

WHITE PAPER



Digital paper in smart product design: Driving innovation. Growing revenue.

*“The Smart Lock made with E Ink became
a killer app in our OneKEY Ecosystem.”*

Jeff Grant | Director of Innovation, InVue

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The smart product revolution is accelerating. From mobile devices and wearables to thermostats and talking speakers, smart products are ubiquitous in everyday life, with exponential growth projected across a range of industries.

Defined as “The integration of information and communication technologies into products anywhere and anytime,”¹ smart products are on their way to becoming a new standard that customers expect and demand.

- The global market for smart home devices is expected to grow 26.9 percent year over year in 2019 to 832.7 million shipments, with 1.6 billion devices expected to be shipped in 2023.²
- The smart home market alone is expected to be worth \$151.4 billion by 2024.³
- The number of connected Internet of Things (IoT) devices worldwide will grow to 125 billion in 2030.⁴
- Smart clothing is projected to become a \$4 billion dollar market by 2024.⁵

Smart products, however, do not need to be connected to the internet to be smart. In fact, exposure to the cybersecurity risks of information passing over the internet is a serious concern. To be smart, products simply have to communicate valuable information to users in a way that enhances their experience, improves efficiency and makes life — and work — better.

Entrepreneurs, product managers and industrial designers are eager to cash in on the smart products movement, but they face an uphill battle: Smart products, in particular those designed to be mobile, have to balance the need for very low power consumption and affordable cost. Too much power demand, or too high a cost per unit, will kill even the most brilliant idea.

Segmented digital paper: The flexible, ultralow power display solution that's driving smart product innovation and sales.

What is digital paper and how does it work? Digital paper is known by most people as the screen in their eReader, mimicking the look of printed paper but bringing the advantages of digital media. Made by E Ink, digital paper has particles within microcapsules or microcups that are coated onto a thin film layer and act as a form of ink. Instead of ink being pressed permanently upon paper, however, the ink particles in digital paper are automatically recycled to form new letters or graphics when the display image is updated.

With E Ink's segmented displays, product developers can specify a predetermined character or image set (such as text or an icon), which helps drive down the cost per unit, making the technology affordable for smart products.

Of particular interest to product developers, the updating of the display image is the only time that power is used. In technical terms, an E Ink display consumes approximately 0.5 micro amps per cm² while switching the display, and requires zero power to display a static image. To put this in perspective, an E Ink display uses about 99 percent less power than the liquid crystal displays (LCD) used in television screens and many types of mobile devices.

Ultralow power consumption, however, is just one of the attributes of digital paper that's unleashing innovation. Because digital paper is essentially a very thin piece of shatterproof plastic film (albeit packed with sophisticated technology), it can be flexible in ways that glass displays can't — curved or with a hole — with a virtually unlimited variety of shapes and assembly options. The display itself is only 580 microns thick, allowing for integration into products as thin as a credit card.

The upshot is that digital paper displays can be easily customized for a design versus trying to make the design fit around the display.

Sunlight readable, with a wide 180-degree viewing angle, E Ink's technology brings the beauty and simplicity of paper into all kinds of smart product development in numerous industries.

Securing value: the story of a killer app.

InVue is a global technology company that provides retailers and brands with innovative merchandising, software and security solutions. InVue's Director of Innovation, Jeff Grant, saw a new product opportunity hidden in the status quo of retail cases that required the management of multiple keys.

- Every retail case necessitated the need for multiple keys used by different sales associates.
- Traditional mechanical keys can be duplicated without knowledge of the key owner.
- Keys and locks often break, causing lost sales.
- Management limited the number of key rings on the sales floor in an attempt to mitigate risks — but this backfired because too often a sales associate would not have the required key and the customer would be frustrated.



The E Ink display on InVue's OneKEY solution requires no electrical connection or battery on the retail case to show if the case is locked or unlocked.

These interrelated challenges sparked an idea. What if there was a way to create a lock system that dispensed with traditional keys altogether? A system that required only one very smart key versus lots of dumb mechanical keys? This was the genesis of InVue's ingenious Smart Lock, part of their OneKEY® ecosystem.

Early prototypes were promising, but as is often the case with the invention process, a new challenge arose. With the new system there was no way to tell from a distance if a retail case was locked or not. How could the system digitally display the state of the lock without being plugged in or require a dedicated battery? These tough technical requirements led Jeff to E Ink's digital paper.

“These days people want information from the product itself. Nobody has patience. If a product doesn’t clearly tell them what to do, they will abandon it for another product that does.”

Jeff Grant, Director of Innovation, InVue

The second generation of the prototype worked flawlessly. The keys, which are charged at a dock overnight, transfer power to locks at the moment of use. As the keys interact with the locks, they check codes to make sure they match, and the lock becomes unlocked. An ultrathin, ultralow power consuming E Ink display in the lock changes from black to white, letting employees know from a distance if a cabinet is locked. Because the digital paper requires no power to show a static image, the image stays in place indefinitely until a key is inserted again, at which time the power from the key can change the state of the lock’s display.

Thinking beyond the square.

