A Review on Pico Projectors

Ritu[1],
Assistant Professor
Computer Science and Engineering
[1]MCA,
Department of Computer Science and Engineering,
GITAM Kablana, MDU Rohtak.

Mr. Joni[2],
[2]Department of Computer Science and Engineering,
GITAM Kablana, MDU Rohtak.

Ms. Renuka[3]
[3]Department of Computer Science and Engineering,
GITAM Kablana, MDU Rohtak

Abstract: **From cell phones to iPods to PDAs, we have at our fingertips connectivity with friends and colleagues around the world, libraries of text, music, photos, videos and more. Unfortunately, the displays that we use to view all this information are also small they are flat-panel screens with just a few square inches of display area. No wonder that projectors that display large images from within hand-held electronic devices-Pico projectors are drawing so much attention in the tech world. It is a response to the emergence/development of compact portable devices such as mobile phones, personal digital assistants, and digital cameras, which have sufficient storage capacity to handle presentation materials but little space to accommodate an attached display screen. Handheld projectors involve miniaturized hardware and software that can project digital images onto any nearby viewing surface**.

***Index Terms*—projectors, finger, mobile, remote &portable devices.**

I. INTRODUCTION

What is a pico projector?

A Pico projector (also known as a mobile projector, pocket projector, handheld projector or mini beamer) is technology that uses an image projector in a handheld device. It is a response to the emergence/development of compact portable devices such as mobile phones, personal digital assistants, and digital cameras which have sufficient storage capacity to handle presentation materials but little space to accommodate an attached display screen. Handheld projectors involve miniaturized hardware and software that can project digital images onto any nearby viewing surface. Pico projectors are small battery powered projectors - as small as a mobile phone - or even smaller: these projectors can even be embedded inside phones or digital cameras.

A Philips pico-projector

Pico-projectors are small but they can make large displays (sometimes up to 100"). While great for mobility and content sharing, pico-projectors offer low brightness and resolution compared to larger projectors. It is a new innovation, but pico-projectors are already selling at a rate of about a million units a year (in 2010) and the market is expected to continue growing quickly.

2. History

Major advances in imaging technology have allowed the introduction of hand-held (pico) type video projectors. The concept was also introduced by Explay in 2003 to various consumer electronics players. Their solution was publicly announced through their relationship with Kopin in January 2005.[1] Insight Media market research has divided the leading players in this application into various categories:[2]

- Micro-display makers (e.g., TI's DLP, Himax, Micron Display tech and Syndiant L CoS, Maradin, Microvision, Lemoptix and b Tendo MEMS scanners)
- Light source makers (e.g., Philips Lumileds, Osram, Cree LEDs and Corning, Nichia, Mitsubishi Lasers
- Module makers (e.g., Jabil/Sypro Digital Light Processing (DLP) with LED, 3MLiquid crystal on silicon (LCoS) with LED, Explay L CoS with laser, AAXA Technologies with LCoS engine)

Manufacturers have given handheld projectors exhibiting high-resolution, good brightness and low energy consumption in a slightly larger format than pico. However, most handheld LED projectors, as of December 2014, have been widely criticized for having insufficient brightness for everyday use in a normally lit room. In 2011, Texas Instruments DLP made improved chip sets that show brighter images and LED advances were such that pico projectors using that technology were also increasing in brightness. The DLP chip sets are designed to enhance image brightness without increasing power usage for both WVGA (native DVD resolution) devices, such as mobile phones and VGA devices such as digital cameras and camcorders. The chip sets have the ability to project an image up to 50 inches (1,300 mm) (1270 mm) on any surface in optimum lighting conditions. The tiny projection chip requires very little space and is virtually

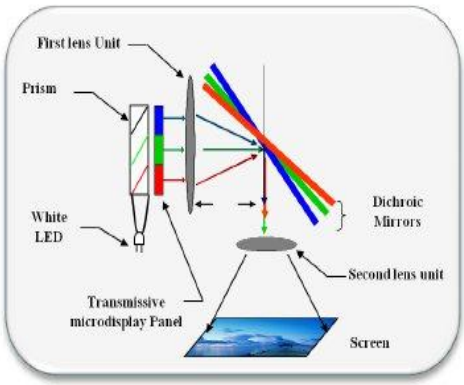
undetected in a device's overall form factor. With advancements in size and performance, the TI DLP Pico chipset supplies big picture experiences with contemporary handsets.

