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(54) **CONTROL OF A TRAFFIC SIGNALING SYSTEM**

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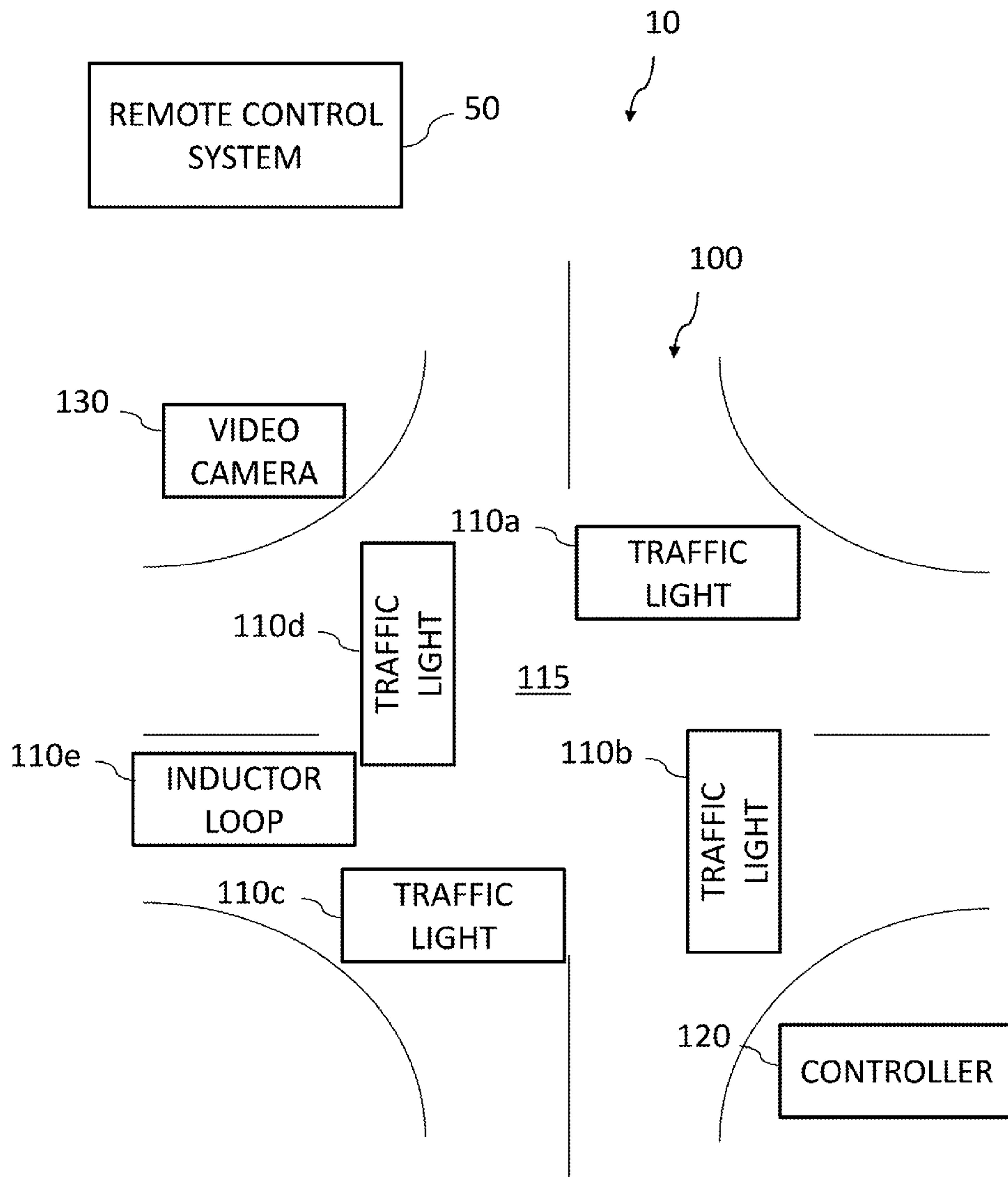
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(60) Provisional application No. 62/119,785, filed on Feb. 23, 2015.

(57) **ABSTRACT**

Provided is a traffic communication network that includes a signaling system having a plurality of light signaling devices, a controller disposed at at least one traffic intersection, and configured to wirelessly control the plurality of light signaling devices, and a video camera configured to obtain status information of the plurality of light signaling devices. A remote control system is also provided to wirelessly transmit commands to the controller and the video camera, for controlling the plurality of light signaling devices.



