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(71) Applicant(s): L&T TECHNOLOGY SERVICES LIMITED

(72) Inventor(s): PILLAI, SATHEESH
SIRIPRAGADA, SANTHOSH KUMAR
KUMAR, RAHUL
KHANUM, ZAIBA NOUSHEEN

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(54) Title: A METHOD AND SYSTEM FOR CHARACTER RECOGNITION FOR SEGMENTED DIGITAL DISPLAY

(57) Abstract: The invention relates to a method and system for identifying one or more characters displayed on a segmented digital display. The disclosed system and method aligns one or more optical sensors corresponding to each segment of one or more characters of the digital display. Segments of a displayed character are determined based on an interruption in a flow of incident light rays received by one or more optical sensors aligned to each of the segments wherein the incident tight rays are being emitted by one or more light sources. The one or more characters are identified after determining the segments of each character.

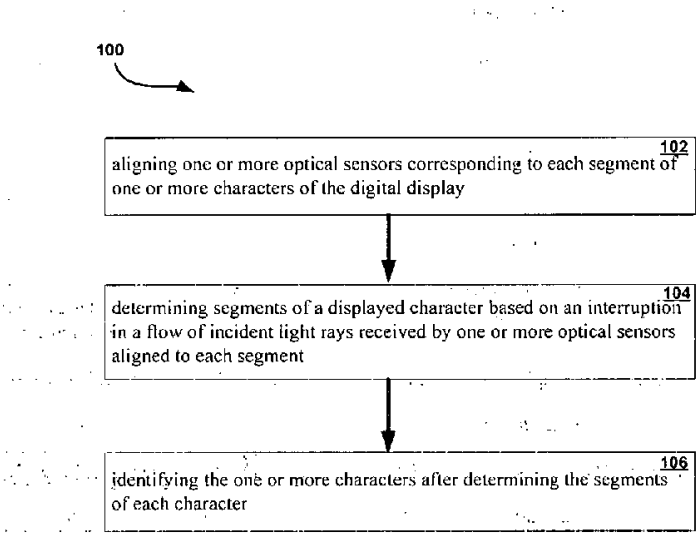
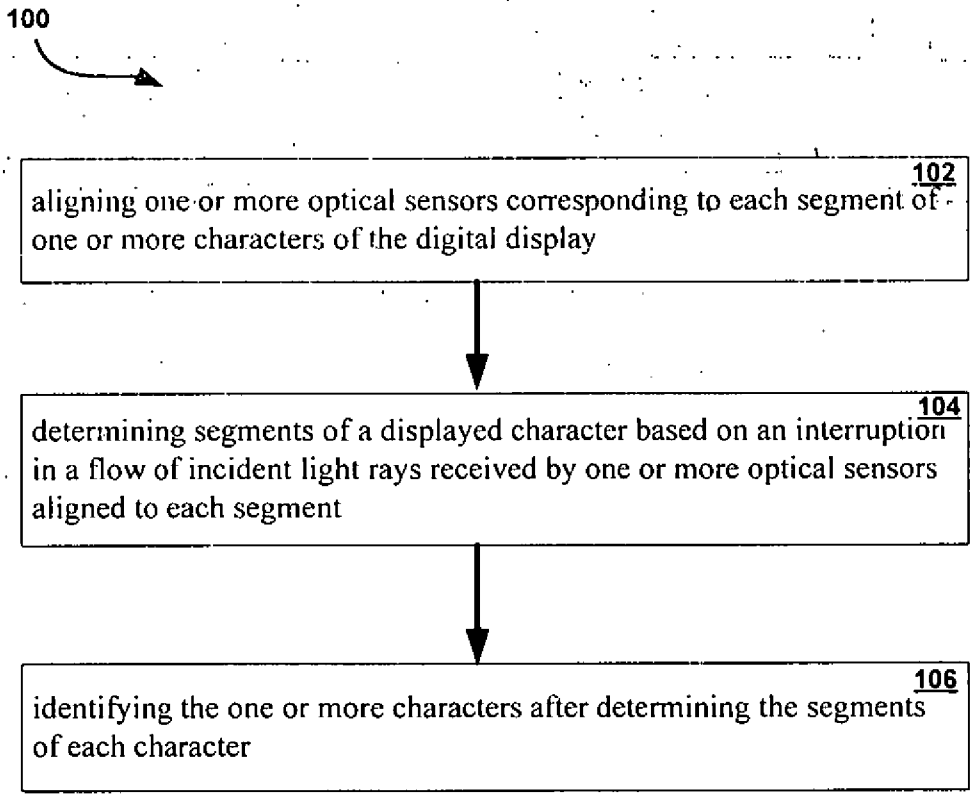


