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RESEARCH ARTICLE

Zforce Touchscreen Technology

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Abstract— Neonode has patented and commercialized the zforce(an abbreviation for "zero force necessary") touch technology ,which was designed to overcome many of the limitations of today's touch screens .The premise of the company's approach entails the projection of an infrared grid across an electronic display. As users tap, swipe, or write on the screen, zforce detects the location of the touch based on the Interruption in infrared light projecting across the screen, which translates to coordinates on the grid. The zforce architecture and input method is believed to be unique to Neonode. A zforce Touch Screen can be activated y multiple modes of input, including bare fingers, gloves, styluses, and (multiple simultaneous to touches). It is uncommon today to find both pens.as well as recognizes multi-touch these features innately built into the same touchscreen. The resistive touch technology used on most PDAs to recognize stylus writing works as a spot on the screen is pressed inward, causing one layer of the touchscreen to make contact with a layer beneath. This contact sends a signal to the device to recognize the touch. Although relatively low cost, resistive touchscreens do not typically allow multi-touch (swiping, gesturing).

I. INTRODUCTION OF ZFORCE TECHNOLOGY

Neonode has patented and commercialized the zForce(an abbreviation for "zero force necessary") touch technology ,which was designed to overcome many of the limitations of today's touchscreens. The premise of the company's approach entails the projection of an infrared grid across an electronic display. As users tap, swipe, or write on the screen, zforce detects the location of the touch based on the Interruption in infrared light projecting across the screen, which translates to coordinates on the grid. The zforce architecture and input method is believed to be unique to Neonode.

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About Neonode Inc

Neonode Inc is the leading provider of optical touch screen solutions for hand-held and small to midsize devices. Neonode is offering software licenses and engineering design services that enable companies to make high functionality touch screens at a low cost. zForce ® is the name of Neonode's proprietary patented touch screen technology. Neonode Inc is listed on the OTCBB under the symbol NEON.OB. Neonode is a trademark and zForce® is a registered trademark of Neonode Inc.

zForce®

Neonode's patented touch solution for portable devices, zForce, is many times more cost effective than any other high performance touch solution in the market today. zForce® supports high resolution pen writing in combination with finger navigation including gestures, multi-touch, sweeps and much more. zForce® doesn't

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require an overlay on top of the display window and provide a 100% clear viewing experience. zForce is the only viable touch screen solution that operates on the new revolutionary reflective display panels. Neonode has signed customer contracts with Sony Corporation and other global OEM's. zForce® is currently being integrated into a variety of mobile phones, eReaders, automotive applications, mobile internet and tablet devices.

II. LITERATURE REVIEW

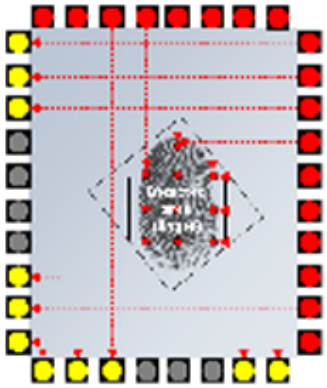
ZForce – An Optical Touch Screen from Neonode:

Optical touch screens like the ones using Neonode's zForce technology offer a cheaper and more versatile alternative to more popular touchscreens like resistive and capacitive types. In addition to obvious applications in devices like cell phones and tablet pc's, they also open the doors to the possibility of producing touch screen ebook readers.

I've always loved the technology behind what I call pure ebook readers, i.e., those devices that use e-ink displays. E-ink technology allows the text to be readable even under direct sunlight, has ultra-low power consumption, and is not as strenuous to the eyes – almost like a real book. However, the allure of having a touch screen display is also overwhelming.

Unfortunately, e-ink screens by themselves are not touch-sensitive. That is why some people are drawn to tablet pc's that enhance the reading experience by adding touch features. But while these devices will allow you to use a stylus or your finger to "flip" pages and interact with the screen, they don't offer the benefits of e-ink mentioned above.

That's where optical touch screen technologies like zForce will come in handy. Let me introduce you to the basic concept first.



Neonode zForce touch screen LEDs and photoreceptors

Imagine a bezel surrounding the screen. This bezel contains pairs of LEDs and photoreceptors (represented by the red and yellow dots in the image above) aligned on opposite sides of the frame. Pulses of infrared light are emitted from the LED to the photoreceptors, effectively forming a matrix as shown.

