magic Leap so we though we would give you our analysis of their tech.

We'll start by analyzing a few of Magic Leap's key patents since there's not much to go by in terms of real demos or images of the hardware that have been made public.

Please note that the analysis below is Optinvent's opinion based on a patent analysis and not on actual measurements made on the Magic Leap demo.
Magic Leap patents cover two main categories :

1. Patents related to Augmented Reality software: These patents generally make claims about the software system to interact with the virtual images using smart glasses.
2. Patents related to the Smart Glass hardware and optics: The main claims for these hardware patents revolve around the display technology.

Main US Patents List:

- 2014/000376 A1
- 2014/0071539 A1
- 2013/01282230 A1
- WO2014113506 A1

Others patents exist from a collection of external patents that belong to Brian Schowengerdt (From Univsersity of Washington) and Samuel Miller.

Patent number 2014/000376 A1

Objective : Allow users to see a 3D virtual image by focusing the image beam in different locations in space (in front of you) using the optical system described in the figures below:

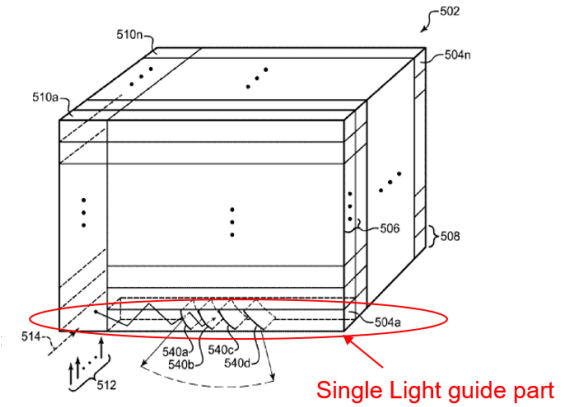
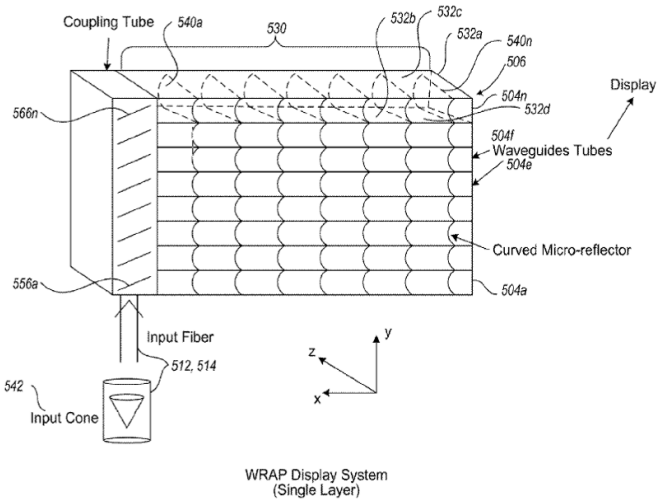


FIG.5A



WRAP Display System
(Single Layer)

The patent claims:
A complex optical arrangement made of an assembly of several light guides (could be up to 36) that use embedded reflectors, where each light guide itself is made up of several embedded reflector (~6). The Light guide arrangement is illuminated by a specific fiber laser arrangement with Electro-optical switches that are claimed to be part of the system. The total thickness for the light guide arrangement is calculated to be 1cm thick.