Figure 1

ABSTRACT

A Method and System for Character Recognition for Segmented Digital Display

The invention relates to a method and system for identifying one or more characters displayed on a segmented digital display. The disclosed system and method aligns one or more optical sensors corresponding to each segment of one or more characters of the digital display. Segments of a displayed character are determined based on an interruption in a flow of incident light rays received by one or more optical sensors aligned to each of the segments wherein the incident light rays are being emitted by one or more light sources. The one or more characters are identified after determining the segments of each character.



We Claim:

1. A method for identifying one or more characters displayed on a digital display, such that each character has at least one segment, the method comprising:

aligning one or more optical sensors corresponding to each segment of one or more characters of the digital display;

determining segments of a displayed character based on an interruption in a flow of incident light rays received by one or more optical sensors aligned to each of the segments wherein the incident light rays are being emitted by one or more light sources; and

identifying the one or more characters after determining the segments of each displayed character.

2. The method as claimed in claim 1, wherein the optical sensors are one or more visible light sensors or infrared sensors.

3. The method as claimed in claim 1, wherein the interruption in a flow of incident light rays depends on a state of the segment.

4. The method as claimed in claim 1, wherein the interruption in a flow of incident light rays indicates either absorption, obstruction, reflection, deflection or no change in the flow of incident light rays.

5. The method as claimed in claim 1, wherein the light sources are LCD backlight, one or more external light sources, one or more LED segments or one or more infrared transmitters.

6. The method as claimed in claim 1, wherein the one or more optical sensors corresponding to each segment of the digital display are mounted on a printed circuit board (PCB).

7. The method as claimed in claim 3, wherein the state of the segment depends on whether the segment is turned ON or an electric field is applied to the segment.

8. The method as claimed in claim 1, further comprising processing the identified one or more characters using a processor.

9. A system for identifying one or more characters displayed on a segmented digital display, the system comprising:

One or more light sources configured to transmit light rays;

One or more optical sensors configured to receive the incident light rays from the one or more light sources;

a processor to identify one or more characters after determining segments of displayed one or more characters wherein determining segments of each displayed character being based on an interruption in a flow of incident light rays received by the one or more optical sensors from the one or more light sources; and

a network module to transfer the identified one or more characters to a receiver.

10. The system as claimed in claim 10, wherein the receiver corresponds to a secondary display, computer, gateway, router, cloud server or repository.

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Mohammed Faisal (INPA No: 1941)
Head, IPR Dept.
L&T Technology Services Limited
DLF 3rd Block, 2nd Floor,
Manapakkam, Chennai, TN, 600089

FIELD OF INVENTION

The invention generally relates to system and methods for reading data from digital displays and more particularly to reading data from segmented digital displays.

BACKGROUND

In present trend of IoT, all the embedded devices in industry which includes industrial meters, sensors, actuators and display panels are connected to internet. Once the devices are connected over internet, data is available real-time from any point across the world. Most of the present day devices are powered with wireless technologies to interface and enable the IoTification. However, few of the legacy devices may be present without any possibility of wireless connectivity and may have digital displays for human interaction.

The legacy devices may have a segmented digital display for reading out the value. There remains a need for a reliable system and method for reading the character displayed in a non-intrusive way as an easily detachable retrofit, thereby ensuring non violation of safety, certification and compliance of the device.

Optical Character Recognition (OCR) has been used for reading out the value in digital displays of devices. OCR refers to the process of recognizing the text present in an image, i.e. converting the pixels of the image into the actual string of text appearing in the image. There has been considerable work done in OCR for text recognition in various applications. However, OCR involves use of camera and intensive image processing algorithms.

Hence, there is a need for a method of reading out the value in segmented digital displays that is cost effective and doesn't involve camera and complex image processing algorithms.