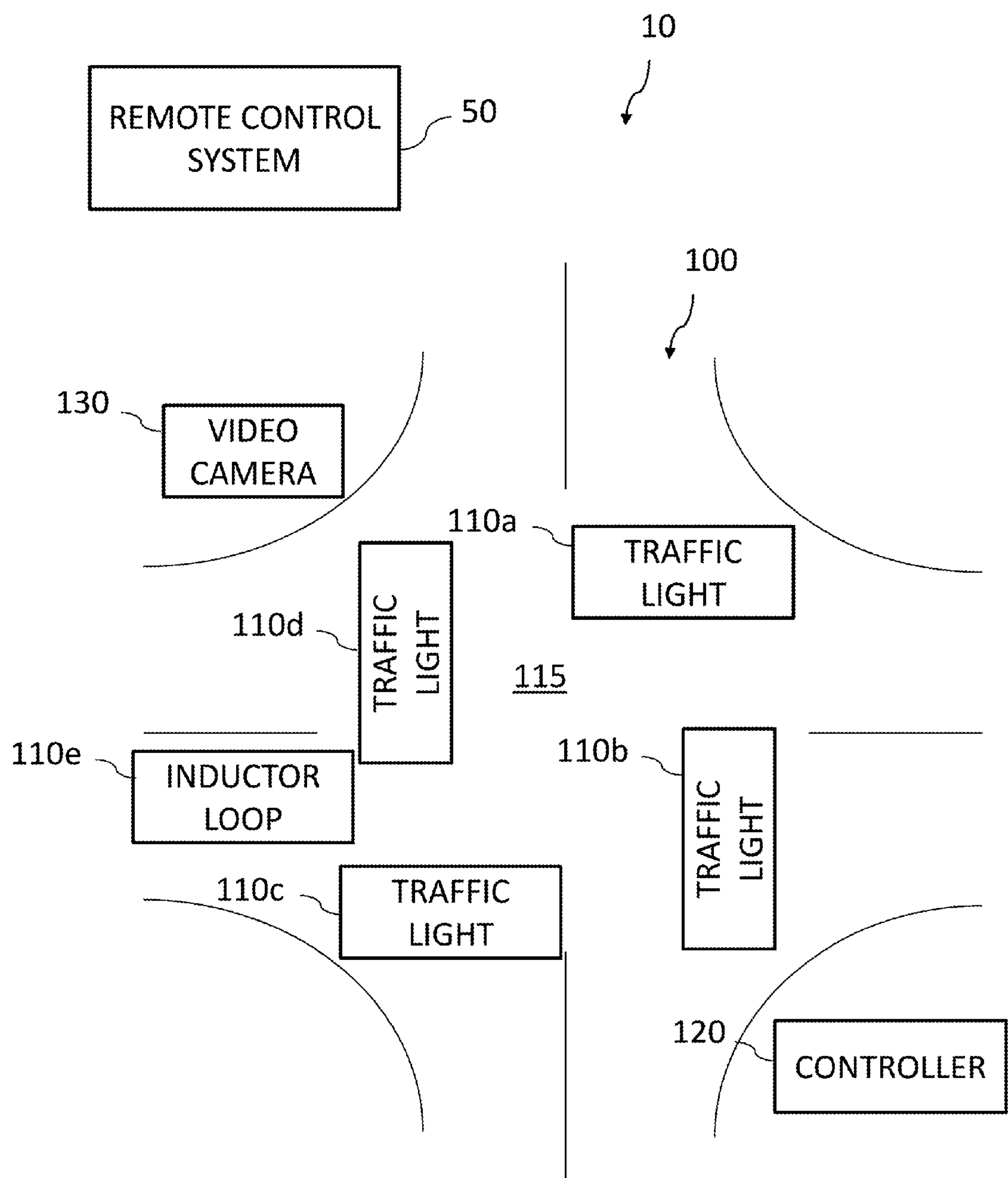


Fig. 1

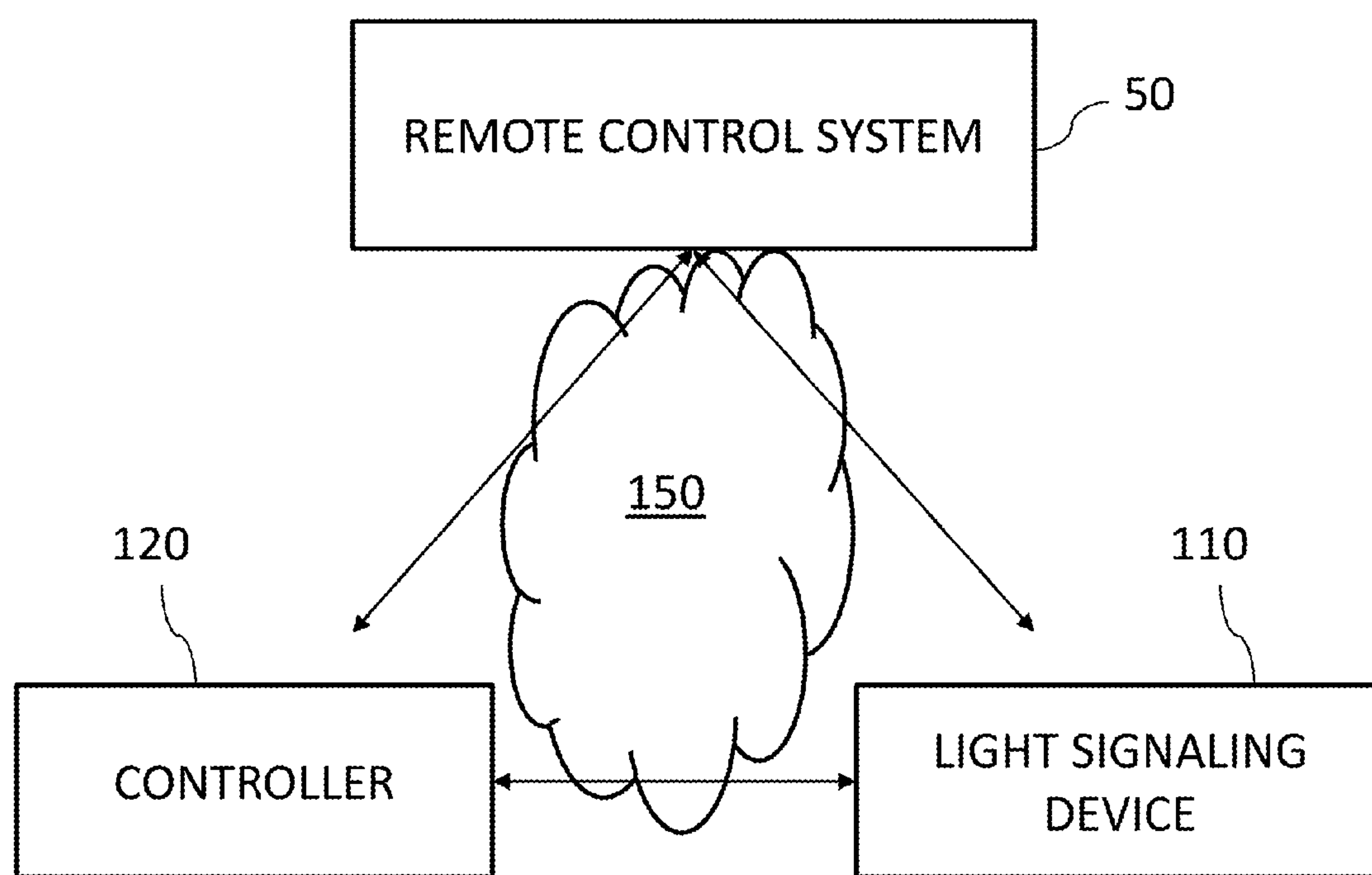


Fig. 2

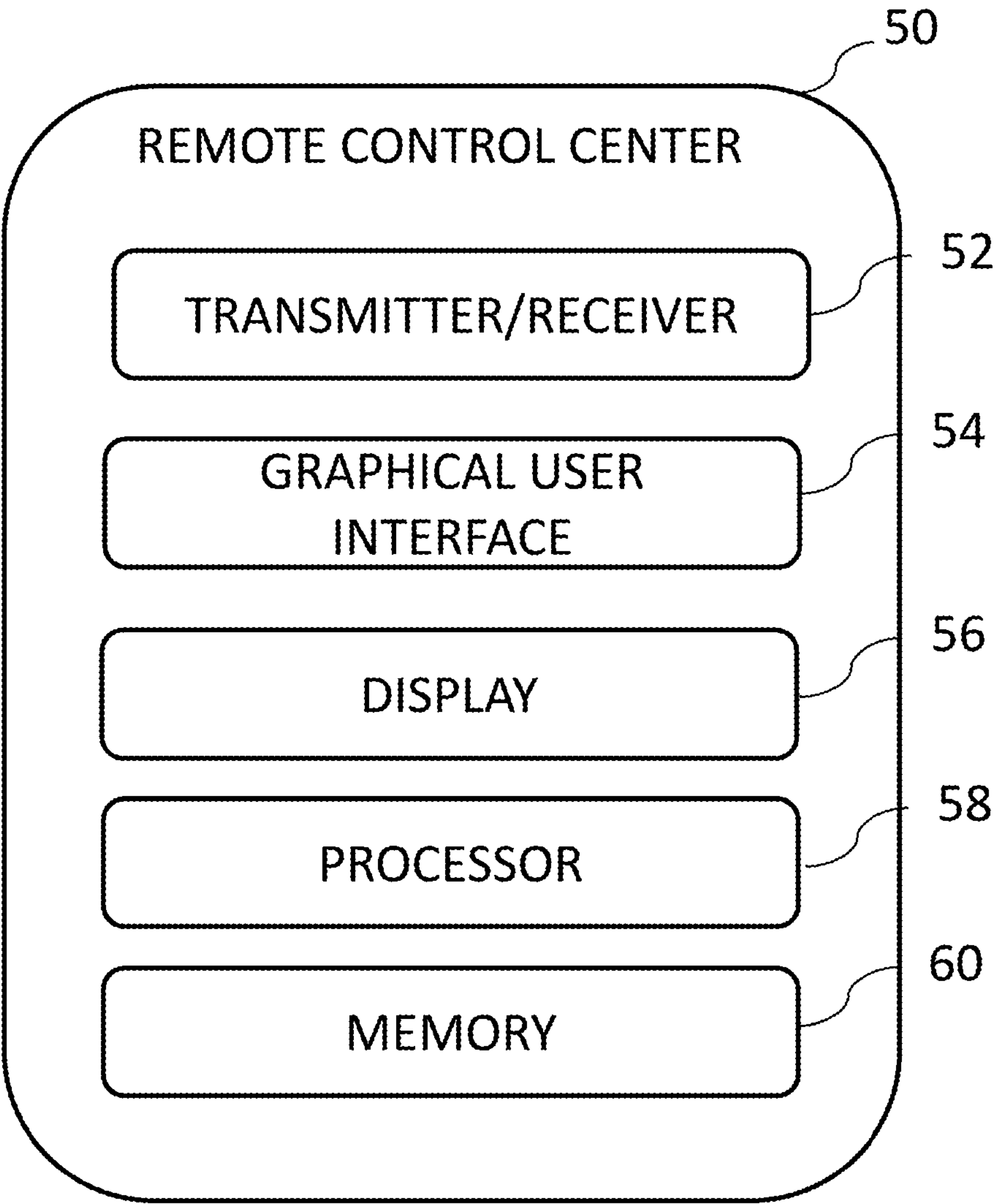


Fig. 3