Instead of requiring a square or rectangular image that would have to be force fit into the display design, the digital paper conformed to Jeff’s creative vision. The E Ink display took the form of a small round disc within a half-inch portal that matched the diameter of OneKEY.

Thinking beyond the square turned out to be highly profitable. InVue’s innovation completely disrupted the market for key/lock systems at retail and became widely adopted at major big-box stores globally.

Mass-producing a new market for secure cards: A very thin story line.

InterActive Cards® is a new company with a bold vision for transforming the security of cards. Like all product pioneers, they started by identifying a problem. Credit cards, with their three-digit security codes, were not actually secure at all. Any information that was passed via the internet was vulnerable to hacking — a huge problem for banks.



InterActive Cards asked, “What if a credit card’s security codes were imbedded into the card, only visible when the cardholder touched a button and changed every time? And with no need to route any information via the internet?” This new breed of card would look and feel like any other card, but be smart enough to prevent billions of dollars in fraud.

InterActive Cards’ technology features miniature display screens made with ultrathin and flexible E Ink digital paper.

To become a reality, the screen on the card showing the codes needed to be incredibly thin, flexible, rugged and require extremely low amounts of power: Only E Ink digital paper fit their vision. In development for several years, Mastercard® certified InterActive Card's product in 2018, meeting the highest standards in the industry. Credit cards even have to pass a PH level test so they can endure contact with sweaty humans, requiring the purchase of commercial batches of human sweat for testing purposes!

The card is 32 thousandth of an inch thick, with a battery that is half the thickness of the card. Each minidisplays has enough power to be turned on and off 13,000 times, with an average life of three to five years.

Inventing the cards is one thing. Manufacturing at scale is a whole different challenge. Fortunately, E Ink's digital paper is so flexible to work with, the cards can be manufactured en masse using a reaction injecting molding process that requires very little heat. While other secure card companies are confined to manufacturing about 2 million cards per year, InterActive Cards can produce 1.5 million cards per month.

The company is branching out with the same basic concept to create security access cards for other industries. One sector on the near horizon is the federal government and its many contractors, providing an ultrasecure access system for sensitive online information.

The Motion Display story: Getting retail customers' attention and opening wallets at the point-of-sale.

Today's brands have a tough time getting noticed in crowded retail environments. Up to 70 to 80 percent of all purchase decisions are made in the store. The 4-7 seconds customers spend in front of a product display is the "moment of truth." They buy or move on.

For one company, Motion Display® based in Sweden, this led to an inspiration: Use motion to get customers' attention and grow sales in the moment. E Ink's Ink-In-Motion® segmented digital paper enabled a solution in the form of eye-catching animated signage at retail.

Each display is made with an underlying digital paper layer with defined parts (segments) that can be individually controlled to switch from black to white or white to black, creating flashing animation sequences. This is paired with a transparent color overlay on top. Thin, light and durable, the signs are designed to be easy to handle and mount on a range of surfaces, from products to shelves and checkout counters. And with a viewing angle of almost 180 degrees, the signs are impossible to miss.



Motion Display's animated point-of-sale signs, made with E Ink's Ink-in-Motion digital paper technology, led to a 66 percent sales increase for Hidden Valley Ranch dressing at Walmart.

As just one example of Motion Display's disruptive impact on the retail sector, their campaign for Hidden Valley Ranch dressing at Walmart stores drove a 66 percent increase in retail sales.

Conclusion: Breakthrough product opportunities are everywhere we look.

More and more, consumers are demanding that their products have built-in smarts, with information displays that are clear and useful. And inventors and entrepreneurs will be capitalizing on this trend. The rapid growth of the IoT, and the burgeoning world of smart home devices, represents only the tip of the digital iceberg for smart product development opportunities.

On the near horizon, we can expect to see next generation pill boxes that remind patients to take their medicine, toll passes that show the balance in our account, lithium battery level indicators on every handheld power tool, and much more.

While no one can say what the next breakthrough smart product will be, it's likely that its display will be made of E Ink's digital paper in some shape or form. Circle or square. Curved or flat. Tiny or big. Requiring ultralow power, or no power at all. Smart products made with digital paper have the future built in.

About the Author

Ted Page is a Co-Founder and Principal of Captains of Industry.® He has worked with numerous technology, energy and consumer product companies, including Microsoft, Starbucks and Levi's.

About the Sponsor

E Ink is the originator, pioneer and commercial leader in digital paper technology. The company delivers its advanced display products to the world's most influential brands and manufacturers, enabling them to install extremely durable, low-power displays in previously impossible or unimaginable applications and environments.

E Ink encompasses the combined E Ink Corporation, which was spun out of the MIT Media Lab in 1997 to commercialize electronic ink and EPD technology, and Prime View International, which was established in 1992 as the first TFT LCD company in Taiwan, focusing on high-quality, small-to-medium sized TFT LCDs. In 2009, Prime View acquired E Ink Corporation to further integrate and expand the EPD supply chain and the new combined companies were branded as E Ink.

E Ink's corporate philosophy centers around delivering revolutionary products, excellent user experiences, and environmental benefits through advanced technology development.

Sources:

1. Wikipedia
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5. Global Market Insights