The present invention is directed to overcoming one or more of the problems as set forth above.

SUMMARY OF THE INVENTION

Exemplary embodiments of the invention disclose a method and system for identifying one or more characters displayed on a segmented digital display. According to an embodiment of the invention, a system and method for identifying one or more characters displayed on a digital display, such that each character has at least one segment is disclosed. According to an exemplary embodiment, the disclosed system and method aligns one or more optical sensors corresponding to each segment of one or more characters of the digital display. Segments of a displayed character are determined based on an interruption in a flow of incident light rays received by one or more optical sensors aligned to each of the segments wherein the incident light rays are being emitted by one or more light sources. The one or more characters are identified after determining the segments of each character.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 illustrates a block diagram of a process for identifying one or more characters displayed on a segmented digital display, according to an exemplary embodiment of the invention; and

Figure 2 illustrates an exemplary system for identifying one or more characters displayed on a segmented digital display, according to one embodiment of the invention.

DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

According to embodiments of the invention, a system and method for identifying one or more characters displayed on a segmented digital display is disclosed. According to an embodiment, the segmented digital display may have one or more display units. According to another embodiment, the display units may be non-directional and thus may be disposed vertically or horizontally.

FIG. 1 illustrates a block diagram of the process 100 for identifying one or more characters displayed on a segmented digital display, according to an embodiment of the invention. The

segmented digital display may comprise at least one display unit comprising segments that are arranged in such a way that segment, when selectively turned ON or turned OFF, displays characters. According to an embodiment, the character may be such as, but not limited to, numerical, digit, alphabet and symbol. According to another embodiment, a shape of the segment may be a dot, circle, square, rectangle, oblong, any polygon, funnel or custom shape. According to yet another embodiment, the alignment of the segments in the display may be regular, irregular, patterned, straight (parallel to edge of display) and tilted (angle made with the edge of display).

According to one embodiment, the segmented display may be a segmented LCD display such as, but not limited to, 7 segment, 8 segment, 13 segment or 14 segment LCD displays. According to another embodiment, the segmented display may be a segmented LED display such as, but not limited to, 7 segment, 8 segment LED displays. According to yet another embodiment, the segmented display may comprise a set of LEDs/LCDs used to display alpha numeric characters or symbols in segmented form. According to an embodiment, the LED display may show characters in primary colours such as Red, Blue and Green. According to another embodiment, the LED display may show characters in mixed colours that are falling in visible and IR wavelength region.

At step 102, one or more optical sensors are aligned corresponding to each segment of one or more characters of the digital display. According to an embodiment, the one or more optical sensors corresponding to each segment of the digital display may be mounted on a printed circuit board (PCB) or substrate in alignment with segments on the digital display. In one embodiment, the substrate may comprise a ceramic substrate, or a metallic lead frame. According to another embodiment, the optical sensors may be one or more visible light sensors

or one or more infrared sensors. According to yet another embodiment, the optical sensors may be one or more visible light transmitter & receiver pair, or one or more infrared transmitter and receiver pair. According to an embodiment, the visible light sensors may be such as, but not limited to, PIN diode or photo diode, Light Dependant Resistor (LDR), Photo Transistor and Light Activated Silicon Controlled Rectifier (LASCR). According to another embodiment, the IR sensors may be an infrared diode or receiver.

According to an embodiment, the one or more optical sensors may be configured to receive incident light rays emitted by one or more light sources. According to another embodiment, the light sources may be LCD backlight, ambient light, external backlight, one or more external light sources attached to display, one or more LED segments, or one or more infrared transmitters.

At step 104, segments of a displayed character is determined based on an interruption in a flow of incident light rays received by the one or more optical sensors aligned to each of the segments. The incident light rays may be emitted by the one or more light sources. According to an embodiment, the interruption in a flow of incident infrared rays may depend on a state of the segment to which the one or more optical sensors are attached. According to another embodiment, the state of the segment may depend on whether the segment is turned ON or an electric field is applied to the segment. According to yet another embodiment, the interruption in a flow of incident light rays may indicate either absorption, obstruction, reflection, deflection or no change in the flow of incident light rays.