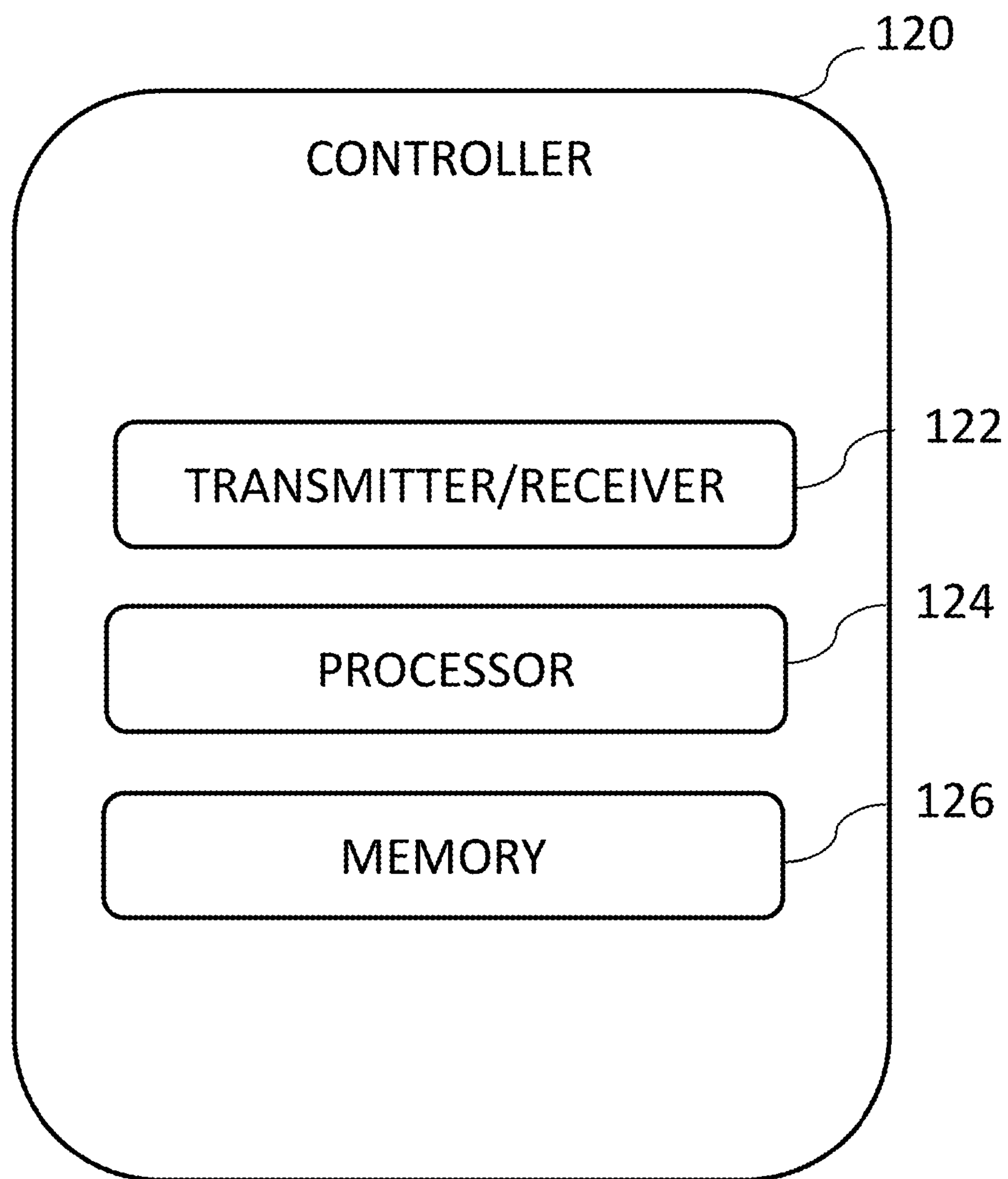


Fig. 4

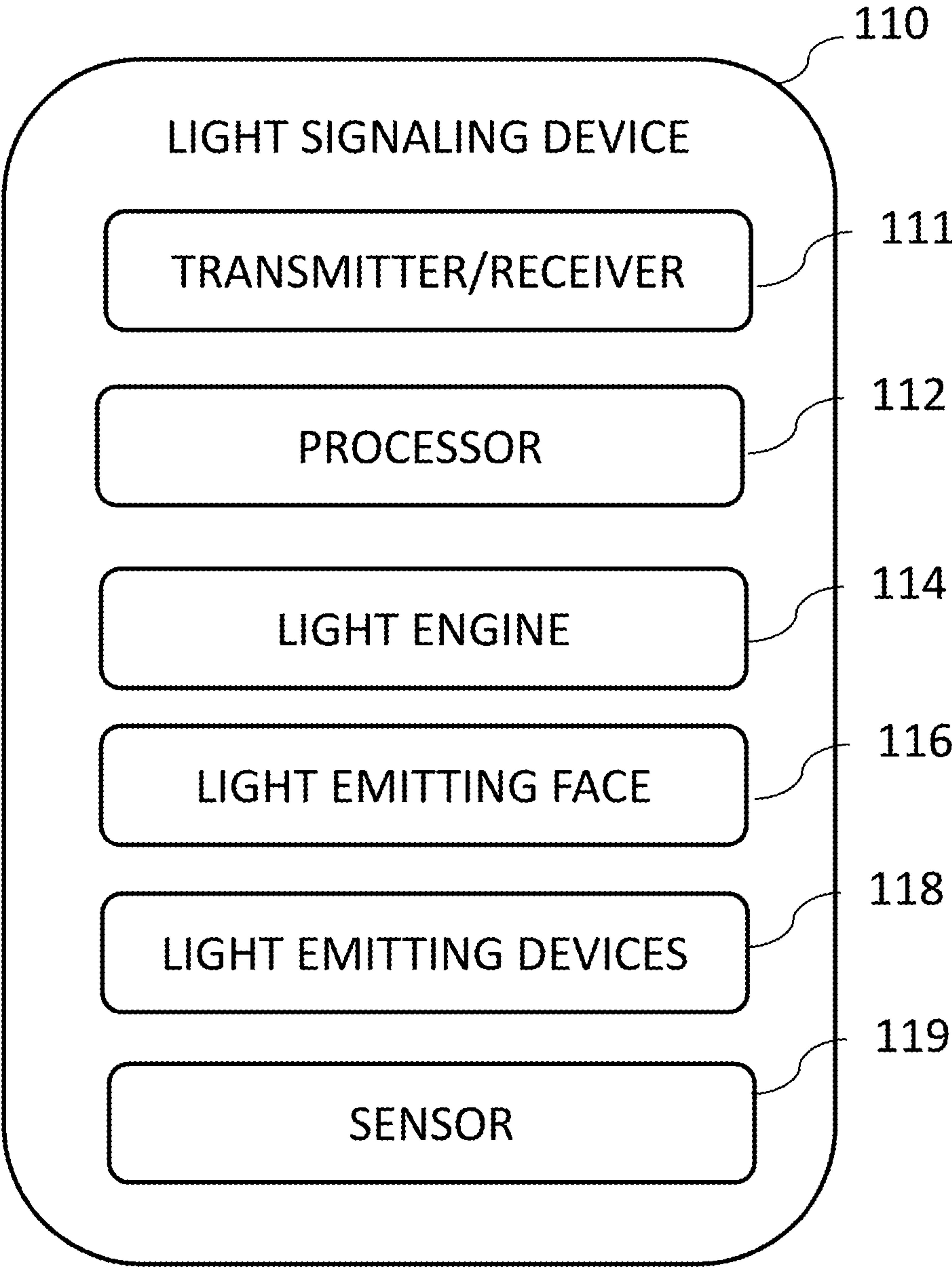


Fig. 5

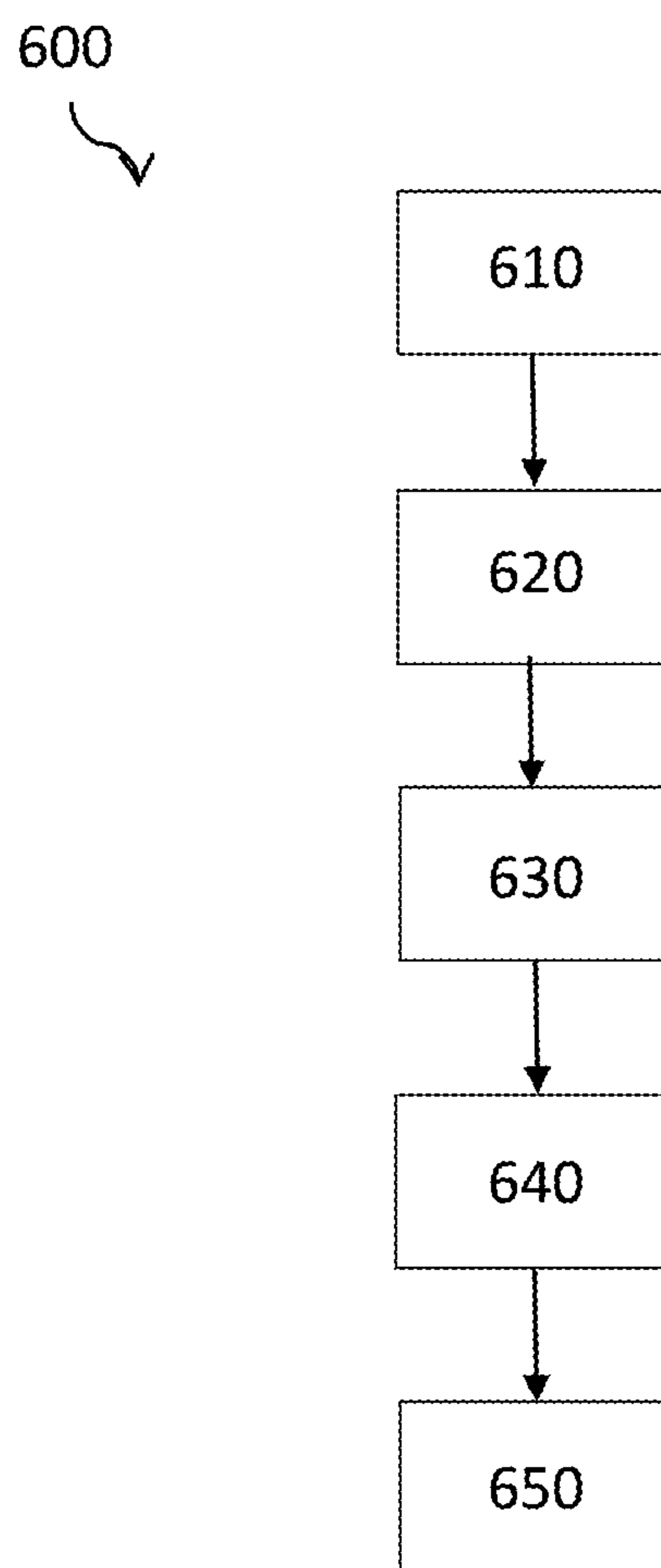


Fig. 6

## CONTROL OF A TRAFFIC SIGNALING SYSTEM

### CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** The present application claims priority from U.S. Provisional Patent Application No. 62/119,785 which was filed on Feb. 23, 2015, and the content of which is incorporated herein by reference in its entirety.