In 2014 Texas Instruments DLP's imagers occupy a significant portion of the handheld projector market share. In combination with Osram's Ostar series LEDs optical engines based on DLP technology have achieved over 15 lumens per watt for high brightness applications (300-500 lumens with 0.45" imager) and over 20 lumens per watt in low brightness applications (10-50 lumens with 0.2" or 0.3" imagers).

3. TECHNOLOGIES

Three major imager technologies for micro projectors are currentlycompeting for market share:

- Texas Instruments'Digital Light Processing (DLP)
- Micro Vision, Inc.'s laser beam-steering (LBS)
- LCoS (Liquid crystal on silicon) manufacturers including Syndiant, Himax, Micron Technologies and Omni vision can usually supply companies with both LED and laser solutions.
- Most micro projectors employ one of these imagers, combined with color-sequential (RGB) LEDs in either a single or triple architecture format. Manufacturers that have adopted this technology include Digislide, Optoma's PK201 / PK301 (DLP), 3M's MPro 160 / 180 (LCoS), Aiptek's V50 (DLP), AAXA's M2 (LCoS), Bonitor MP302 (LCos), Micron's PoP Video (LCoS), and Vivitek's High Definition Qumi (DLP). Some older models incorporated a single LCoS imager chip with single white LED which is recognized to offer lower cost, high resolution, and fast response at the expense of color quality. Other models such as the Dell M109S employed a color wheel plus white LED technology which improves color quality but generally requires a larger form factor. Other micro projectors such employ RGB laser technology such as Micro vision's beam-steering plus laser technology and AAXA's laser plus LCOS technology.



The advantages and disadvantages of each technology vary. For example, while DLP typically has slightly lower resolution than their LCoS counterparts due to the tiny mirrors used in DLP technology, 3-LED DLP projectors are generally regarded as having a higher contrast, better efficiency and lower power consumption as opposed color-sequential LCoS units and better color quality than white LED LCoS units. Laser scanning projectors such as Micro vision'sShowX and AAXA's L1 offer very good color gamut and low power consumption due to the use of lasers as the light source and also present an image that is always in focus. However, high speckle noise along with thermal instability in the image remains a major challenge, primarily due to the pumped green laser. The new "Direct Green Laser" (DGL) technologies that replace the "pumped green laser" in next generation Laser scanning projectors, in combination with improved hardware optics, MEMS Mirror designs and other operational methods are being deployed or are under development. Speckle noise should be reduced significantly, plus greatly improve thermal issues and reduce power consumption even further.

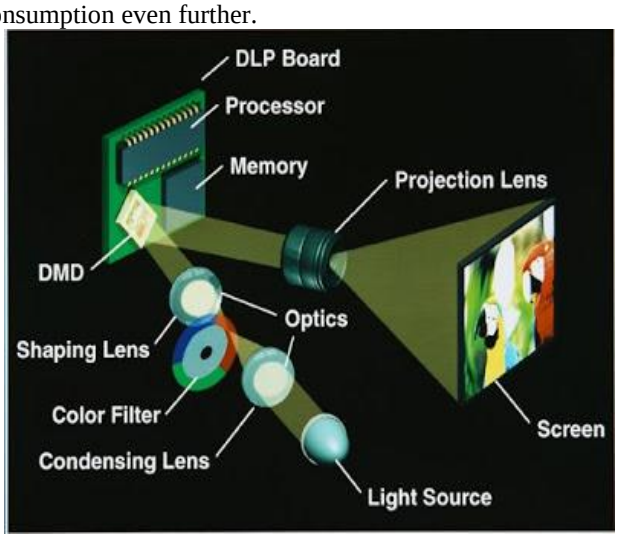


Figure.3

4. APPLICATIONS

Handheld projectors can be used for different applications from small conventional projectors. Since 2008[4] researchers are studying applications that are specifically designed for handheld projectors often using prototypes of mobile phones with an integrated projector.