Neonode zForce touch screen matrix

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Thus, when you touch the screen with your finger, it gets in the way of one or more infrared beams. This allows the system to determine the X and Y coordinates where the obstruction took place. The same thing happens when you use either a stylus or another object like the side of a card.

At this point, the advantages of an optical touch screen like this are now pretty obvious. Let's mention some of them:

Neonode zForce feature highlights

- It does not require a glass overlay. This translates to better light transmission and subsequently better display quality.
- It does not require any force. With a resistive display, you need to press the surface with some amount of force before any feedback is received.
- It supports interactions using a finger, a stylus, or even a gloved hand. Most capacitive touch screens cannot function when you use a stylus or a gloved hand.
- Since it leaves the e-ink display as is, all the benefits associated with an e-ink display is retained.

Other not-so-obvious benefits include the following:

- It is cheaper than capacitive touch screen solutions
- It supports multi-touch
- It consumes minimal power
- It is not sensitive to Radio Frequency Interference (RFI) or Electromagnetic Interference (EMI)
- It is able to provide high resolutions.

III. ZFORCE: A NEXT GENERATION ALTERNATIVE

Neonode overcomes limitations of both resistive and capacitive screens with its zforce technology creating a next generation touch surface that the company believes can be more economical as well as higher performing than either of the main technologies in use today. Currently, projected capacitance touch screens represent the mainstream technology for multi-touch interfaces. However, zforce also enables the convenient multi-touch features of capacitive screens but at the cost structure of more affordable resistive technologies. Further, as overviewed on, in february2012, the company introduced a new multi sense component to the zforce technology that is intended to improve upon standard multi-touch processes

In contrast to capacitive and resistive screens, which have microscopic circuits embedded on a glass substrate, Neonode's controller projects a grid of infrared light beams across the display layer. Importantly, the company's technology is display (LCD),eink, organic light emitting diodes(OLED),and electronic paper displays(EPD).

Touch is detected as a finger or object interrupts (by obstructing or reflecting) the light beams projected across the screen surface, which identifies the X and Y coordinates of the touch. The zforce infrared optical

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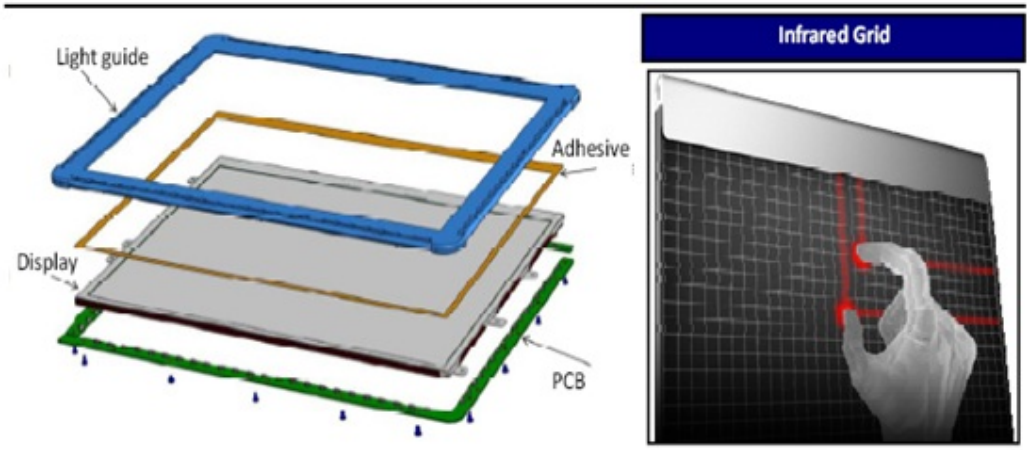
touch screen relies neither on pressure nor conduction, enabling consumers to use a Neonode touchscreen barehanded or while wearing gloves, holding pens or styluses, etcetera. As illustrated in fig 11, there is a glass substrate or glass overlay required.

Figure 11

LAYERS OF THE ZFORCE® OPTICAL INTERFACE



In fig11 ,a plastic light guide is located under the bezel on top of the display. It serves to reflect and focus light are shown attached to an around the zforce display. LEDs and photo diodes printed circuit board (PCB) display (also shown in fig 12).The zforce Technology.

Pulses an infrared light across the screen at a rate of up to 120 times a second so the grid is continuously refreshed. As the user's fingers move across the screen, the grid's coordinates where the screen is touched are converted into mathematical algorithms in a process that is unique to Neonode .The Company holds patents worldwide related to the zforce architecture and input method.