### TECHNICAL FIELD

**[0002]** The present invention relates generally to a traffic communication network. In particular, the present invention relates to a traffic communication network capable of controlling lighting signaling devices through remote communication.

### BACKGROUND

**[0003]** In an existing traffic communication network, traffic lights of a traffic intersection are typically controlled manually by a technician at the traffic light controller located at the traffic intersection.

**[0004]** The traffic controller is connected to the traffic lights at the traffic intersection by a grid system whereby the traffic controller and the traffic lights are coupled together (e.g., hard-wired). The traffic controllers are used to manually synchronize the traffic lights at each traffic intersection. Given a time delay in manual setting of the traffic lights, it can be difficult to successfully synchronize the traffic lights at multiple traffic intersections. Further, it can be difficult to make modifications to the traffic lights, globally or specifically, at multiple traffic intersections, manually and in real-time.

### SUMMARY OF THE EMBODIMENTS

**[0005]** Given the aforementioned deficiencies, a need exists for a more adaptable and more automated traffic control network.

**[0006]** Embodiments of the present invention provide traffic communication network that includes a signaling system including a controller and a plurality of light signaling devices, and a remote control system, whereby communication between the signaling system and the remote control system is performed wirelessly.

**[0007]** In one exemplary embodiment, a traffic communication network is provided. The traffic communication network includes a signaling system including a plurality of light signaling devices, and a controller disposed at at least one traffic intersection, and configured to wirelessly control the light signaling devices; and a remote control system in wireless communication with the controller, and configured to transmit commands to the controller for controlling the light signaling devices.

**[0008]** In another exemplary embodiment, a traffic communication network is provided. The traffic communication network includes a signaling system that includes a plurality of light signaling devices, a controller disposed at at least one traffic intersection, and configured to wirelessly control the plurality of light signaling devices, and a video camera configured to obtain status information of the plurality of light signaling devices; and a remote control system configured to wirelessly transmit commands to the controller and the video camera, for controlling the plurality of light signaling devices.

**[0009]** In another exemplary embodiment, a traffic communication network is provided. The traffic communication network includes a signaling system that includes a plurality of light signaling devices, a controller disposed at at least one traffic intersection, and configured to wirelessly control the plurality of light signaling devices; and a remote control system configured to wirelessly transmit commands to the controller and directly to the plurality of light signaling devices.

**[0010]** In another exemplary embodiment, a traffic communication network is provided. The traffic communication network includes a signaling system including a plurality of light signaling devices configured to selectively emit light, a controller configured to wirelessly control the plurality of light signaling devices; and a remote control system configured to wirelessly control the controller and the plurality of light signaling devices.

**[0011]** Methods for controlling the plurality of light signaling devices within the above-mentioned traffic communication network are also provided.

**[0012]** The foregoing has broadly outlined some of the aspects and features of various embodiments, which should be construed to be merely illustrative of various potential applications of the disclosure. Other beneficial results can be obtained by applying the disclosed information in a different manner or by combining various aspects of the disclosed embodiments. Accordingly, other aspects and a more comprehensive understanding may be obtained by referring to the detailed description of the exemplary embodiments taken in conjunction with the accompanying drawings, in addition to the scope defined by the claims.

### DESCRIPTION OF THE DRAWINGS

**[0013]** FIG. 1 is a schematic illustrating a traffic communication network that can be implemented within one or more embodiments of the present invention.

**[0014]** FIG. 2 is a block diagram illustrating various communication operations of the remote control system, the controller, and a light signaling device shown in FIG. 1 that can be implemented within one or more embodiments.

**[0015]** FIG. 3 is a detailed block diagram illustrating the remote control system of FIG. 1 that can be implemented within one or more embodiments of the present invention.

**[0016]** FIG. 4 is a detailed block diagram illustrating the controller of FIG. 1 that can be implemented within one or more embodiments of the present invention.

**[0017]** FIG. 5 is a detailed block diagram illustrating a light signaling device of FIG. 1 that can be implemented within one or more embodiments of the present invention.

**[0018]** FIG. 6 is a flow chart illustrating a method of controlling the light signaling devices of FIG. 1 that can be implemented within one or more embodiments of the present invention.

**[0019]** The drawings are only for purposes of illustrating preferred embodiments and are not to be construed as limiting the disclosure. Given the following enabling description of the drawings, the novel aspects of the present disclosure should become evident to a person of ordinary skill in the art. This detailed description uses numerical and letter designations to refer to features in the drawings. Like or similar designations in the drawings and description have been used to refer to like or similar parts of embodiments of the invention.

## DETAILED DESCRIPTION

[0020] As required, detailed embodiments are disclosed herein. It must be understood that the disclosed embodiments are merely exemplary of various and alternative forms. As used herein, the word “exemplary” is used expansively to refer to embodiments that serve as illustrations, specimens, models, or patterns. The figures are not necessarily to scale and some features may be exaggerated or minimized to show details of particular components. In other instances, well-known components, systems, materials, or methods that are known to those having ordinary skill in the art have not been described in detail in order to avoid obscuring the present disclosure. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art.

[0021] Embodiments of the present invention provide a traffic communication network that includes a signaling system and a remote control system, for wirelessly and remotely monitoring and configuring a plurality of light signaling devices of the signaling system.