According to an exemplary embodiment, when a segment on a LCD is turned off or no electric field is applied to the segment, segment may not have any impact on the optical characteristics

of the display as the molecules in the segment are disoriented, thereby allowing the incident rays to pass through and reflect back without any change in the optical characteristics of the display. According to another embodiment, if a segment is turned on or electric field is applied to the segment, the molecules in the segment get oriented to form a structure thereby absorbing or obstructing or reflecting or deflecting the flow of incident rays. Therefore, a clear indication may be that, when incident rays are received by the optical sensors, there is no electric field applied on the particular segment and vice versa. The character recognition may be achieved after determining all the segments of the character.

According to another exemplary embodiment, in segmented LED displays, when a LED segment is turned ON or when electric field is applied to the segment, the segment may act as a light source and emit light. When the segment is turned OFF or when no electric field is applied to the segment, the segment may not emit light and light rays may be received by receiver aligned to the segment. According to an embodiment, there may be one or more receivers aligned to each segment.

According to an embodiment, there may be a single light source for each segment. According to another embodiment, there may not be a light source for each segment. According to yet another embodiment, there may be a single light source for multiple segments of the segmented display.

At step 106, one or more characters are identified after determining the segments of each character. According to an embodiment, the identified characters are processed through a processor. According to another embodiment, the processor may be a microcontroller.

According to an embodiment, after determining the segments of each character, the one or more characters may be identified using a pattern matching algorithm.

FIG. 2 illustrates an exemplary system 200 for identifying one or more characters displayed on a segmented digital display, according to one embodiment of the present invention.

The disclosed system 200 may include a sensor module 202, a processor 204, a display device 206 and a network module 208.

The sensor module 202 may include one or more optical sensors attached to each segment of the segmented digital display. According to an embodiment, the one or more optical sensors may be mounted on a printed circuit board (PCB) or substrate in alignment with segments on the digital display. According to another embodiment, the one or more optical sensors may be mounted on a ceramic substrate or metallic lead frame or transparent material. According to yet another embodiment, the one or more optical sensors placed on the substrate may comprise a plurality of through holes configured to receive a plurality of electrically conductive pins. According to yet another embodiment, the electrically conductive pins from the substrate may be spherical, needle shape or electrode shape. According to another embodiment, the optical sensors may be one or more visible light sensors, or one or more infrared sensors. According to yet another embodiment, the optical sensors may be enclosed in a reflective chamber filled with epoxy or silicon to direct incident rays. According to an embodiment, the reflective chamber may create a contour that matches shape of segments in the display. According to embodiments of the invention, the optical sensors could be any component, which may generate electrical signal for applied optical stimuli. According to an embodiment of the invention, a shape of the optical sensors may be such as, but not limited to, a circle, square,

rectangle or any polygon. According to another embodiment, a location of the optical sensors on a segment may be anywhere in the segment. According to yet another embodiment of the invention, there may be a single or multiple optical sensors for each segment.

According to an exemplary embodiment, an infrared transmitter and receiver may be mounted on a printed circuit board (PCB) in proper alignment with segments on the segmented digital display. According to another embodiment, the infrared transmitter may be configured to transmit infrared rays onto the segmented digital display and the infrared receiver may be configured to receive the incident infrared rays from corresponding infrared transmitter.

The processor 204 may determine segments of each displayed character based on an interruption in a flow of incident light rays received by the one or more optical sensors aligned to each of the segments. According to an embodiment, the incident light rays may be emitted by one or more light sources. According to another embodiment, the interruption in a flow of incident light rays may depend on a state of the segment to which the one or more optical sensors are attached. According to another embodiment, the state of the segment may depend on whether the segment is turned ON or an electric field is applied to the segment. According to yet another embodiment; the interruption in a flow of incident infrared rays may indicate either absorption, obstruction, deflection or no change in the flow of incident infrared rays. The processor 204 may identify the one or more displayed characters after determining segments of displayed one or more characters.

According to an exemplary embodiment, the processor 204 may determine segments of each displayed character based on an interruption in a flow of incident infrared rays received by infrared receivers from the corresponding infrared transmitters attached to the segments of a

displayed character. According to an embodiment, the interruption in a flow of incident infrared rays may depend on a state of the segment to which the infrared transmitter and receiver are attached. According to another embodiment, the state of the segment may depend on whether the segment is turned ON or an electric field is applied to the segment. According to yet another embodiment, the interruption in a flow of incident infrared rays may indicate either absorption, obstruction, reflection, deflection or no change in the flow of incident infrared rays.

