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Electronic Perception Technology Applications in Food Service

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Electronic Perception Technology Applications in Food Service

Abstract
Electronic Perception Technology (EPT) enables automated equipment to gain artificial sight commonly referred to as "machine-vision" by employing specialty software and embedded sensors to create a "Visual" input field that can be used as a front-end application for transactional behavior. The authors review this new technology and present feasible future applications to the food service industry in enhancing guest services while providing a competitive advantage.

Keywords
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Electronic Perception Technology (EPT) enables automated equipment to gain artificial sight commonly referred to as "machine-vision" by employing specialty software and embedded sensors to create a "visual" input field that can be used as a front-end application for transactional behavior. The authors review this new technology and present feasible future applications to the food service industry in enhancing guest services while providing a competitive advantage.

Electronic Perception Technology (EPT) is an innovative technology that enables automated equipment to gain artificial sight commonly labeled "machine-vision." It provides electrical components and specialty devices with the ability to recognize and respond to nearby objects in real time. EPT employs application software and embedded sensors to create "visual" input and to enable transactional behavior (action/reaction). Until recently, the field of machine-vision was limited to such devices as auto-focus cameras, digital measuring equipment, and related devices. Now, the field has expanded to incorporate EPT projection phenomena.

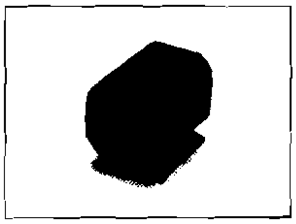
Unlike face recognition, an EPT sensor recognizes movement and gestures by interpreting the reflection of light projected against a flat object or surface. Basically, an EPT projector beams an image onto a flat surface (e.g., projection of a full-size typewriter keyboard onto a table top) and is capable of recognizing user interaction with the projected item (e.g., "typing" using the artificial keyboard to create distinguishable data entry). Current EPT applications have been limited to projection devices designed to extend the capabilities of cellular phones, personal digital assistants (PDA), interactive game boards, and a variety of industrial, medical, and security equipment.[1]

Canesta patents process

Canesta, Inc. patented a process that uniquely allows machines to recognize three-dimensional objects. EPT permits an array of products to perceive and react to objects in a restricted plane in real time through the medium of "sight." The process relies on low-cost, high-performance, embedded sensors and specialty software.[2] Unlike an Eigenface algorithm that maps the characteristics of a person's face into a multidimensional space (thereby creating a face print), EPT is also capable of recognizing actions and gestures.[3]

Although technological developments have continually produced a variety of sophisticated devices, until recently there has been little progress in providing devices with a vision or sight capability.[4] This lack of sight is often perceived as a major stumbling block to innovative progress and product advancement. The goal of EPT is to enable devices or applications of any complexity to be able to perceive objects and features in real time so that the identification of actions and reactions are practical and productive.

Figure 1
Canesta keyboard pattern projector

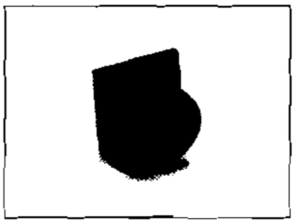


Courtesy of Canesta, Inc. (canesta.com)

Figure 2
Canesta keyboard IR light source

Courtesy of Canesta, Inc. (canesta.com)

Figure 3.
Canesta keyboard sensor module



Courtesy of Canesta, Inc. (canesta.com)

Components required

An EPT configured device consists of three required component parts: projector, infrared light source, and sensing system (http://www.canesta.com). The projector is used to propel an image (e.g., virtual keyboard) onto a flat surface. The image projector uses a holographic format to defract a single beam of laser light directly into the image/pattern being projected (see Figures 1, 2 and 3).