The newer and higher-cost capacitive technology, such as that used on apple inc's(AAPLNASDAQ)iPhone, is activated by conductive material rather than applied pressure. Electrodes in the display contact with an electrical conductor, such as a finger. Capacitive devices perform multi touch but cannot be activated by standard pointers or gloves as these are nonconductive As a result, many users find that their touch screen can recognize taps from their fingers but not finger nails. In contrast, the z force screens offer full finger touch capabilities as well as high-resolution pen support in the same solution.

IV. WORKING PRINCIPLE OF NEONODE zFORCE

Infrared touch screen is a touch frame which is usually installed in front of the display screen.

The frame is integrated with printed circuit board which contains a line of IR-LEDs and photo transistors hidden behind the bezel of the touch frame. Each of IR-LEDs and photo transistors is set on the opposite sides to create a grid of invisible infrared light. The bezel shields the parts from the operation environment while allowing the IR beams to pass through.

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The infrared Touch Screen controller sequentially pulses Les to create a grid of IR light beams. When a user touches the screen ,enters the grid by a stylus which can interrupt the IR light beams, the photo transistors from x and Y axes detect the IR light beams which have been interrupted and transmit exact signals that identify the X and Y axes coordinates to the host.

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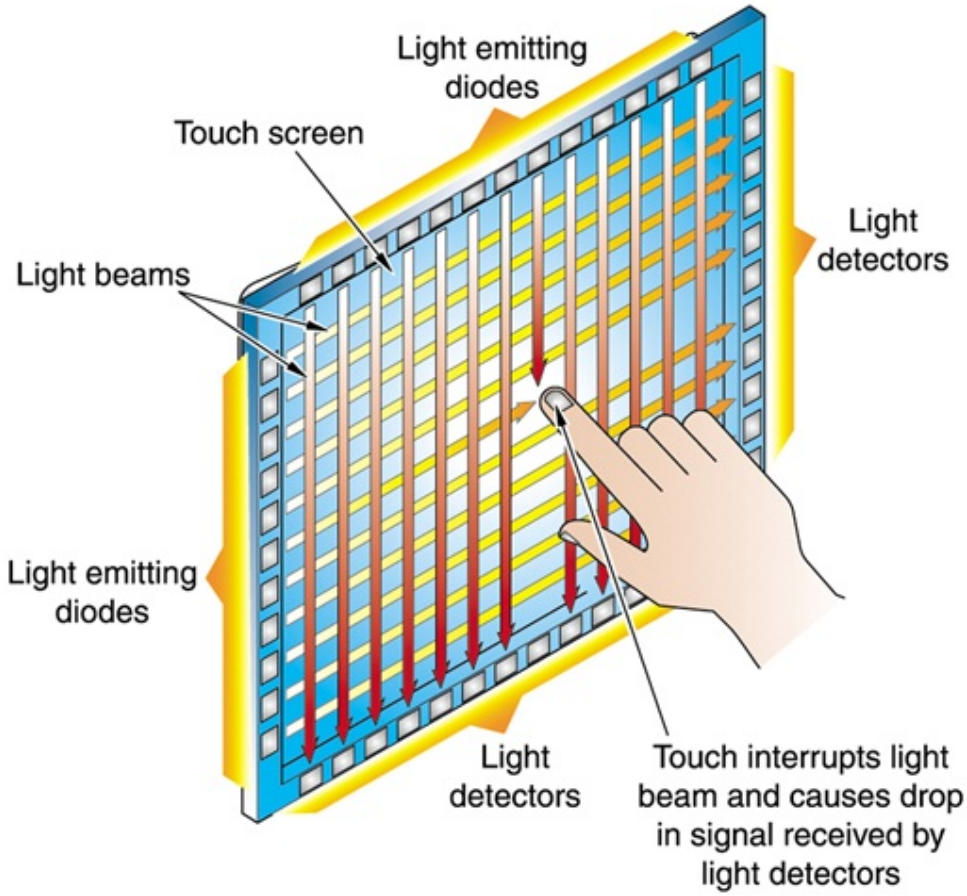

Neonode zforce is set to replace capacitive touch screens. Back to using infrared bezel sensing. Touchscreen of the past. Back in 1981, the PLATO V terminal used infrared bezel sensing touchscreens.