4.1 Mobile

Recent mobile phones have the ability to store thousands of photos and can be used to take photos with resolutions up to several megapixels. Viewing the photos is restricted by the phones' small displays. Projector phones allow photographs to be shared with a larger audience.[5] One study found that people preferred to view and share photos with projector phones, compared to using conventional mobile phones.[6]

Figure.4

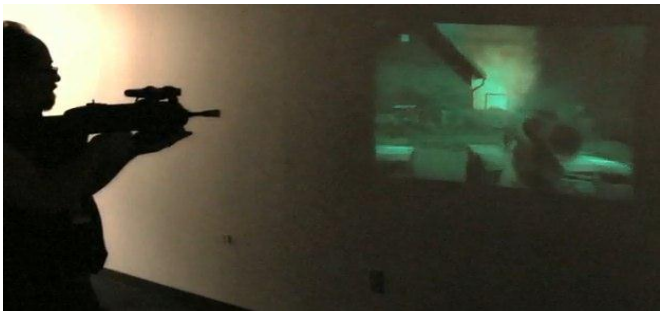


Figure.5

4.2 Gaming

Handheld projectors, in particular projector phones, could offer new possibilities for mobile gaming, as demonstrated by the adaptation of the PlayStation 3 game LittleBigPlanet.

Players can sketch a world on a sheet of paper or use an existing physical configuration of objects and let the physics engine simulate physical procedures in this world to achieve game goals.[7]

4.3 Hand gesture recognition

Size reduction of mobile devices is often limited by the size of the used display. Apart from the display a complete phone can be, for example, integrated in a headset. It has been demonstrated that Pico projectors integrated in headsets could be used as interaction devices, *e.g.*, using additional hand and finger tracking.[8][9][10] The MIT Media Lab proposed a wearable gestural interface device named Sixth Sense. Chris Harrison developed a working system called Omni touch.[11] Finally, the Light Blue Optics Light Touch is yet another similar device.[12] Lisa Cowan from UCSD showed a proof of concept of gesture recognition using shadow-occluding of the projector, called Shadow Puppets.[13] A modified laser projector has been used to perform gesture recognition and finger tracking using laser-based active tracking techniques at the University of Tokyo (Smart Laser Scanner and Laser Sensing Display).

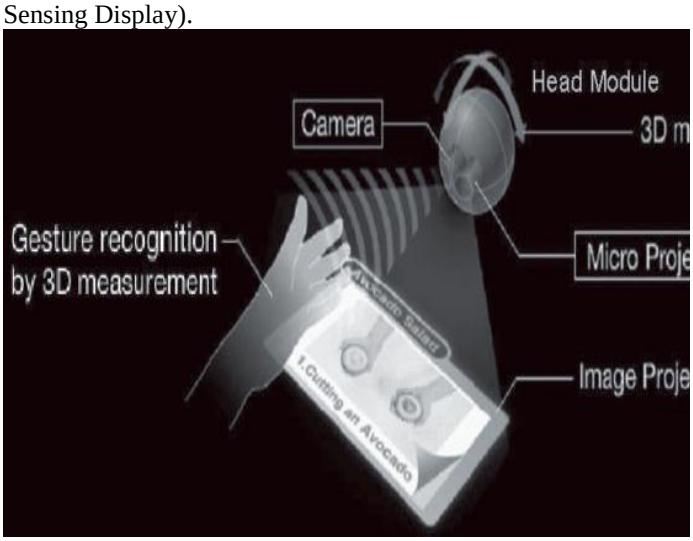


Figure.6

4.4 Pointer-based computer control

Combining a Pico projector with a webcam, a laser pointer, and image processing software enables full control of any computing system via the laser pointer. Pointer on/off actions, motion patterns (e.g., dwell, repetitive visit, circles, etc.) and more can all be mapped to events which generate standard mouse or keyboard events, or user-programmable actions.