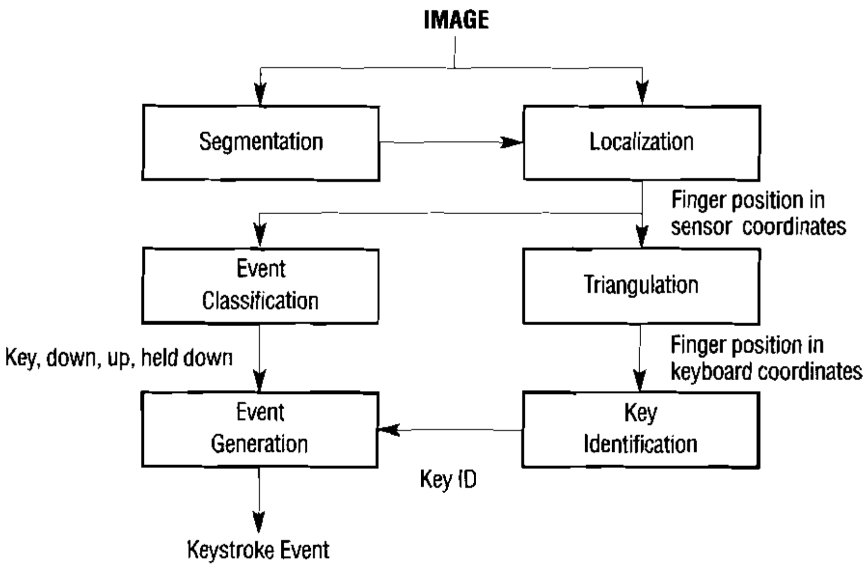
EPT applies an infrared light source to the illuminated object. Infrared is an invisible band of radiation at the lower end of the electromagnetic spectrum that starts at the middle of the microwave spectrum and approximates the beginning of visible light. Infrared transmission requires an unobstructed line of sight between transmitter and receiver. Infrared is used for wireless transmissions between computer devices as well as most remote control units for television sets and stereo equipment. In addition, an infrared band can also be used in a variety of security detection equipment.

In a virtual keyboard projection, for example, the user's typing activity occurs in the thin layer of space that separates the hovering object and the moving fingers of the user from the surface of the keyboard.[5] The infrared light source projects straight lines and the user's fingers become visible to the sensor as they intersect one or more of the projected lines. This intersection forms the basis of visible recognition.

Sensors read light

The light illuminating each individual pixel in an image sensor comes from a different feature in the image/pattern being viewed. An EPT sensor, housing an embedded complementary metal oxide semiconductor (CMOS) chip, is capable of reading reflected images of light emanating from objects. Since light moves at a constant speed and takes a measurable time to travel between points, it is possible for the CMOS chip to calculate the distance between those points. Knowing the amount of time light takes to reach each pixel makes it possible to calculate, with certainty, the exact distance to the object. In other words, it is possible to develop a three-dimensional "relief" map of the surfaces contained or created within the projected scene. In three dimensional space objects previously indis-

Figure 4
Flow diagram of the key stroke interpretation algorithm



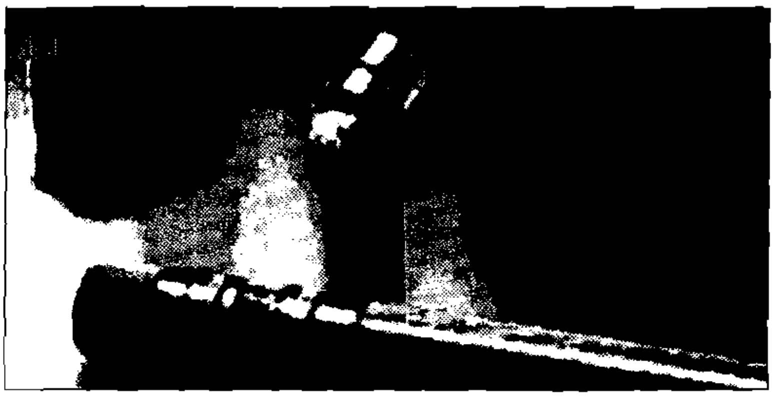
tinguishable from the background, for example, metaphorically "jump" out toward the viewer (http:www.canesta.com). Returning to the virtual keyboard example, the user's fingers can be identified and separated from the background objects in the image. This series of actions can lead to formulation of a key stroke algorithm (see Figure 4).

Localization determines the position and time of each keystroke. Event classification determines the type of action (i.e., taping, landing, moving, and takeoff). Triangulation transforms image points into keyboard positions as a table, then maps to the identity of the key associated with that position. Key identity and event type determine the appropriate keyboard event. For a broad class of applications, multidimensional mapping can be extremely helpful in reducing the mathematical and physical complexities that have prohibited successful computer vision development and application in earlier developments.

In a recently issued U.S. patent, Canesta was able to apply a new class of low-cost sensor chips to clock the travel time of light. The chips function in a manner similar to radar in that the distance to remote objects is calculated by measuring the time it takes an electronic burst of radio waves to make the round trip from transmitting antenna to reflective object. Similarly, the EPT Canesta sensor chip relies on a burst of unobtrusive light as a transmission media for round-trip monitoring (http://www.canesta.com).

The EPT chip, which is not susceptible to ambient light, measures the duration of the pulse to reflect back to each pixel via a high speed, on-chip, timer. Alternatively, the EPT chip can be calibrated to simply count the number of returning photons — an indirect measure of distance that can also be useful. From a technical perspective, onboard miniature components are used to perform these computations.