Fast forward 31 years, we have the Neonode zforce. It does not use the electrical properties of the human body to track movement. An array of infrared LEDs are used to track where fingers on the screen are the drawback of this kind of technology is that a raised bezel is places around the screen. This raised bezel houses an array of infrared LEDs and sensors. The new technology has already been licensed to companies to use this technology. The swips company has noted that power consumption is as low as 1mw at 100hz.Battery life of tablets devices will benefit from such a new type of touch screen. ims response times are quite possible with this new technology and there is little to no lag.

Neonode zForce technology has been seen in a slew of lower-end eReaders for a number of years. The company estimates that it holds 80% of the market for touchscreen interfaces in black-and-white eReaders. This all might change in 2013 as major companies are abandoning the Neonode technology and instead going with Capacitive Multi-Touch.

If you ever had a Kobo Touch, Kindle Touch, or Barnes and Noble Simple Touch Reader, you have experienced Neonode technology. There are small infrared areas built around the side of the bezel that allow for finer pin-point accuracy when interacting with the touchscreen.

The biggest customer Neonode has was Amazon, which accounted for 50% of the company's entire revenue in the last two quarters, and 40% in 2011. Barnes and Noble was the second largest customer with 26% of licensing, followed by Sony at 21%, and Kobo with 11%. This amounted to a grand total of $5.8 million dollars in all of 2011. At a recent earnings call, the CEO of Neonode confirmed that Amazon was no longer a customer. This is mainly attributed to the discontinuation of the Kindle Touch.

The Kobo Glo and Amazon Kindle Paper white are abandoning the zForce technology and instead going with capacitive multi-touch. This is indicative to the higher-end nature of the products and customers are willing to pay a premium to enjoy an eReader that lets you read in the dark. Barnes and Noble, Kobo, and Amazon are all are pumping out a myriad of tablets that no longer employ this technology.

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With so many of the major companies not using Neonode's technology, what will happen to the company? It is still being paid licensing fees continuously from all the big name companies, mainly through the patents Neonode holds on touchscreen technology. Apple recently inquired about a possible purchase of the company to help in its growing patent disputes across the globe.

It really comes down to most major eReader companies evolving past super cheap devices and competing with better hardware and core features. The entire glowing screen syndrome is reverberating throughout the industry and many of the top players have already produced solid eReaders that use it. Even the smaller companies are getting into the game, such as Onyx Boox and Pocketbook.

As much as hardware is evolving, there is still a strong market for budget eReaders. The Barnes and Noble Nook Simple Touch, Kobo Mini, and Sony PRS-T2 are still being produced. They are not being made in super high volumes right now, because most people are gravitating towards tablets like the iPad or Kindle Fire.

Things aren't all doom and gloom for Neonode. The company was just awarded with the "Best Optics and Photonics Company of the Year 2012″ by renowned organization PhotonicSweden. Neonode was awarded for its contribution to the touch industry due to its technology innovation, successful economic ventures, and excellent growth and profitability.

It is safe to say that when you lose your biggest customer and your existing base is not mass producing digital readers anymore, something needs to happen. Neonode is in the late stages of expanding from its core business and diversifying into mobile phones, tablets, office equipment, in-car infotainment displays, GPS, gaming devices, and toys. The majority of those products are intended to be launched during 2013 and onwards. With around five million in liquid capital currently, Neonode does have the cash to fund various new ventures.

V. EXISTING SYSTEM

N1m

- Launched: Q1 2005
- Operating system: Windows CE 5.0 and 4.2
- Display: 176 × 220 Pixels (Width × Height), 16-bit Colour TFT
- Audio: Stereo 48 kHz playback
- Memory storage: SD card up to 2 GB
- Connectivity: GSM Triband: GSM900, GSM1800, GSM1900 MHz), USB 1.1
- Size: 88 × 52 × 21 (H × W × D)
- Weight: 94g
- Imaging: Megapixel Camera (1024x1024), Imageviewer, Videoplayer (MPEG 1, MPEG 4, WMV)

Technology:

zForce: The technology is based on light fields. As the light is interrupted by fingers or objects, the system notes the position. Other objects than fingers are therefore possible to use, since the screen responds to any type of material.´

NN1001: On 03Jan12, Neonode announced a new optical touch controller NN1001, developed in cooperation with TI, that tracks any high-speed multi-touch gesture with any object (finger, gloved finger and passive pen). NN1001 connects to any microcontroller or application processor with a high-speed SPI interface.

VI. PROPOSED SYSTEM

Former products:

Neno Neno was Neonodes custom graphical user interface (GUI) controlling the Microsoft Windows CE operating system. Neonode devices ran Neno from a removable Secure Digital card.