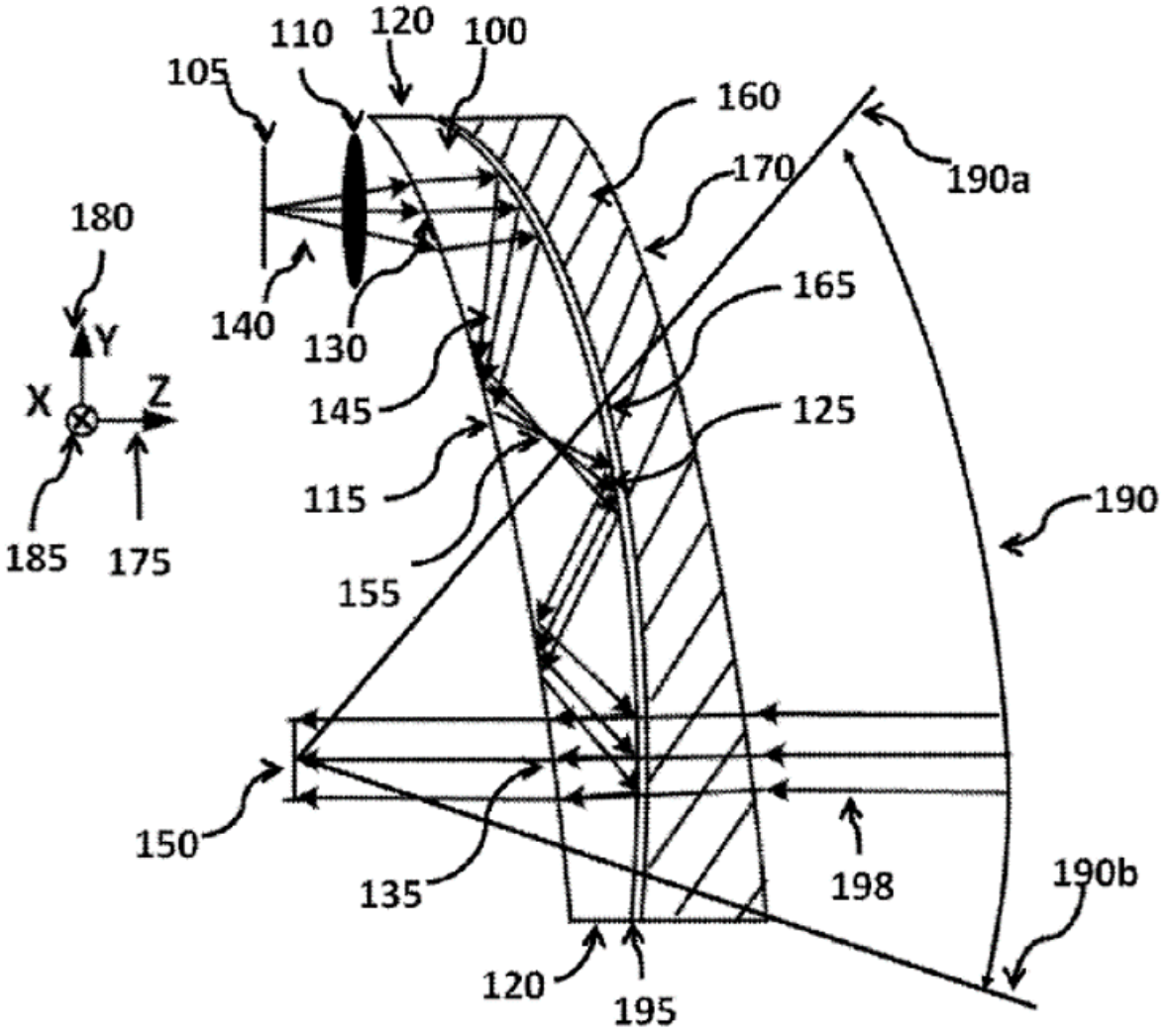
Our Analysis: This type of optical element is extremely difficult to manufacture in high volume due to its complexity. If Magic Leap succeeds in doing it, it would be extremely costly to produce and could take several years to become a consumer reality. An additional difficulty is that the claimed reflectors are curved with different kinds of exotic and specific coatings between each light guide assembled in a very tiny area. The fiber laser adds an additional layer of complexity to the system. Some arrangements claim to have tiny liquid crystal lenses who's feasibility has yet to be demonstrated. In general, this patent is reads like a wish list of someone who's never dealt with mass produced hardware and optics. The claims reads like lines of code without any consideration for hardware manufacturing feasibility, yield, cost, and reliability. The complexity of the claimed arrangement is not only related to the optics, but to the opto-electronic systems, piezo vibrating fiber, liquid crystal, mechanical assembly, lasers and electronics. We doubt the manufacturing feasibility of such a system. Its doubtful that the images we've seen of the "photonics chip" that Abovitz, Magic Leap's CEO has been showing are a real working component.

Patent number 2014/00715539 A1

Objective: To patent a curved light guide?

The patent claims:

Two light guide assemblies separated by air. The light from a micro display system is in-coupled to one part and extracted toward the eye by a specific coating as seen in the figure below:



Our Analysis: The claimed system is not new, Canon and Sony have similar patented concepts. Maybe Magic Leap has bought a license from them? The total thickness of the free form light guide in front of the eye is between 12 and 15mm for moderate FOV (field of view) which is very thick. There's also nothing innovative about this patent.

Patent number 2013/01282230 A1

Objective: To solve the issue of having the same focal plane for any content in the virtual image plane by adding a means of defocus and obstruction over the light guide or display optics in front of the eye as seen in the figure below:

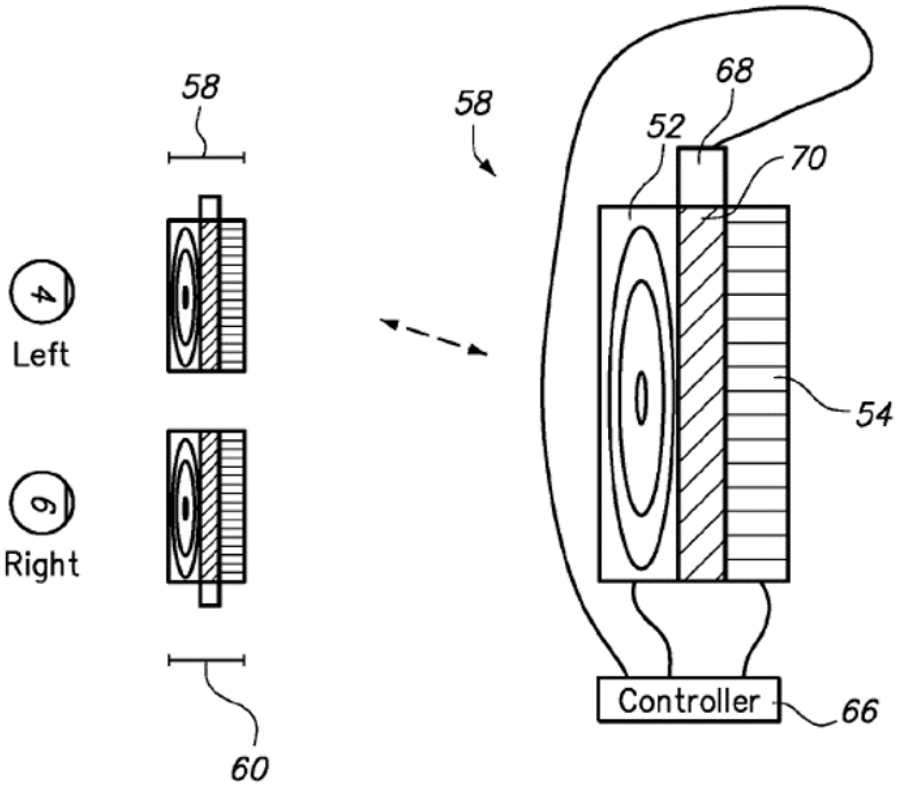


FIG. 12A FIG. 12B

The patent claims: A diffractive zone plate pattern with an LCD or other display system as the obstructing means to switch between focal planes.

Our Analysis: The means claimed above are complex with a very challenging driving scheme and we are doubtful that they will work as described. The diffractive zone plate pattern will generate ghost images. The obstructing means made of an LCD or other display system would reduce the brightness significantly. The association of zone plate diffraction pattern and a diffractive light guide remains to be demonstrated. This patent present concepts that are extremely difficult to mass produce at a reasonable cost with current manufacturing techniques. Maybe that's the reason Magic Leap has been taking so long to come up with a public demo, much less a product?

Published patent number WO2014113506 A1

Objective: To patent a high resolution microdisplay system that can reduce the size of the optical engine and who's driving circuits can be offloaded from the wearable device.

The patent claims: A collimated micro display to be used in Smart Glasses using a vibrating optical fiber array (7×11) to scan the image powered by a laser light source located away from the display itself. The system targets high resolution.

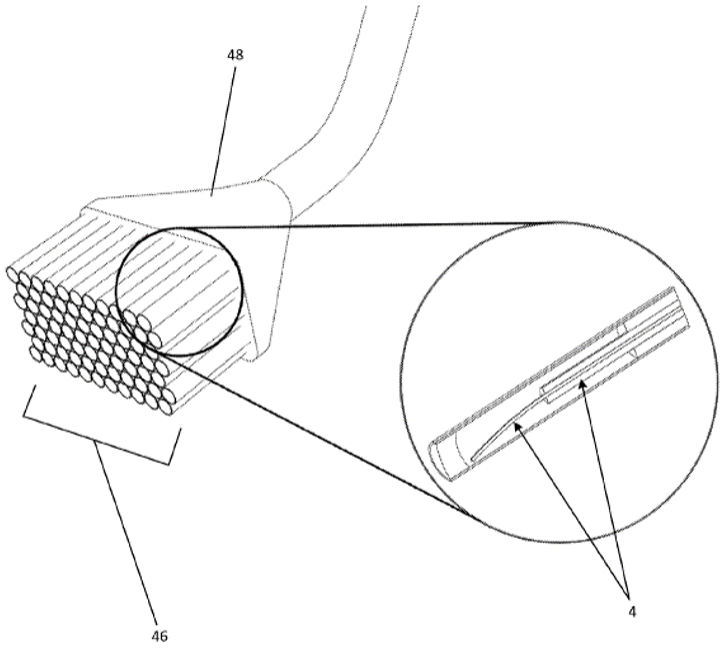


Figure 6A

Our Analysis: The "Fiber Scan Display" or FSD system as described will be very difficult to produce regarding tolerances, required precision, and brightness as well as color variation over the projected image. The claimed system will have a very high cost and very low yield in comparison to other display technologies like OLED, LCD, etc. combined with collimated beam systems. We are surprised by the need for such a complex system to build compact Smart Glasses and therefore are doubtful of the viability of Magic Leap's technology when it comes to high volume production at a reasonable cost. There are some articles that claim that Magic Leap has scrapped their plans on building this complex vibrating fiber-optic FSB microdisplay. Here's an excellent article on the subject: http://www.kguttag.com/2016/11/28/magic-leap-no-fiber-scan-display-fsd/ Perhaps those claims are true judging from the complexity of building such tech. That's too bad because we had previously considered this part to be the most feasible part of the Magic Leap system since we saw a prototype of this display some time ago…

In Conclusion, we would like to reiterate what we've always said about this field (and other tech we've seen): One can always make a great demo under controlled conditions. However its something entirely different to make a technology scalable and repeatable for volume production.

The simple analogy is this; with enough funding you can send a man to the moon….once, but making that process scalable, repeatable, and cost effective is another story.

That said, we would like nothing more than to see Magic Leap succeed big because this industry has already seen its share of failures!