Figure 5
Size of EPT components



Courtesy of Canesta, Inc. (canesta.com)

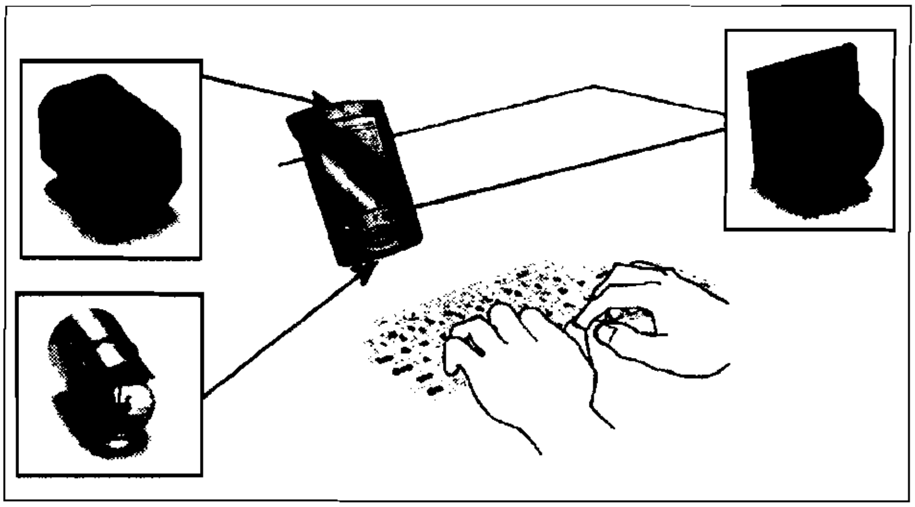
Data entry resolved

EPT may soon be used to solve several of the data entry challenges posed by tiny mobile and wireless devices (http://www.ananova.com). As electronic devices continue to become more miniaturized, data entry becomes problematic. To compensate for the small size of a data capture device, EPT can be used to provide a rich set of user input formats capable of recognizing pen/stylus movements, human gestures, and body movements (see Figure 5). Applying miniature components to traditional stand-alone devices, for example, enables the projection of a virtual keyboard from a standard PDA device to simplify data input (see Figure 6).

There are two EPT user input formats available: embedded (EPT-enabled) format and add-on (EPT-applied) format. An EPT embedded format involves the pre-installation of EPT components to a stand-alone appliance or device. There is no need for additional parts; the embedded components render the unit EPT-enabled (see Figure 7). Alternatively, a separate EPT peripheral can be attached to the body of an appliance or device as an add-on to form an EPT-applied unit (see Figure 8).

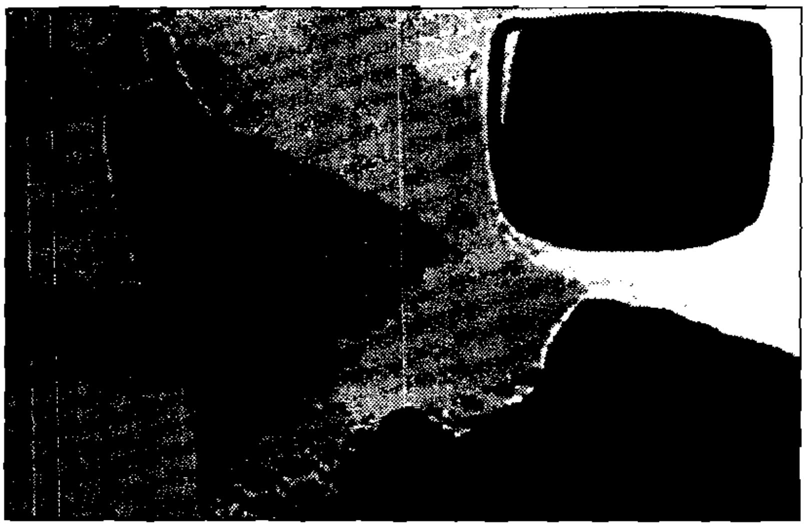
In an automobile, for example, EPT can be applied to locate and clarify blind spots as well as warn the driver to steer clear of dangerous objects in the approaching roadway (http://www.onstar.com). Since EPT is capable of recognizing movements and gestures, the driver can use hand gestures to control the car's radio, heater, cellular phone, or air conditioner thereby minimizing distractions while allowing the