N2

- Operating system: Windows CE 6.0 Pro
- Display: 176 × 220 Pixels (Width × Height), 16-bit Colour TFT
- Audio: Stereo 48 kHz playback
- Memory Storage: miniSD / miniSDHC
- Connectivity: GSM Quadband
  GSM850,GSM900,GSM1800, GSM1900 MHz, Bluetooth, GPRS
- Size: 47×77×14,7 mm (W×H×T)

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- Weight: Approximately 60g
- Imaging: 2 Megapixel Fixed Focus Camera, Still pictures, Video play-back (MPEG, WMV), Video Recording (MPEG-4) (not yet, but planned in further updates)
- Messaging: SMS, Support for long SMS, MMS, Predictive text input, T9 (English, Swedish, German, Dutch, Spanish, Norwegian, French and Greek), Call history (dialed, received and missed calls)
- Audio: Audio player (MP3, WAV, WMA), stereo 48 kHz playback, Custom ring tones (MP3, WAV, WMA), Alarm application
- Entertainment: Windows Media Player, Internet Explorer (web browser), 2 integrated games.
- Third-party software.
- Software development environment.
- Messaging: Short message service, Support for long SMS, Multimedia Messaging Service, Predictive text input, T9 (English, Swedish, German, Spanish, French and Russian), Call history (dialed, received and missed calls)
- Audio: Audio player (MP3, WAV, WMA), stereo 48 kHz playback, Custom ring tones (MP3, WAV, WMA), Alarm application
- Entertainment: Windows Media Player, Internet Explorer (web browser), Games, third-party software downloadable
- Organiser: Calendar, Tasks, Phonebook with storage capacity of 1000 contacts, Add an individual picture for each contact, Synchronize with your PC using ActiveSync (requires extra software free of charge from Microsoft)
- Miscellaneous: Large touch-screen, On-screen keyboard, Screen saver, Vibrator, Calculator, Updates available at the Neonode website, USB memory functionality, use N1 as portable storage device. A generic positive gesture (slide left to right) and negative gesture (slide right to left) were used consistently through the interface to unlock, go back to home screen, etc.

VII. WELL POSITIONED AND PROTECTED

- Neonode is prepared for long-term growth through multi-year technology license agreements with several global consumer electronics companies with additional new contracts having been signed already in 2011 to complement a host of previous agreements. The latest design win, which is quantified by projected annual sales of at least one million units, with a major mobile phone manufacturer will integrate the Neonode zForce ® optical touch screen solution into Android based mobile phones. Although this does not carry any guarantee of mass production, it is a critical step in in the regimented process towards large-scale manufacturing contracts. This “design win” comes on the heels of a “contract win” with a global retail electronics company to incorporate Neonode’s touch screen solution into its family of products and carries with it the potential to be the largest technology license agreement that Neonode has signed to date. As customary, the names of these industry leaders have not yet been released for product secrecy reasons.
- A key component in the highly-competitive world of technology is patent-protection of intellectual property. Neonode has secured the safety of another of their technology’s future through the issuance by the US Patent Office of a patent 7,880,732 for disambiguating a finger touch that covers more than one character on a virtual keyboard, using a light-based touch for small and medium sized screens. The patent, which is vital to the Company’s touch screen technology, is the fifth awarded to Neonode, with an additional 17 patents pending worldwide.

VIII. NEONODE’S ZFORCE ALWAYSON (TM) TECHNOLOGY

Neonode’s patented touch screen technology, zForce(R), supports high-resolution pen writing in combination with finger navigation including gestures, multi-touch, sweeps and much more. Unlike resistive and capacitive touch screens, the company’s technology has no overlay on top of the display window and provides a 100% clear viewing experience that is free from reflection.

zForce(R) is also many times more cost-effective than any other high-performance touch solution in the market today, and the only viable solution that will operate on the popular reflective display panels that offer a paper-like reading experience in almost any ambient lighting conditions, while greatly reducing power consumption.

Reflective Screens Soar in Popularity:

Reflective liquid crystal displays (LCDs) have soared in popularity – particularly in the e-book marketplace – because they operate without the use of a backlight. By relying on ambient light to power the screens, the reflective displays have 60% less power consumption, while some also offer the ability to switch to a backlit display when needed.