According to an embodiment, the identified one or more characters may be displayed on a display device 206. According to an embodiment, the processor 204 may display the one or more characters on a display device 206 such as but not limited to Cathode ray tube display (CRT), Light-emitting diode display (LED), Electroluminescent display (ELD), Plasma display panel (PDP) etc. According to another embodiment, the display may include a graphical user interface (GUI).

According to an embodiment, the processor 204 may be in communication with a network module 208. The network module may include a communication network. According to another embodiment, the read out data from the processor consisting of one or more characters may be transmitted through the communication network. According to an embodiment, the communication network may be a wired or wireless communication network. The wireless communication network may be such as, but not limited to, Zigbee, LoRa, Wi-Fi and Bluetooth.

According to an embodiment, the read out data may be sent to a receiver. According to an exemplary embodiment, the receiver may correspond to a secondary display, computer,

gateway or router. According to another embodiment, the read out data may be sent to cloud through the communication network for further processing. According to an exemplary embodiment, notifications related to read out data may be sent to users. According to yet another embodiment, the read out data may be sent through the communication network to a database or repository.

In the drawings and specification there has been set forth preferred embodiments of the invention, and although specific terms are employed, these are used in a generic and descriptive sense only and not for purposes of limitation. Changes in the form and the proportion of parts, as well as in the substitution of equivalents, are contemplated as circumstances may suggest or render expedient without departing from the spirit or scope of the invention. It is intended that the present disclosure cover modifications and variations of this disclosure provided they fall within the scope of the claims and their equivalents.

Throughout the various contexts described in this disclosure, the embodiments of the invention further encompass computer apparatus, computing systems and machine-readable media configured to carry out the foregoing systems and methods. In addition to an embodiment consisting of specifically designed integrated circuits or other electronics, the present invention may be conveniently implemented using a conventional general purpose or a specialized digital computer or microprocessor programmed according to the teachings of the present disclosure, as will be apparent to those skilled in the computer art.

Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. The invention may also be implemented by the preparation of application-specific integrated

circuits or by interconnecting an appropriate network of conventional component circuits, as will be readily apparent to those skilled in the art.

As the display unit of the digit display may operate based on the principle of persistence of vision, the sequence in which pertinent character segments emit light may vary.