Figure 6
EPT-enabled PDA illustration



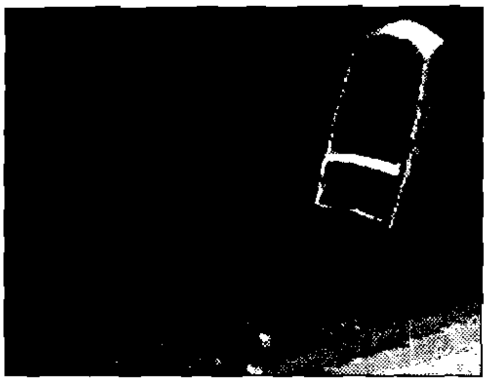
Courtesy of Canesta, Inc. (canesta.com)

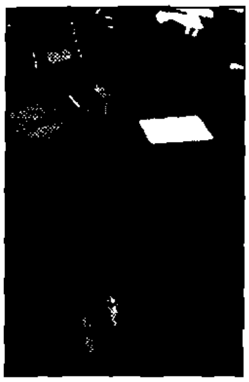
Figure 7
EPT-enabled mobile phone illustration



Courtesy of Canesta, Inc. (canesta.com)

Figure 8
EPT-enabled add-on peripherals





Courtesy of Canesta, Inc. (canesta.com)

driver to focus on external safety concerns.[6] EPT can be used to create a driver automobile assistance system (see Figure 9).

For security systems, replacing closed circuit television monitors with EPT technology can significantly increase a building's level of security. For example, to facilitate entry to a restricted area, authorized personnel may be identified through instant ID recognition. EPT sensors, trained to read facial appearance and expressions, can be used to match images with a media-friendly database, and to activate and verify authorization within a restricted entry location (see Figure 10).

Figure 9
EPT-enabled automobile assistance system

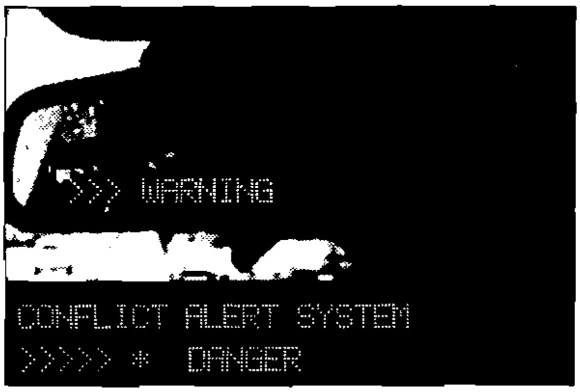
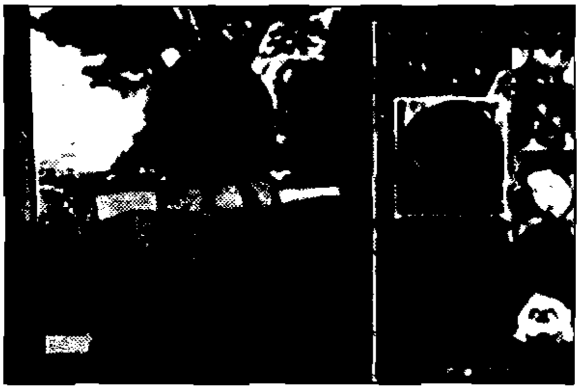


Figure 10
EPT-enabled security recognition system



By recognizing a wide array of movements, EPT devices are capable of detecting a variety of activities. This feature can be applied to health monitoring, inventory monitoring, hotel guest room monitoring, and so on (http://www.canesta.com).

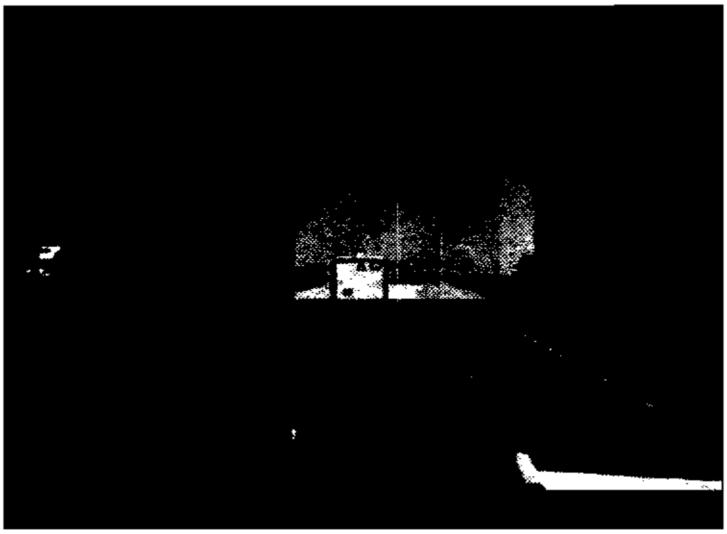
Just as an EPT projector can beam a virtual keyboard onto a flat surface, an EPT-enabled device can project a drink and snack menu onto the counter of a dining room table or bar counter to encourage customer self-order entry (see Figure 11). It will be easy to place a drink or food order, given the relative simplicity and limited offerings projected by the system. Once an order has been entered, the order can be transmitted from the EPT capture device to the restaurant's POS system for production and service. A confirmation message can be beamed back to the customer acknowledging receipt of order.

