THE FUTURE OF TOUCH

ShadowSense White Paper

ShadowSense Touch Detection

Baanto ShadowSense touch technology is an innovative and patented optical position sensing technology. Unlike other optical technologies that utilize cameras or imaging arrays, ShadowSense designs use high performance sensors operating in the analog domain to provide unprecedented performance, stability and accuracy. Featuring an efficient sensor architecture coupled with elegant position detection algorithms, ShadowSense designs overcome many of the challenges faced by traditional optical designs.

The best analogy for ShadowSense technology lies in the 6,000 year old sundial. The shadow cast by a sundial instantly and accurately responds to the position of a light source without the use of lenses, with an infinite depth of field and without the need for exposure control. ShadowSense technology exploits the same characteristics for touch applications, resulting in one of the highest performance, most robust optical sensing solutions available. The characteristics as they relate to touch are:

High Performance

- Sensors directly read the light intensity and operate at up to 10,000 frames per second without the need for integrating photons across literally millions of pixels

No Lens

- ShadowSense sensors can be configured with a field of view approaching 180°
  - Eliminates the requirement to place sensors only in the corners of a touch area
  - Provides additional perspective of objects in the touch field
  - Dramatically improves touch stability by eliminating ghost points from position determination
- Totally avoids processing optical aberrations that require substantial computational correction

No Exposure Control

- Sensor performance is constant regardless of illumination changes due to the distance or velocity vector an object has with respect to different sensors

Infinite Depth of Field

- Position detection algorithms are unrelated to the position of an object in a sensors field of view

ShadowSense touch is a bezel based technology which decouples the touch detection from the protective glass used to cover the TFT surface. This approach eliminates the coatings, films and glass dependencies characteristic of the conventional overlay technologies such as resistive, surface acoustic wave (SAW), surface capacitive and projected capacitive. The result is improved optical performance, durability, reliability and environmental stability.

Optical Performance

- Transmissivity of up to 96% compared to resistive (75% to 80%), SAW (90%) and capacitive (90%)
- Hardened glass minimizes casual scratches and image clouding due to normal use

Durability

- No depositions or films which reduce or totally compromise touch detection when scratched or damaged
- Millions of touches, slides and gestures possible without any degradation of performance

Reliability

- ShadowSense products are designed to meet stringent IP65 ratings for dust and fluid intrusion

Environmental Stability

- High reliability designs and manufacturing techniques result in outstanding shock, vibration and humidity specifications, eliminating the need for field calibration and repair

A typical configuration of a ShadowSense touchscreen utilizes four (4) sensors on the top bar; one in each corner and two mid-span. For illumination, 940 nm IR LEDs are deployed on both sides and the bottom of the frame. This is shown in *Figure 1* below.

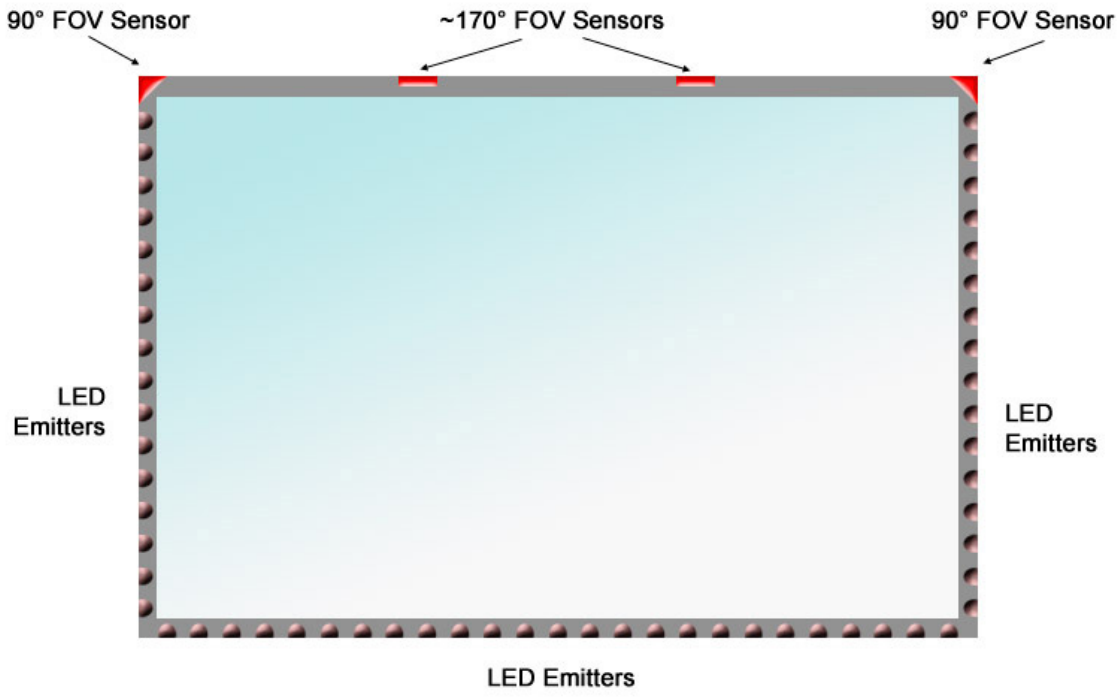

Figure 1: ShadowSense architecture

ShadowSense Touch Detection

ShadowSense touch is based upon the precise and accurate detection of an object's shadow as it enters, hovers within, or transitions out of a sensor's field of view. The object's position in the touch plane is then calculated based upon the ratio of a fully illuminated condition to the shadowed state for multiple light sources and multiple sensors. This is illustrated with the series of images in *Figure 2*.

