example, the touch screen system **100** may be positioned and/or secured in front of the display device **190**, so that a user can view and interact with the visual output of the display device **190** through the touch screen **110**.

[0025] Thus, the touch screen system **100** may have overlay or retrofit applications for existing display devices **190**. However, it should be understood that other applications of the exemplary touch screen system **100** are contemplated by the present invention. For example, the touch screen system **100** may be applied as an integrated component of a display device **190** and may, in that regard, also function as a display screen for the display device **190**. The exemplary touch screen system **100** may be used in conjunction with display devices **190** of all sizes and dimensions, including but not limited to the display screens of small handheld devices, such as mobile phones, personal digital assistants (PDA), pagers, etc.

[0026] At least a portion of the touch screen **110** is typically transparent and/or translucent, so that images or other objects can be viewed through the touch screen **110** and light and/or other forms of energy can be transmitted within or through the touch screen **110** (e.g., by reflection or refraction). For example, the touch screen **110** may be constructed of a plastic or thermoplastic material (e.g., acrylic, Plexiglass, polycarbonate, etc.) and/or a glass type of material. In certain embodiments, the touch screen may be polycarbonate or a glass material bonded to an acrylic material. The touch screen **110** may also be constructed of other materials, as will be apparent to those skilled in the art. The touch screen **110** may also be configured with a durable (e.g., scratch and/or shatter resistant) coating. The touch screen **110** may or may not include a frame or bezel, i.e., a casing or housing that surrounds the perimeter of the touch screen **110**.

[0027] The touch screen system **100** includes an energy source **120** that is configured to emit energy, for example, in the form of pulses, waves, beams, etc. (generally referred to herein as "energy beams" for simplicity). The energy source **120** is typically positioned within or adjacent (e.g., in proximity) to one or more edge of the touch screen **110**. The energy source **120** may emit one or more of various types of energy. For example, the energy source **120** may emit infrared (IR) energy. Alternately, the energy source **120** may emit visible light energy (e.g., at one or more frequencies or spectrums).

[0028] The energy source **120** may include one or more separate emission sources (emitters, generators, etc.) For example, the energy source **120** may include one or more infrared light emitting diodes (LEDs). As another example, the energy source **120** may include one or more microwave energy transmitters or one or more acoustic wave generators. The energy source **120** is positioned and configured such that it emits energy beams **140** across the surface of the touch screen **110**, so as to create an energized plane adjacent to the touch screen surface. For example, suitable reflective or refractive components (such as reflective tape, paint, metal or plastic, mirrors, prisms, etc.) may be used to form and position the energized plane.

[0029] Energy beams **150** that are reflected across the front surface **111** of the touch screen **110** are detected by detectors **130**, **131**. These detectors **130**, **131** may be configured to monitor and/or detect variations (changes, etc.) in the energy beams **150**. Depending upon the orientation of the energy source **120** and the detectors **130**, **131**, the energy beams **150** may either have a "back-lighting" or "fore-lighting" effect on a finger, stylus, or other object that touches the touch screen **110**. In a backlighting scenario, a touch on or near the front surface of the touch screen **110** may cause a level of interruption of the reflected energy beams **150** such that the touch location appears as a shadow or silhouette (i.e., absence of energy) when detected by the detectors **130**, **131**. In a fore-lighting scenario, energy reflected by the finger, stylus or other object will appear to the detectors **130**, **131** as an area of increased energy intensity.

[0030] In some embodiments, filtering may be employed by the detectors **130**, **131** and/or software in order to enhance the detection of energy beam intensity variations. However, the contrast of intensities between the energy beams **150** and surrounding noise may be sufficient to negate the need for filtering. Information signals generated by the detectors **130**, **131** may be processed by a video processing unit (e.g., a digital signal processor) and/or a computing device, as discussed below with reference to see FIG. **2**.

[0031] The detectors **130**, **131** may be positioned within or adjacent (e.g., in proximity) to the touch screen **110** such that they can monitor and or detect the energy beams **150** in the energized plane that is adjacent to the touch screen surface. Reflectors and/or prisms can be used, as or if needed, depending on the location of the detectors **130**, **131**, to allow the detectors **130**, **131** to detect the energy beams **150**. In the example shown in FIG. **1**, the detectors **130**, **131** are positioned within or along the bottom edge of the touch screen **110**, one in each corner. At least two spaced apart detectors are included in preferred embodiments, so that the location of a touch can be determined using triangulation techniques, as described below.

[0032] A detector **130**, **131** can be any device that is capable of detecting (e.g., imaging, monitoring, etc.) variations in the energy beams **150** reflected across the front surface of the touch screen **110**. For example, a suitable detector **130**, **131** may be one of various types of cameras, such as an area scan or line scan (e.g., digital) camera. Such an area scan or line scan camera may be based on complementary metal oxide semiconductor (CMOS) or charge coupled device (CCD) technologies, which are known in the art. Furthermore, monochrome (e.g., gray-scale) cameras may be sufficient because the detectors **130**, **131** do not need to acquire detailed color images.

[0033] While cameras generally are more expensive than other types of detector devices that can be used in touch screen systems **100**, such as photo-detectors (e.g., photodiodes or photo-transistors), they allow greater accuracy for touch detection. As known in the art, area scan or line scan cameras (particularly those with monochrome capability) are typically less expensive than cameras configured to acquire detailed images and/or that have color detection capability. Thus, relatively cost effective area scan or line scan cameras can provide the touch screen system **100** with accurate touch screen capability. However, it should be understood that other devices may be used to provide the functions of the detectors **130**, **131** in accordance with other embodiments of the invention.

[0034] Accordingly, the touch screen system **100** of the present invention is configured to detect a touch (e.g., by a finger, stylus, or other object) based on detected variations in energy beams **150** that form an energized plane adjacent to the touch screen surface. The energy beams **150** are monitored by the detectors **130**, **131**. The detectors **130**, **131** may be configured to detect variation (e.g., a decrease or increase)