[0022] Details regarding the traffic communication network of the present invention will now be discussed with reference to FIGS. 1-5. FIG. 1 illustrates the traffic communication network 100 in accordance with one or more embodiments of the present invention.

[0023] In FIG. 1, the traffic communication network 100 includes a remote control system 50 and a signaling system 100 comprises at least one traffic intersection 115 comprises a plurality of light signaling devices 110 (e.g., traffic lights 110a, 110b, 110c and 110d and inductor loop 110e) and a controller 120. The remote control system (e.g., a control center) 50 is in wireless communication with the controller 120. The remote control system 50 is capable of configuring the signaling system 100 as necessary.

[0024] According the embodiments, the remote control system 50 can configure parameters of the signaling system 100 including, for example, electrical parameters e.g., adjusting the output current or input voltage to the light signaling devices 110, lamp failure conditions, lamp location (e.g., by GPS), intersection phasing, timing functions, synchronization of a clock of the controller 120.

[0025] The controller 120 controls the light signaling devices 110 in real-time based on commands received from the remote control system 50. The controller 120 can modify the status of the light signaling devices 110, simultaneously, including for example, synchronizing the light signaling devices 110. The present invention is not limited to any particular commands being transmitted to the controller 120 and/or light signaling devices 110. According to other embodiments, a video camera 130 can also be located at the traffic intersection 115, for monitoring the status of the light signaling devices 110 and transmit the status information to the remote control system 50 for further diagnostics. The remote control system 50 wirelessly transmits commands to the video camera 130, to request status information of the light signaling devices 110. The commands can be transmitted continuously, or periodically during a predetermined time intervals, e.g., every two hours, once daily, etc. Upon receipt of the status information, the remote control system 50 performs diagnostics and wirelessly transmits commands to the controller 120 based on the status information, for wirelessly controlling the light signaling devices 110 based on the status information received. The remote control system 50 also syn-

chronizes the video camera 130 and the controller 120 using at least one of global positioning, network time and computer system time and the controller 120 synchronizes the light signaling devices 110.

[0026] As shown in FIG. 2, communication between the remote control system 50, the video camera 130, the light signaling devices 110 and the controller 120 is performed wirelessly via a wireless communication network 150 that can include Wi-Fi, 6LoWPAN, mesh network.

[0027] Details of the remote control system 50 are described in reference to FIG. 3. Referring now to FIG. 3, the remote control system 50 includes a transmitter/receiver 52, a graphical user interface (GUI) 54, a display 56, a processor 58, and a memory 60. The remote control system 50 is capable of wirelessly transmitting commands to and receiving signals from the controller 120 (depicted in FIG. 1).

[0028] A user is able to input necessary commands to the remote control system 50 via the GUI 54 for monitoring and configuring of the signaling system 100. Real-time parameters of the signaling system 100 are able to be displayed at the display 56 including for example, current status information, historical data, and identification information of the light signaling devices 110 and the controller 120. The identification information can include population, state, installation date, run-time, and warranty expiration, etc. This information can be stored in a centralized inventory in the memory 60.

[0029] The remote control system 50 is further configured to perform real-time diagnostics and failure determination of the signaling system 100. The remote control system 50 can perform real-time modifications of the signaling system 100 based on current environmental conditions and historical traffic patterns. The real-time modifications can include activating a heating function via the controller 120 or a light signaling device 110 to defrost the light emitting face 116 (as depicted in FIG. 5), locate and mitigate failures on the signaling system 100 based on GPS signaling of the respective light signaling devices 110.

[0030] The real-time modifications can also include the ability to modify operational status of each light signaling device 110 via the controller 120 or directly. By way of example, “flashing red” might indicate stop or a dimming operation, based on the time of day, to enhance driving visibility of drivers. The remote control system 50 is located remotely to the signaling system 100 being monitored.

[0031] According to the embodiments, the remote control system 50 can be a web-based or browser based interface accessible via a remote computer system.

[0032] Details regarding the controller 120 and the plurality of light signaling devices 110 of the signaling system 100 will now be described with references to FIGS. 4 and 5.

[0033] As shown in FIG. 4, the controller 120 includes a transmitter/receiver 122, a processor 124, and memory 126. The controller 120 is configured to transmit and receive commands from the remote control system 50 to further control the light signaling devices 110 of the signaling system 100. The processor 122 is configured to process the information received from the light signaling devices 110 and the remote control system 50. Instructions received from the remote control system 50 can be stored in the memory 126.

[0034] The light signaling devices 110 can include for example, traffic lights, rail lamps, traffic heads and housings, rail signal head and housings, inductor loops or other vehicle detector, obstruction lighting, airport runway lighting. The signaling system 100 can include one or more traffic inter-

sections **115**. At the exemplary traffic intersection **115** shown in FIG. **1**, the four traffic lights **110a**, **110b**, **110c** and **110d** are provided. Each traffic light **110a**, **110b**, **110c** and **110d** is configured to transmit and receive signals wirelessly from the controller **120** in communication therewith.

[0035] As shown in FIG. **5**, each light signaling device **110** includes a wireless node including transmitter/receiver **111**, a processor **112**, a light engine **114**, a light emitting face or display **116** and light emitting devices **118** (e.g., LEDs). Signals for controlling the light signaling device **110** can be received from the controller **110** and the remote control system **50**, and processed by the processor **112**. The processor **112** drives the light engine to control the light emitting devices **118** on the light emitting face **116** of the light signaling device **110**.