Basing touch detection on the shadow of an object results in the touch screen detecting the position of almost any object entering the touch plane. This eliminates the need to use a specific object such as a bare finger or specialty pen to activate the screen and provides for "zero force" activation, improving the user experience.

The use of the ratio between fully illuminated, partially shadowed and fully shadowed events provides significant operational advantages. First, the design is tolerant of different LED power levels around the array, eliminating the need to source specific "binned" LEDs and thereby reducing the BOM cost. Secondly, since the algorithms utilize the ratio between readings, changes in total received power don't impact the position calculation. This characteristic results in better tolerance to environmental factors such as spillage, dust build up, or the natural aging of the LED structure over the years.

Lastly, ShadowSense detects and calculates not just the position of a touch object, but also its size and opacity. From enabling creative applications such as a paint program that uses real paint brushes to improving the touchscreen performance in challenging outdoor environments, these capabilities provide unique extensions to the traditional touchscreen application.

The results of this innovation are products featuring some of the highest performance, most robust, multi-touch capabilities available in the market today.

For more information about ShadowSense, please contact a member of our sales team at **sales@baanto.com**.

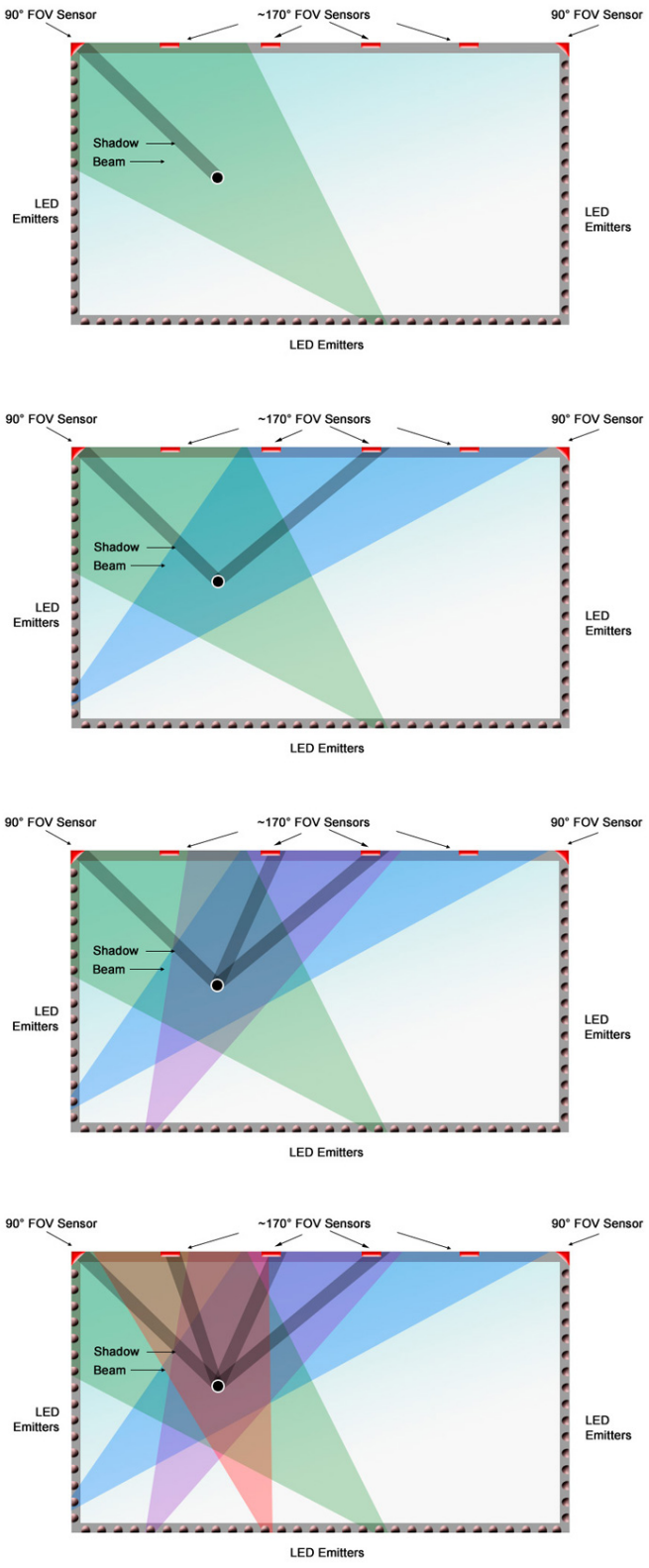

Figure 2: Determining the position of an object