2. Related Work

A. 2.1 How do Pico projectors work?

There are several companies developing and producing Pico projectors, and there are 3 major technologies: DLP, LCoS and Laser-Beam-Steering (LBS).

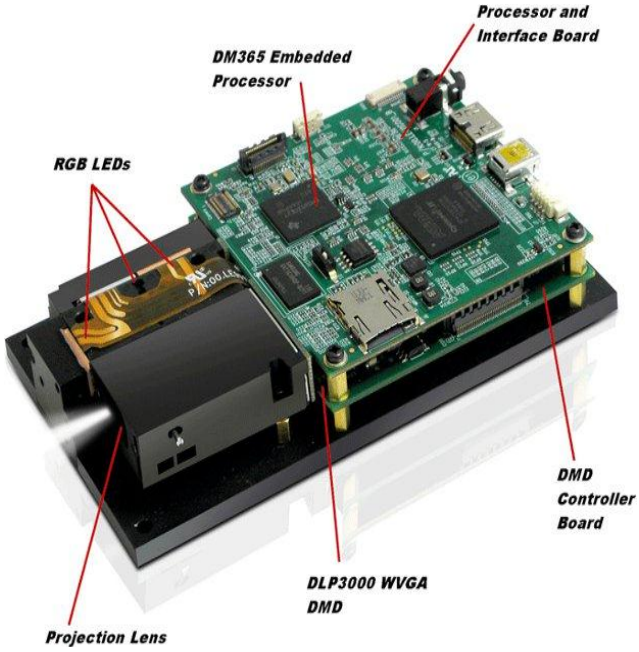


Figure.7

DLP and LCoS use a white light source, and some sort of filtering technique to create a different brightness and color on each pixel:

- DLP (Digital Light Processing) - pioneered by TI, the idea behind DLP is to use tiny mirrors on a chip that direct the light. Each mirror controls the amount of light each pixel on the target picture gets (the mirror has two states, on and off. It refreshes many times in a second - and if 50% of the times it is on, then the pixel appears at 50% the brightness). Color is achieved by a using a color wheel between the light source and the mirrors - this splits the light in red/green/blue, and each mirror controls all thee light beams for its designated pixel.
- LCoS (Liquid Crystal on Silicon): an LCoS projector uses a small liquid-crystal display (LCD) to control how much light each pixel gets. There are two basic designs to get color: Color-Filter (CF-LCoS) which uses 3 sub pixels, each with its own color (RGB) and a Field-Sequential-Color (FSC) which uses a faster LCD with a color filter - so you split the image for the 3 main colors (RGB) sequentially and you refresh the LCD 3 times (once for each color). The light source for the LCoS can be LED or diffused laser.

Figure.8Pico projector module

2.2 Laser-Beam-Steering (LBS) projectors are different, creating the image one pixel at a time, using a directed laser beam. You start with 3 different lasers (Red/Green/Blue), each at its required brightness, which are combined using optics, and guided using a mirror (or two mirrors in some designs). If you scan the image fast enough (usually at over 60Hz), you do not notice this pixel-by-pixel design.

Micro vision is currently the only company with commercialized LBS projectors, offering both standalone projectors (the Show WX Plus) and embeddable modules. There are several other companies developing their own LBS modules, and we expect them to be commercialized within a year or two. There are several theoretical advantages to LBS over DLP and LCoS:

- Focus free - the image is always focused, even on curved surfaces. A laser-based LCoS is also focus-free, by the way
- Low power consumption - especially since pixels that are darker require less energy, and a 'black' pixel requires no energy at all
- Small size

There are some disadvantages to lasers, though:

- Laser is expensive
- Speckle: a random intensity pattern produced by the mutual interference of a set of wave fronts. It basically means that there are shiny black dots visible all over the image, (it's mostly on static images, videos suffer much less). You can see the speckle dots with any laser-pointer as well.