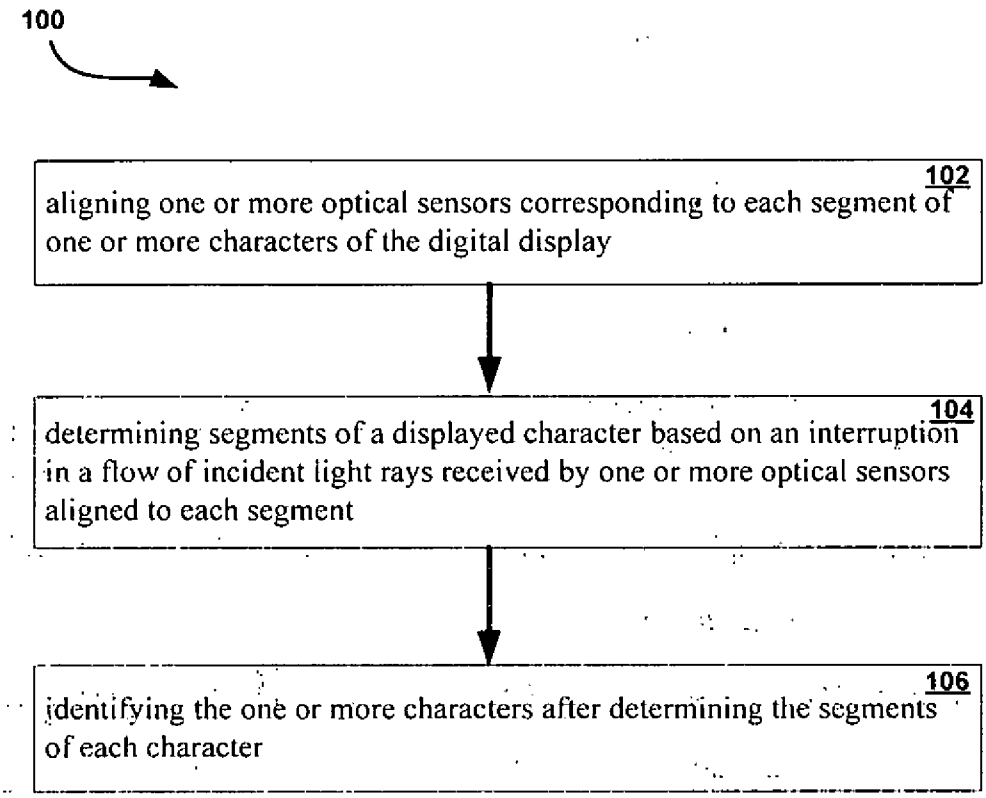

Figure 1

Mohammed Faisal (INPA No: 1941)
Head, IPR Dept.
L&T Technology Services Limited
DLF 3rd Block, 2nd Floor,
Manapakkam, Chennai – 600089

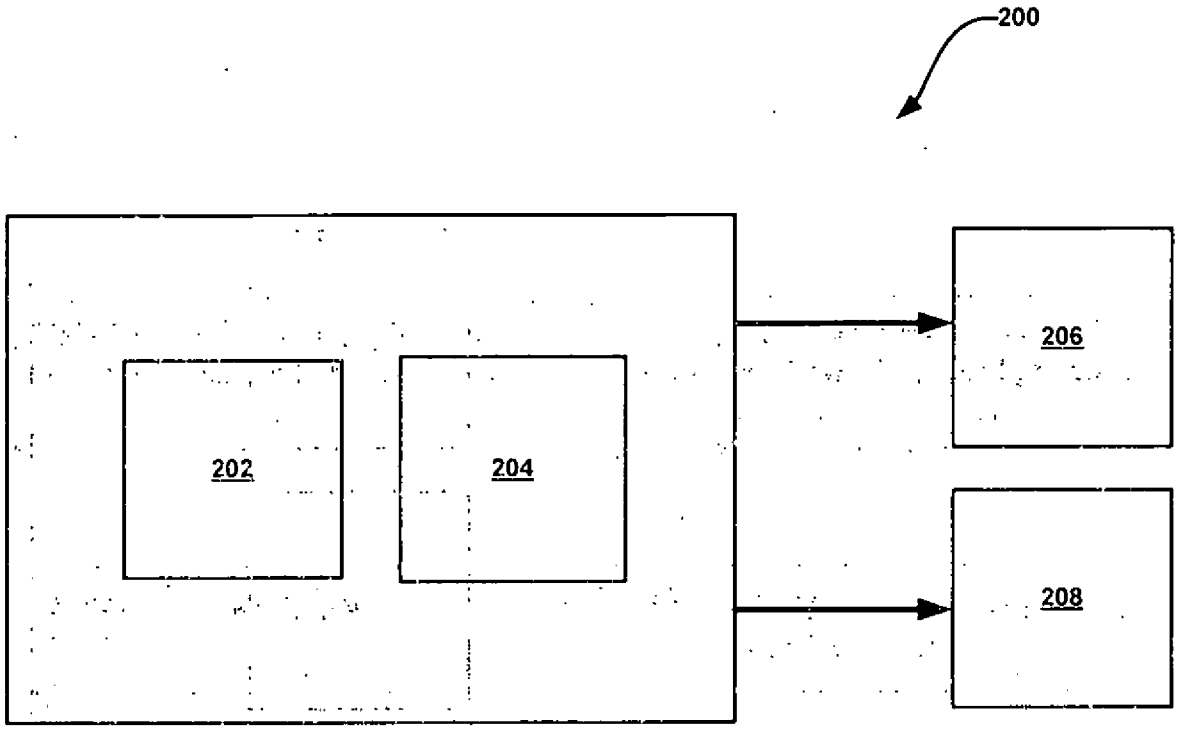

Figure 2

Mohammed Faisal (INPA No: 1941)
Head, IPR Dept.
L&T Technology Services Limited
DLF 3rd Block, 2nd Floor,
Manapakkam, Chennai – 600089