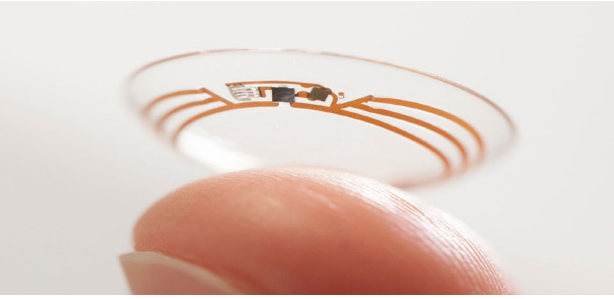
Google [x]



What is Google doing with a smart contact lens?

We are testing a prototype for a smart contact lens that we built to measure glucose in tears continuously using a wireless chip and miniaturized glucose sensor. We hope this could someday lead to a new way for people with diabetes to manage their disease.

The problem: the daily burden of diabetes

Many people with diabetes live with painful and disruptive daily routines for managing their glucose levels, such as wearing continuous glucose monitors embedded beneath their skin and finger-pricking to take a blood test. As a result, many people check less often than they should. This raises their risk of developing dangerous complications associated with uncontrolled blood sugar, such as kidney failure and blindness.

As a result, many researchers have spent years looking for alternative, less invasive methods for measuring glucose levels in the body, such as via sweat, saliva, urine or tears.

Trying to crack the mystery of tear glucose

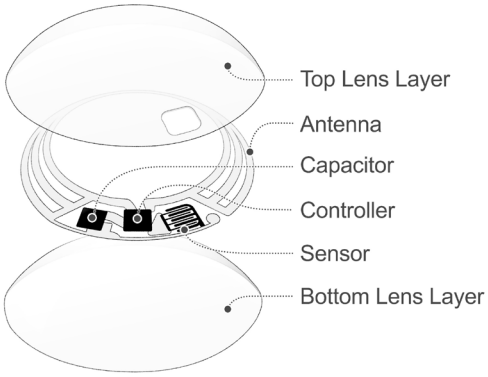
Scientists have long known that tears contain glucose. Unfortunately, it's extremely hard to study tear fluid in its natural state. It's only available in very small quantities, and it's difficult to collect without disrupting the eye's natural state (imagine plucking a nose hair and then sticking a piece of paper in your eye).

This means it's incredibly difficult to answer the kinds of questions you need to answer if tears are to be seen as a possible path to a new way of managing diabetes. For one, you need to be able to explore the correlation between tear glucose and blood glucose, e.g. what it is, how close, if/how anything affects it, if there's lag time, etc. And you need to know the basics of tear glucose itself, e.g. how much there is, how it's affected by factors like illness, exercise, sleep, a windy day, a humid climate, lying down vs standing up...you get the idea.

Tiny tech

We wondered if miniaturized electronics — think chips and sensors so small they look like bits of glitter, and an antenna thinner than a human hair — might be a way to crack the mystery of tear glucose and measure it with greater accuracy. We hope a tiny, super sensitive glucose sensor embedded in a contact lens could be the first step in showing how to measure glucose through tears, which in the past has only been theoretically possible.

The chip and sensor are embedded between two layers of soft contact lens material. A tiny pinhole in the lens allows tear fluid from the surface of the eye to seep into the glucose sensor. The prototypes we're testing can take a glucose level reading once every second.



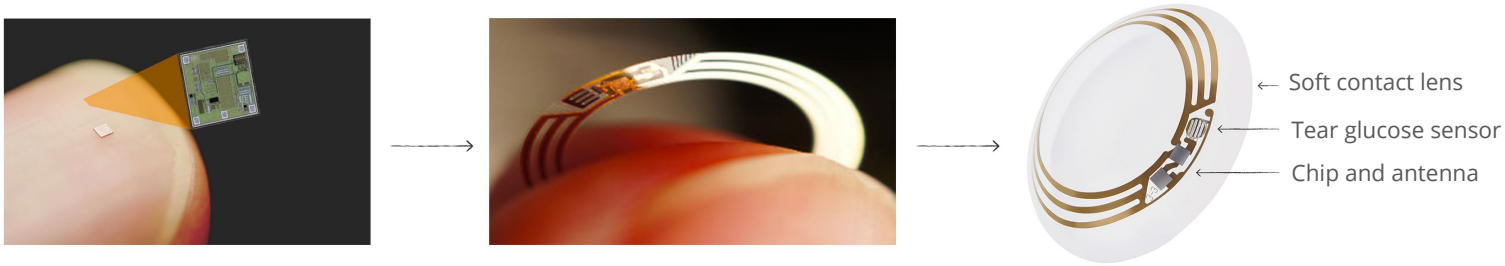
Please note: relative sizes have been exaggerated for illustrative clarity

Google[x]

How did we do it?

The less-famous benefit of Moore's Law is that it can be applied to dramatically shrink the size of computer chips so they can be used in new ways. Once we decided we were going to aim for a really tiny chip that could fit into a contact lens, we had to rethink everything we knew about building wireless electronics systems.

First, we got rid of all the unnecessary components and shrunk only the most important ones onto a really tiny chip. To do this, we had to completely redesign them — and in some cases, build entirely new tools to make the components. Then, instead of mounting the components on a typical fiberglass circuit board, we mounted them on a very thin, flexible, plastic-like film.



Close-up of wireless chip | Chip, sensor and antenna mounted | Electronics ring embedded in contact lens

Finding a home at Google[x]

Project co-founders Brian Otis and Babak Parviz worked together at the University of Washington. Then Babak headed to Google[x] to work on Google Glass. Brian soon followed, intrigued by the opportunity to work in Google[x], the "secret lab" that focuses on building radical new technology that could help solve really big problems in the world. Brian then set about trying to build a lens from scratch that could live up to the ultimate test -- a prototype that could actually be tested in the real world, in clinical studies.

Next steps

It's early days and there's still a lot more work to do to turn this technology into a product that people can use. We have completed multiple studies that test the comfort and functionality of the lens and explore how tear glucose correlates with blood glucose, particularly in people with diabetes.

We're in discussions with the FDA, and plan to look for expert partners who can bring this technology to market.

Key facts about diabetes

- One in every 19 adults in the world — some 382 million people — have diabetes, and it's increasing in every single country.
- More than 25 million children and adults in America suffer from diabetes — that's more than 8% of Americans. Another 25% of the population of the US is pre-diabetic.
- In the U.S., we now spend four times as much on diabetes in one year than we did to send a man to the moon.
- Diabetes is the leading cause of kidney failure, non-traumatic lower limb amputations, and new cases of blindness among adults in the U.S. It also caused 5.1 million deaths in 2013, making it the 7th leading cause of death in the U.S.

More information

For press questions, please contact press@google.com.