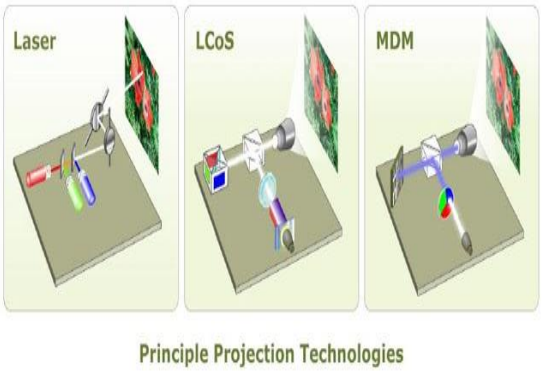


Figure.9

- Eye-safety concerns

Currently the major problem with laser projectors is the fact that there is no commercial 'direct' green laser, and so companies has to use the expensive, in-efficient and bulky frequency-doubled green laser. Direct green lasers are expected by 2011-2012 and these should help bring the price, size and power consumption down.

Another method to create a Pico-projector is called Holographic Laser Projection - in which a hologram is used to diffract a laser. This is explained here.

B. 2.3 Pico-Projector types

There are 4 basic types of Pico projectors:

- Stand-alone: these receive the input via a cable (A/V, USB, etc) and cannot display anything unless you use another device to stream the video signal.

Figure.10

- USB projector: standalone projectors that use USB for both power and data, and so require a laptop (or tablet). They are the smallest projectors as they do not include a battery.

Figure.11

- Media-player**:** projectors that include on-board memory (or a memory-card slot) and can play files directly from the memory (usually photos, videos and sometimes office documents too). This is really useful for some people, but file format support and lack of convenient controls sometimes make media player projectors less useful then they could have been.

Embedded projector**:** in this case the light-engine is embedded inside a mobile device such as a phone, camera, laptop, tablet or PDA.

2.4 What's on the market today?

There are many pico projectors already available - from companies such as 3M, Philips, Samsung, Optoma, AAXA and Aiptek - ranging in price from $99 to about $400, depending on features and brand. You can read our buyer's guide and use our tools to find the best projector for you

Figure.12

Embedded projectors are also starting to appear - projector-phones from Samsung, LG and others, projector cameras, camcorders and other devices.

CONCLUSION

If there's two things humans can't seem to resist doing with technology, is making everything bigger, in case of displays, mobile phone screens, storage options and much more; or smaller, in case of computer chips, devices and more. Pico projectors are a result of the second, and while not many would agree to their usefulness, in the near future we might just completely abandon full size projectors if pico projectors keep getting powerful. There might be a time when offices use only pico projectors, and movie projectors, instead of being huge and bulky, might just become big enough to fit in a suitcase. Just so you know, an IMAX projector can weight upto 2000 kg, and be over 6 feet tall and high! So for now pico projectors might be the unattended offshoot of projectors, but could quickly become the primary technology for broadcast if we have our way with miniaturizing technology!

REFERENCES

[1] Jump up ^"Kopin Team up with Explay to Develop Nano-Projector Engine". 2005-01-04.
[2] Jump up ^Brennesholtz 2008, p.84.
[3] Jump up ^ Freeman, Champion, Madhaven--Scanned Laser Pico-Projectors: Seeing the Big Picture (with a Small Device) http://www.microvision.com/wp-content/uploads/2014/07/OPN_Article.pdf
[4] Jump up ^ A. Hang, E. Rukzio, and A. Greaves "Projector Phone: A Study of Using Mobile Phones with Integrated Projector for Interaction with Maps" Proceedings of the Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI), 2008.
[5] Jump up ^ A. Greaves and E. Rukzio, "View & Share: A Collaborative Media Viewing and Sharing Framework using a Projector Phone", Proceedings of the Workshop on Mobile Interaction with the Real World (MIRW), 2008.
[6] Jump up ^ A. Greaves and E. Rukzio, "View & Share: Exploring Co-Present Viewing and Sharing of Pictures using Personal Projection" Proceedings of the Workshop on Mobile Interaction with the Real World (MIRW), 2009.
[7] Jump up ^ M. Löchtefeld, J. Schöning, M. Rohs, and A. Krüger, "Little Projected Planet: An Augmented Reality Game for Camera Projector Phones", Proceedings of the Workshop on Mobile Interaction with the Real World (MIRW), 2009.