[0036] Each light signaling device **110** may also include a sensor **119** for independently sensing environment changes and activating dimming operation or defrost operation of the light emitting face **116** in accordance with some embodiments. Thus, each light signaling device **110** is controlled by the controller **120**. According to other embodiments, each light signaling device **110** is controlled by the controller **120** and/or directly by the remote control system **50**.

[0037] In other embodiments, the traffic communication network **10** is capable of being operated on a pay-per-use basis given the real-time usage information collectable by the remote control system **50** via the controller **120** or directly from the light signaling devices **110**.

[0038] FIG. **6** illustrates a method **600** for controlling the light signaling devices **110** of the signaling system **100**. The method **600** begins at operation **610** where a remote control system wirelessly communicates with a controller and/or a light signaling device of a signaling system to receive status information of the signaling system. The remote control system can further transmit a signal to a video camera at the traffic intersection for obtaining status information of the signaling system.

[0039] From operation **610**, the process continues to operation **620** where the controller transmits a signal to the light signaling device requesting status information in real-time and the light signaling device transmits the status information back to the controller or directly to the remote control system. Alternatively, or in addition to, at operation **620**, a video camera determines status of the light signaling devices.

[0040] From operation **620**, the process continues to operation **630** where the status information is sent to the remote control system from the controller, the video camera, and/or directly from the light signaling devices.

[0041] From operation **630**, the process continues to operation **640** where the remote control system memory performs real-time diagnostics and failure determination, and modifications of the signaling system. The operations performed by the remote control system can be based on current environmental conditions and historical traffic patterns.

[0042] From operation **640**, the process continues to operation **650** where the remote control system transmits command signals to the controller or the light signaling device directly to activate a heating function of the light signaling device to defrost the light emitting face, mitigate failures on the signaling system based on GPS signaling of the respective light signaling devices **110**, modify operational status of each light signaling device **110**.

[0043] This written description uses examples to disclose the invention including the best mode, and also to enable any

person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

What is claimed is:

1. A traffic communication network comprising:
  - a signaling system comprising:
    - a plurality of light signaling devices,
    - a controller disposed at at least one traffic intersection, and configured to wirelessly control the plurality of light signaling devices, and
    - a video camera configured to obtain status information of the plurality of light signaling devices; and
  - a remote control system configured to wirelessly transmit commands to the controller and the video camera, for controlling the plurality of light signaling devices.
2. The traffic communication network of claim 1, wherein the remote control system is configured to wirelessly receive the status information from the video camera and to wirelessly transmit commands to the controller for controlling the light signaling devices, based on the status information received.
3. The traffic communication network of claim 2, wherein the remote control system is further configured to synchronize the video camera and the controller using at least one of global positioning, network time and computer system time and the controller is configured to synchronize the light signaling devices.
4. The traffic communication network of claim 2, wherein the status information comprises current environmental conditions and historical traffic patterns regarding the light signaling devices, and the remote control system is configured to perform real-time modifications of the signaling system based on the status information.
5. The traffic communication network of claim 1, wherein the remote control system comprises:
  - a transmitter/receiver configured to transmit and receive signals to and from the controller and the video camera;
  - a graphical user interface configured to receive input data;
  - a display configured to display real-time parameters of the signaling system;
  - a processor configured to perform real-time diagnostics and modifications of the signaling system via the controller.
6. The traffic communication network of claim 3, wherein the remote control system further comprises a memory configured to store the status information, historical data and identification information for the light signaling devices, the video camera, and the controller of the signaling system.
7. The traffic communication network of claim 3, wherein each light signaling device comprises:
  - a wireless node comprising a transmitter/receiver for transmitting and receiving signals from the video camera and the controller;
  - a processor configured to process the signals received;
  - a plurality of light emitting devices configured to emit light; and
  - a light engine for driving the light emitting devices.

**8.** The traffic communication network of claim **6**, wherein the light signaling device is in wireless communication with the video camera, and is configured to:

- (i) transmit status information to the video camera; and
- (ii) provide location information using global positioning.

**9.** A method for controlling a signaling system including a plurality of light signaling devices, a video camera and a controller of a traffic communication network, the method comprising:

wirelessly transmitting commands from a remote control system to the video camera, to receive status information of the plurality of light signaling devices;

wirelessly obtaining, at the remote control system, the status information from the plurality of light signaling devices; and

wirelessly transmitting commands to the controller, for controlling the light signaling devices in real-time based on the status information

**10.** The method of claim **9**, further comprising:

synchronizing, via the remote control system, the video camera, based on global positioning; and

synchronizing, via the controller, the plurality of light signaling devices, simultaneously.

**11.** The method of claim **9**, wherein the status information comprises current environmental conditions and historical

traffic patterns regarding the light signaling devices, and the remote control system is configured to perform real-time modifications of the signaling system based on the status information.

**12.** The method of claim **9**, further comprising:

storing, at the remote control system, the status information and identification information for the video camera, the light signaling devices, and the controller of the signaling system.

**13.** The method of claim **9**, further comprising:

wirelessly transmitting location information of the light signaling devices to the video camera using global positioning.

**14.** The method of claim **9**, further comprising:

modifying an operational status of the light signaling devices based on the status information received.

**15.** The method of claim **14**, wherein modifying the operational status comprises:

adjusting the output current or input voltage of the plurality of light signaling devices; and

modifying intersection phasing of the plurality of light signaling devices.

\* \* \* \* \*