SEQUENTIALLY OPERATED MODULES

FIELD OF THE INVENTION

The present invention relates generally to a system including interconnected modules, and, more particularly, to a system wherein a signal, such as a payload control or activation signal, is propagated sequentially from a module to another module connected thereto for controlling a payload or payloads.

BACKGROUND OF THE INVENTION

Examples of a distributed control system having modules connected for distributed control of payloads are disclosed in U.S. Pat. No. 5,841,360 to Binder entitled: "Distributed Serial Control System", in U.S. Pat. No. 6,480,510 to the same inventor entitled: "Local area network of serial intelligent cells", and in U.S. Pat. No. 6,956,826 to the same inventor entitled: "Local area network for distributing data communication, sensing and control signals", which are all incorporated in their entirety for all purposes as if fully set forth herein.

Toys are known in the art for providing amusement, education and entertainment particularly for children. Toy building sets and building blocks known as LEGO® bricks are disclosed in U.S. Pat. No. 3,034,254 to Christiansen entitled: "Toy Building Sets and Building Blocks". Examples of electrically conductive toys such as conductive LEGO® bricks are disclosed in U.S. Pat. No. 6,805,605 to Reining et al. entitled: "Electrically Conductive Block Toy", in U.S. Pat. No. 4,883,440 to Bolli entitled: "Electrified Toy Building Block with Zig-Zag Current Carrying Structure", and in U.S. Pat. No. 5,848,503 to Toft et al. entitled: "Constructional Building Set Having an Electric Conductor", which are all incorporated in their entirety for all purposes as if fully set forth herein. Three-dimensional conductive building block toys are disclosed in U.S. Patent Application Publication Number 2007/0184722 to Doherty entitled: "Powered Modular Building Block Toy", which is incorporated in its entirety for all purposes as if fully set forth herein.

In consideration of the foregoing, it would be an advancement in the art to provide a method and system that is simple, cost-effective, faithful, reliable, has a minimum part count, minimum hardware, and/or uses existing and available components for providing additional functionalities, amusement, education, entertainment and a better user experience relating to control of one or more payloads.

SUMMARY OF THE INVENTION

In one aspect of the present invention, a module or modules each having payload (or payloads) and related methods are described, and a system formed by plurality of connected modules. The payload (or payloads) in the system are activated or controlled based on a logic embedded in the modules or the system. The payloads may be activated or controlled sequentially, wherein a payload in a module is activated based on an activation signal propagated in the system according to the modules connection scheme.

A module may include a payload functionality, which includes receiving an activation signal, waiting for a pre-set time period and then activating (or controlling) a payload associated with the module. Further, the module may transmit the activation signal to another connected module concurrently with the payload activation (or control), or after a

pre-set time period (independent from the former time period). A payload functionality may include two timers, one used for the initial delay from receiving the activation signal until generating an activation of the payload via an activation or control port, and another timer triggered at the end of the initial delay and active until transmitting the activation signal to a connected module. Each of the timers may be delay-line or monostable based. The payload may be part of the payload functionality and may be integrated within the module housing, or can be external to the module and activated or controlled via a corresponding connector. Further, payload activation may use either level activation ('active low' or 'active high') or edge triggering (riding or trailing edge).

In one aspect, a timer (or both timers) introduces a random time delay selected within a specified range. The delay can be randomly selected upon power up and retained throughout the operation until de-energized, or can be selected each time the activation signal is propagated through the module. The random delay scheme includes a random signal generator coupled to the timer to control its delay. The random signal generator may be based on a digital random signal generator having a digital output. Alternatively, the random signal generator may be based on analog random signal generator having an analog output. Analog random signal generator may use a digital random signal generator which output is converted to analog using analog to digital converter, or can use a repetitive analog signal generator (substantially not synchronized to any other timing in the system) which output is randomly time sampled by a sample and hold. A random signal generator (having either analog or digital output) can be hardware based, using a physical process such as thermal noise, shot noise, nuclear decaying radiation, photoelectric effect or other quantum phenomena, or can be software based, using a processor executing an algorithm for generating pseudo-random numbers which approximates the properties of random numbers.

A module includes one or more connectors for connecting to other modules for forming a system. In one aspect, each connector is used for connecting to a single other module using a point-to-point connection scheme. A connection may be input only, being operative only to receive an activation signal from the connected module, and thus including a line receiver connected to the connector for receiving the activation signal. A connection may be output only, being operative only to transmit an activation signal to the connected module, and thus including a line driver connected to the connector for receiving the activation signal. A connection may double as both input and output functions, being operative both to transmit an activation signal to the connected module by a line driver and to receive an activation signal from the connected module by a line receiver. The connection may use balanced (e.g. RS-422 or RS-485) or single-ended communication (e.g. RS-232 or RS-423), using corresponding line driver and/or line receiver, and may use either level activation ('active low' or 'active high') or edge triggering (riding or trailing edge).

A module may include the payload functionality connected to an input (or input/output connection), wherein the activation signal received from the line receiver initiates the payload functionality. Further, a module may include the payload functionality connected to an output (or input/output connection), wherein the activation signal output from the payload functionality is fed to the line driver and transmitted to the connected module. Furthermore, a module that includes two or more connections may include multiple