Figure 11
EPT-enabled bar counter projection

Similarly, consider the possibility of a road warrior driving down the road with a hungry passenger who may be able to place an order directly to a nearby restaurant through an installed EPT device. By using an EPT-enabled handheld PC, PDA, or cell phone inside the car, the eatery can be contacted for order placement, table reservation, or related action. Using the handheld device to connect to the Internet, for example, he can apply an EPT-enabled device to generate a menu image and project that image on the inside of the car's windshield. By touching or pressing the menu item icons projected, the EPT sensor can read and process customer actions and transmit that information to the restaurant POS system. Since the image can also be projected in proximity of the driver's view, the driver can safely keep one eye on the road while placing his/her own order (see Figure 12). The information can then be converted to an electronic signal and delivered through CDMA or WCDMA (Wideband Code Division Multiple Access) to the restaurant for processing. Probably the virtual menu projected onto a flat surface will be an abbreviated version of the restaurant's physical menu. It is a simplified version designed to ease food service ordering, similar to what might be contained in a kiosk order entry system.[7]

Similarly, passengers may be able to place a food service order while in transit aboard an airplane.

Figure 12
EPT-enabled Automobile Windshield Menu Projection



The inflight menu can be projected onto the passenger tray table and the order entry completed by touching menu item descriptors. The order can then be automatically communicated to a designated production station for inflight dining. By adding an EPT projector to the light panel above select seats, the airline company may gain a competitive advantage while enhancing operational efficiency. This process can improve service speed as passengers choose inflight meals from a projected menu rather than through flight attendant interaction (see Figure 13).

EPT is innovative

EPT is an innovative technological advancement capable of providing vision to projected virtual objects. In food service, for example, EPT projection might enable guests to self-order without having to rely on a physical, printed menu. By projecting a virtual menu, item selection can be rapidly relayed, processed, and served with greater efficiency. Self-entry orders can be available wherever an EPT-enabled device and projection surface are found. Devices need not be larger than a hand-held terminal, PDA, or cellular phone with a high-resolution display. In the not too distant future, in addition to in-house clientele, approaching drivers may be able to place an order from the road via EPT windshield projection. While the feasibility of a cellular phone call being placed from an automobile appeared to be impractical only a few years ago, mobile EPT services are likely to arrive sooner than expected. Hospitality firms would be wise to consider the myriad of possibilities of EPT applications in extending

Figure 13
EPT-enabled Flight cabin Illustration

guest services, improving productivity, and providing a competitive advantage.

References

[1] "Electronic perception technology," retrieved November 24, 2003, from http://www.canesta.com/technology.htm; www.poseidon-tech.com.

[2] P. Michelson and A. Johnson, "Background Information: Electronic Perception Technology," retrieved November 24, 2003, from http://www.roederj.com/RJDocs/CABG.html

[3] www.techweb.com

[4] www.canesta.com

[5] C. Tomasi, A. Rafii, and I. Torunoglu, "Full-size projection keyboard for handheld devices," *Communications of the ACM*, 46, no.7: 70 – 75.

[6] S. Klapper, R. Kyle, R. Nicklin, and A. Kormos, "Night Vision – changing the way we drive," Retrieved December 3, 2003, from http://www.raytheoninfrared.com/admin/file/SPIE4360-211finalauto.pdf

[7] N. Richardson "Kiosk: the new hot thing?" *Hospitality Technology*; electronic perception technology, retrieved November 24, 2003, from http://www.poseidon-tech.com/us/technology.html; electronic perception technology, retrieved November 24, 2003, from http://www.ananova.com/news/story/sm_548253.html; face recognition, retrieved December 3, 2003, from http://www.techweb.com/encyclopedia/defineterm?term=face+recognition; OnStar, retrieved December 3, 2003, from http://www.onstar.com/us_english/jsp/index.js; bar counter image retrieved December 3, 2003, from http://www.michaelangelosrestaurant.com/Cocktail%20Bar.htm; car image retrieved December 3, 2003, from http://images.google.com/images?q=driving&hl=en&lr=&ie=UTF-8&oe=UTF-8&newwindow=1; flight image retrieved December 3, 2003, from http://www.flypiedmont.com/aac/HTML%20Data/B-757.htm.

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