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According to the VDC Research Group, the market for touch screens has been growing at a 10%+ compounded annual growth rate. Meanwhile, the new reflective touch screens represent one of the fastest growing segments, given the relatively few number of touch screen providers addressing the market and the enormous demand for a paper-like reading experience

Summary

Reflective touch screen solutions are rapidly growing as more consumers demand a paper-like reading experience and greater battery life. Neonode's zForce(R) represents one of the only touch screen solutions on the market that can incorporate this new technology, while offering both high-performance and low-cost to OEM manufacturers.

As a result, Neonode (OTC-BB: NEON) is one stock that technology investors may want to take a closer look at moving forward.

Benefits

- 100% light transmission(not an overlay)
- Long service life
- Can be scaled to any size without losing resolution
- High chemical, scratch, breakage, and liquid resistance
- Touch can be activated by anything including finger, gloved hand, or stylus.

IX. RESULT AND DISCUSSIONS

New Technology for Your Touchscreen:

Neonode is a developer of infrared, multi-sensing interfaces that make handheld, consumer, and industrial electronic devices touch sensitive. The Company's touch technology platform is branded zForce®, upon which Neonode has developed a variety of features that sense any object—its size, its pressure on a surface, its depth, its velocity, and even its proximity to the surface. This feature set is called Neonode MultiSensing® touch technology, which represents a newer alternative to standard capacitive touch solutions (such as is used on the iPad®). To date, the Neonode MultiSensing® solution has been used on more than 10 million touch-enabled consumer devices worldwide, including in a Kindle Touch eReader from Amazon.com, Inc., the Nook eReader from Barnes & Noble, Inc., eReaders from Sony Corp., Kobo Inc., and several other manufacturers, and in the MEEP! tablet from Oregon Scientific Inc. The technology has also been licensed for a variety of other consumer electronics and automotive solutions, including to Alpine Electronics, Inc., BYD Co. Ltd., and One Laptop per Child, among other companies in the tablet PC, mobile phone, office equipment, and automotive sectors.

No Screen? No Problem!

The zForce® technology is display agnostic, indicating that it can be added to a variety of surfaces, including liquid-crystal display (LCD), electronic ink (e-ink), organic light-emitting diode (OLED), and electronic paper display (EPD). Accordingly, Neonode's addressable market is considerable, comprising today's touchscreen products as well as any product that may in the future be made touch sensitive. A visual display is not required; thus, zForce® is applicable to touchpads, keypads, door locks, appliances, industrial goods, and other items in addition to handheld consumer electronics.

NEONODE'S "TOUCH ANYTHING" DEMO AT CES 2013

Technology Licensing:

Neonode operates via a technology licensing model where revenues are primarily generated through non-exclusive, royalty-based licenses to original equipment manufacturers (OEMs), original design manufacturers (ODMs), and component suppliers. In addition, the Company may offer engineering design services to its

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customers as well. For the first quarter 2013, Neonode reported net revenue from licenses and engineering design fees of $0.5 million, a considerable decline from the Company's performance last year—when Neonode reported revenues of $1.2 million for the first quarter 2012.

Despite the Company's recent decrease in revenue, Neonode appears to have been hard at work opening up future opportunities. As reported in the Company's Form 10-Q filed on May 8th with the SEC, Neonode has signed 29 technology license agreements with global OEMs, including for many industries beyond the eReader sector. Of note, Neonode expects its customers to ramp-up production and sales of tablets, printers, and handsets in the second half of 2013, and some of the Company's newest technology licenses signed in the first quarter 2013 are with major automotive brands. Subsequent to the quarter's end, Neonode also signed an agreement to incorporate its MultiSensing® technology into certain ATM machines, and the Company believes that some of its key recent agreements in the PC space can lead to touch innovations for Windows® notebook PCs in the near future.

Future Technologies Are Driven by Today's Product R&D:

As Neonode seeks to open up additional sources of technology licensing revenue going forward, the Company has drastically increased its investments in research and development (R&D). Neonode reported product R&D for the first quarter 2013 of $1.6 million, up 138% over the first quarter 2012, when product R&D was only $0.7 million. Likewise, the Company has continued its commitment to patenting its innovations, and has received three new patents in 2013. Neonode now holds 12 patents and 72 pending patent applications. For the first quarter 2013, Neonode reported a net loss of $3.6 million, or ($0.11) per share, versus a net loss of $1.6 million, or ($0.05) per share, for the comparable quarter last year.

X. CONCLUSION

Neonode could be a solid stock for technology growth investors. The firm's unique technology, solid business model, near-term revenues and long-term contracts make it worth a second look.

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Authors Bibliography

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